Appendix I

Vegetation and Wildlife (including the Biological Assessment)

I. TABLES

TABLES

TABLE I-1

Commonly Occurring Fish and Invertebrate Species in Coos Bay

Common Name	Scientific Name
Fish Species	
American shad	*Alosa sapidissima*
Arrow goby	*Clevelandia ios*
Bay goby	*Lepidogobius lepidus*
Bay pipefish	*Syngnathus griseolineatus*
Black rockfish	*Sebastes melanops*
Bocaccio	*Sebastes paucispinis*
Brown rockfish	*Sebastes auriculatus*
Buffalo sculpin	*Enophrys bison*
Cabezon	*Scorpaenichthys marmoratus*
Chinook salmon	*Oncorhynchus tshawytscha*
Coast range sculpin	*Cottus aleuticus*
Coho salmon	*Oncorhynchus kisutch*
Copper rockfish	*Sebastes caurinus*
Crescent gunnel	*Pholis laeta*
Cutthroat trout	*Oncorhynchus clarki clarki*
English sole	*Parophrys vetulus*
Fluffy sculpin	*Oligocottus snyderi*
Green sturgeon	*Acipencer medirostris*
High cockscomb	*Anoplarchus purpurescens*
Jack smelt	*Atherinopsis californiensis*
Kelp greenling	*Hexagrammos decagrammus*
Largescale sucker	*Catostomus macrocheilus*
Lingcod	*Ophiodon elongatus*
Longnose dace	*Rhinichthys cataractae*
Northern anchovy	*Engraulis mordax*
Pacific herring	*Clupea harengus pallasi*
Pacific lamprey	*Entosphenus tridentatus*
Pacific sand lance	*Ammodytes hexapterus*
Pacific sardine	*Sardinops sagax*
Pacific staghorn sculpin	*Leptocottus armatus*
Pacific tomcod	*Microgadus proximus*
Pile perch	*Rhacochilus vacca*
Pinpoint gunnel	*Apodichthys flavidus*
Prickly sculpin	*Cottus asper*
Rainbow (steelhead) trout	*Oncorhynchus mykiss*
Red Irish lord	*Hemilepidotus hemilepidotus*
Redside shiner	*Richardsonius balteatus*
Rex sole	*Glyptocephalus zachirus*
Rock greenling	*Hexagrammos lagocephalus*
Rockweed gunnel	*Xererpes fucorum*
Saddleback gunnel	*Pholis ornata*
Sand sole	*Psettichthys melanostictus*
Sand lance	*Ammodytes hexapterus*
Shiner perch	*Cymatogaster aggregata*
Silver surf perch	*Hyperprosopon allipticum*
Speckled dace	*Rhinichthys osculus*
Speckled sanddab	*Citharichthys stigmaeus*
Staghorn sculpin	*Leptocottus armatus*
Starry flounder	*Platichthys stellatus*
Striped bass	*Morone saxatilis*
Striped perch	*Embiotoca lateralis*
Surf smelt	*Hypomesus pretiosus*

TABLE I-1 (continued)

Commonly Occurring Fish and Invertebrate Species in Coos Bay

Common Name	Scientific Name
Threespine stickleback	*Gasterosteus aculeatus*
Topsmelt	*Atherinops affinis*
Tube-snout	*Aulorhynchus flavidus*
Walleye perch	*Hyperprosopon argenteum*
White bait smelt	*Aliosmerus elongatus*
White perch	*Phanerodon furcatus*
White sturgeon	*Acipenser transmontanus acipenser*
Invertebrate Species	
Butter clams	*Saxidomus gigantea*
Cockle clam	*Clinocardium nuttallii.*
Dungeness crab	*Cancer magister*
Porcelain crab	*Petrolisthes cinctipes*
Pea crab	*Pinnotheres pisum*
Green crab	*Carcinus maenas* (introduced sp.)
Gaper clams	*Tresus capax*
Ghost shrimp	*Neotrypaea californiensis*
Olympia oyster	*Ostrea lurida*
Pacific oyster	*Crassostrea gigas*
Mussels	*Mytilus* spp.
Softshell clam	*Mya arenaria*

TABLE I-2

Fish Utilization, EFH in, and Crossing Techniques and In-Water Work Windows for Waterbodies Crossed by the Proposed Route (revised April 2018)

Waterbodies Crossed and Waterbody ID	NHD Waterbody Reach Code a/ and Jurisdiction	Approximate Pipeline Milepost (MP)	Waterbody Type Size b/	Proposed Crossing Method Scour Level c/	Waterbody Crossing Rationale d/	ESA Species Present/Habitat e/	Anadromous Species Present f/	Resident Coldwater Species Present	EFH Species Present g/	EFH Component Present g/	Fishery Construction Window h/	Equipment Bridges Y=Yes, Y* = Yes if flowing at time of construction, 1o= 1 pass required outside fish window1i = 1 pass required inside fish window, i =set inside fish window, N=None
Coast Range Ecoregion, Coos Sub-basin (HUC 17100304), Coos Bay-Frontal Pacific Ocean (HUC 1710030403) Fifth field Watershed 8, Coos County, Oregon												
Estuary Drain (Alt Wet NH (West))	17100304006491 State	0.00	Estuarine Major	Pullback TEWA Adjacent to Pipeline	The Estuary Drain is not crossed by the centerline. TEWA 0.10, which crosses the drain, is required for the HDD of Coos Bay to fabricate the HDD pipe string and to facilitate the HDD pullback operations. The Estuary Drain will be bridged to minimize disturbance	Southern DPS Green Sturgeon, T, CH Oregon Coast ESU Coho, migration, rearing habitat T, CH Southern DPS Eulachon, T	Fall Chinook, Coho, Winter Steelhead, Pacific Lamprey, Eulachon	Various Marine Fish and Shellfish	4 Coastal Pelagic spp., 21 Groundfish spp, 2 Salmonid spp. Pelagic, Groundfish, and Salmonids (see Table 3B- 6)	Coastal Pelagic spp., Groundfish spp, Salmonid spp. Fall Chinook/ Coho Rearing, Migration	Oct 1 to Feb 15 j/	Y
Coos Bay (NE-26) WB-T02-001	17100304006491 State	0.28 to 1.00	Estuarine Major	HDD	HDD feasibility based on geometry, topography, and expected geotechnical conditions along proposed alignment. Primary HDD activities are significantly set back from crossing. The HDD crossing method will not encumber the Federal Navigation crossed along the HDD alignment. The HDD avoids in-water open cut crossing methods. Other trenchless crossing methods (conventional bore and Direct Pipe®) are not feasible based on crossing length.	Southern DPS Green Sturgeon, T, CH Oregon Coast ESU Coho, migration, rearing habitat T, CH Southern DPS Eulachon, T	Fall Chinook, Coho, Winter Steelhead, Pacific Lamprey, Eulachon	Various Marine Fish and Shellfish	4 Coastal Pelagic spp., 21 Groundfish spp, 2 Salmonid spp. Pelagic, Groundfish, and Salmonids (see Table 3B- 6)	Coastal Pelagic spp., Groundfish spp, Salmonid spp. Fall Chinook/ Coho Rearing, Migration	Oct 1 to Feb 15 j/	N
Coos Bay (NE-26) WB-T02-002 W-T02-001D	171003040064961 State	1.46 to 3.02	Estuarine	HDD	HDD feasibility based on geometry, topography, and expected geotechnical conditions along proposed alignment. Primary HDD activities are significantly set back from crossing. The HDD crossing method will not encumber the Federal Navigation crossed along the HDD alignment. The HDD avoids in-water open cut crossing methods. Other trenchless crossing methods (conventional bore and Direct Pipe®) are not feasible based on crossing length.	Southern DPS Green Sturgeon, T, CH Oregon Coast ESU Coho, migration, rearing habitat T, CH Southern DPS Eulachon, T	Fall Chinook, Coho, Winter Steelhead, Pacific Lamprey, Eulachon	Various Marine Fish and Shellfish	4 Coastal Pelagic spp., 21 Groundfish spp, 2 Salmonid spp. Pelagic, Groundfish, and Salmonids (see Table 3B- 6)	Coastal Pelagic spp., Groundfish spp, Salmonid spp. Fall Chinook/ Coho Rearing, Migration	Oct 1 to Feb 15 k/	N
Kentuck Slough EE-SS-9004 (EE-6)		3.02 to 6.39R	Perennial Minor	HDD Pullback TEWA Adjacent riparian zone	Adjacent riparian zone overlaps construction ROW	Oregon Coast ESU Coho, spawning habitat T, CH	Coho, Winter Steelhead	Assumed	Coho	Coho Rearing, Migration	Jul 1 to Sep 15	
Trib to Coos Bay (S1-01/EE-6)	17100304000767 Private	6.39R	Perennial Minor	Dry Open-Cut	Dry open-cut method feasible/practical on small channelized tributary within golf course lacking effect riparian vegetation.	Oregon Coast ESU Coho, assumed habitat T	Coho Assumed, Winter Steelhead	Assumed	Coho Assumed	Unknown	Jul 1 to Sep 15	Y*
Willanch Slough (EE-7) S1-04 (EE-7 MOD))	17100304001393 Private	8.27R	Perennial Intermediate	Dry Open-Cut	Dry open-cut method feasible/practical on small tributary within pasture/hayfield lacking effect riparian vegetation.	Oregon Coast ESU Coho, migration, rearing habitat T, CH	Coho, Winter Steelhead	Assumed	Coho	Coho Rearing, Migration	Jul 1 to Sep 15	Y*

TABLE I-2 (continued)

Fish Utilization, EFH in, and Crossing Techniques and In-Water Work Windows for Waterbodies Crossed by the Proposed Route (revised April 2018)

Waterbodies Crossed and Waterbody ID	NHD Waterbody Reach Code a/ and Jurisdiction	Approximate Pipeline Milepost (MP)	Waterbody Type Size b/	Proposed Crossing Method Scour Level c/	Waterbody Crossing Rationale d/	ESA Species Present/Habitat e/	Anadromous Species Present f/	Resident Coldwater Species Present	EFH Species Present g/	EFH Component Present g/	Fishery Construction Window h/	Equipment Bridges Y=Yes, Y* = Yes if flowing at time of construction, 1o= 1 pass required outside fish window1i = 1 pass required inside fish window, i =set inside fish window, N=None
Johnston Creek Willanch Creek S1-05 (GDX-29 / EE-8 (MOD))	17100304000413 17100304000409 Private	8.35R	Perennial	Adjacent riparian zone	Adjacent riparian zone overlaps construction ROW	Oregon Coast ESU Coho, spawning habitat T, CH	Coho, Winter Steelhead	Assumed	Coho	Coho Rearing, Migration	Jul 1 to Sep 15	
Trib. to Willanch Slough S - T0 - 1 - 003 (GDX030)	Private	8.46R	Intermittent Intermediate	Dry Open-Cut	Dry open-cut method feasible/practical on small intermittent channelized tributary on edge of pasture.	None	Unknown	Unknown	None	None	Jul 1 to Sep 15	Y*
Trib. to Cooston Channel (Echo Creek) S-T01-003 (SS-100-002)	17100304005045 Private	10.21R	Intermittent Intermediate	Dry Open-Cut	Dry open-cut method feasible/practical on small headwater tributary, if flowing at the time of construction.	Oregon Coast ESU Coho, spawning habitat T	Winter Steelhead Coho	Assumed	Coho	Coho Spawning, Rearing	Jul 1 to Sep 15	Y*
Coos River (BSP-119)	17100304005030 Private	11.13R	Estuarine Major	HDD 10 Level 1 m/	HDD feasible based on geometry, topography, and geotechnical conditions along proposed alignment. Primary HDD activities are significantly set back from crossing. Conventional bore not feasible/practical because of crossing length and high groundwater areas on either side of river. Dry open-cut or diverted open- cut methods not practical/feasible based on flow volumes and tidal influence.	Southern DPS Green Sturgeon, T, CH Oregon Coast ESU Coho, migration, rearing habitat T, CH Southern DPS Eulachon, T	Fall Chinook, Coho, Winter Steelhead, Green Sturgeon, Pacific Lamprey, Eulachon	Various Marine Fish and Shellfish	Chinook, Coho Pelagic, Groundfish, (see Table 3B- 5)	Fall Chinook/ Coho (Rearing, Migration)	Oct 1 to Feb 15 l/	N
Vogel Creek (SS-100-005)	17100304005031 Private	11.55BR	Perennial Minor	Dry Open-Cut	Dry open-cut methods feasible/practical during low flow period within fish window. A conventional bore crossing is problematic because of expected high groundwater levels within the Coos River floodplain that would be encountered within the bore pit at design depths.	Oregon Coast ESU Coho, spawning habitat T, CH	Coho, Winter Steelhead	Assumed	Coho	Coho Rearing, Migration	Jul 1 to Sep 15	Y*
Ditch Trib. to Vogel Creek (BR-S- 04)	17100304000790 Private	11.88BR	Intermittent Intermediate	Dry Open-Cut	Dry open-cut methods feasible/practical on small intermittent ditched tributary if flowing at the time of construction.	None	None	None	None	None	Jul 1 to Sep 15	Y*
Ditch Trib. to Vogel Creek (BR-S- 06)	17100304000798 Private	12.11BR	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small 2' wide intermittent ditched tributary if flowing at the time of construction.	None	None	Assumed	None	None	Jul 1 to Sep 15	Y*
Ditch Trib. to Vogel Creek (EE- SS-9046)	17100304006569 Private	12.18BR	Intermittent N/A	Adjacent to centerline within ROW	Small headwater, interpreted Intermittent, tributary not crossed by centerline on edge of TEWA and can likely be avoided, if present. If present and cannot be avoided, would be restored to approximate original contour and grade during restoration.	None	None	None	None	None	Jul 1 to Sep 15	N

TABLE I-2 (continued)

Fish Utilization, EFH in, and Crossing Techniques and In-Water Work Windows for Waterbodies Crossed by the Proposed Route (revised April 2018)

Waterbodies Crossed and Waterbody ID	NHD Waterbody Reach Code a/ and Jurisdiction	Approximate Pipeline Milepost (MP)	Waterbody Type Size b/	Proposed Crossing Method Scour Level c/	Waterbody Crossing Rationale d/	ESA Species Present/Habitat e/	Anadromous Species Present f/	Resident Coldwater Species Present	EFH Species Present g/	EFH Component Present g/	Fishery Construction Window h/	Equipment Bridges Y=Yes, Y* = Yes if flowing at time of construction, 1o= 1 pass required outside fish window1i = 1 pass required inside fish window, i =set inside fish window, N=None
Trib. to Stock Slough (BR-S-31)	17100304002068 Private	14.72BR	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small non- fish intermittent ditched tributary if flowing at the time of construction.	None	None	None	None	None	Jul 1 to Sep 15	Y*
Trib. to Stock Slough (Laxstrom Gulch) (BR-S-30)	17100304000493 Private	14.82BR	Intermittent	Adjacent riparian zone	Adjacent riparian zone overlaps construction ROW	Oregon Coast ESU Coho, spawning habitat T, CH	Coho, Winter Steelhead,	Assumed	Coho	Coho Spawning, Rearing	Jul 1 to Sep 15	
Stock Slough (BR-S-36)	17100304000507 Private	15.11BR	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on creek during low flow period within fish window. A conventional bore crossing is problematic because of expected high groundwater levels within the Stock Slough floodplain and Laxstrom Gluch that would be encountered within the bore pit at design depths.	Oregon Coast ESU Coho, spawning habitat T, CH	Coho, Winter Steelhead,	Assumed	Coho	Coho Spawning, Rearing	Jul 1 to Sep 15	Y*
Trib. To Stock Slough (Laxstrom Gulch)	17100304000493 Private	15.16BR	Intermittent Minor	Adjacent to centerline within ROW crossed by PAR 15.07	PAR 15.07 uses an existing road with a culverted crossing that does not need to be improved for project use - no impacts	Oregon Coast ESU Coho, spawning habitat T	Coho, Winter Steelhead	Assumed	Coho	Coho Spawning, Rearing	Jul 1 to Sep 15	N
Stock Slough (EE-SS-9068)	17100304000507 Private	15.32BR	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small waterbody during low flow period within fish window and if flowing at the time of construction. A conventional bore crossing is problematic because of expected high groundwater levels within the Stock Slough floodplain that would be encountered within the bore pit at design depths. A bore crossing is not feasible because of topographic constraints on west side of creek because of grading/excavation requirements for a bore pit.	Oregon Coast ESU Coho, spawning habitat T, CH	Coho, Winter Steelhead,	Assumed	Coho	Coho Spawning, Rearing	Jul 1 to Sep 15	Y*
Coast Range Ecoregion, Coquille Sub-basin (HUC 17100305), North Fork Coquille River (HUC 1710030504) Fifth field Watershed 8 Coos County, Oregon												
Steinnon Creek (SS-500-003; BR-S-63)	17100305000361 BLM	20.20BR	Perennial Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small non- fish tributary. Steep topographic conditions prevent a conventional bore because of bore pit grading/excavation requirements on both sides of the crossing.	None	Unknown	Assumed	None	None	Jul 1 to Sep 15	Y

TABLE I-2 (continued)

Fish Utilization, EFH in, and Crossing Techniques and In-Water Work Windows for Waterbodies Crossed by the Proposed Route (revised April 2018)

Waterbodies Crossed and Waterbody ID	NHD Waterbody Reach Code a/ and Jurisdiction	Approximate Pipeline Milepost (MP)	Waterbody Type Size b/	Proposed Crossing Method Scour Level c/	Waterbody Crossing Rationale d/	ESA Species Present/Habitat e/	Anadromous Species Present f/	Resident Coldwater Species Present	EFH Species Present g/	EFH Component Present g/	Fishery Construction Window h/	Equipment Bridges Y=Yes, Y* = Yes if flowing at time of construction, 1o= 1 pass required outside fish window1i = 1 pass required inside fish window, i =set inside fish window, N=None
Steinnon Creek (BR-S-63)	171003050000361 BLM	24.32BR	Perennial Intermediate	Dry Open-Cut	Dry open-cut methods feasible/practical during low flows periods within ODFW in- water work window. Right-of- way has been necked down to 75 feet and TEWAs located in cleared areas to minimize riparian disturbance. A conventional bore (geotechnical conditions unknown) would require additional riparian impacts because TEWAs to accommodate the bore pits would be required closer to the waterbody in forested riparian areas.	Oregon Coast ESU Coho, spawning, rearing habitat T, CH	Fall Chinook, Coho, Winter Steelhead, Pacific Lamprey	Assumed	Chinook, Coho	Fall Chinook, Coho Rearing, Migration	Jul 1 to Sep 15	Y-1i
Ditch (DA-10X)	17100305012102 Private	22.72	Intermittent Minor	Dry Open-Cut	Dry-open cut methods feasible/practical on small field drainage ditch if flowing during construction.	None	Unknown	Assumed	None	None	Jul 1 to Sep 15	Y*
North Fork Coquille River (BSP-207)	17100305000339 Private	23.06	Perennial Intermediate	Dry Open-Cut Level 1 m/	Dry open-cut method feasible/practical on 20' wide river during low flow period within fish window. Impacts to riparian vegetation minimized by placement/setbacks of TEWAs on west side of river in field and eastside setback 100 feet from waterbody. ROW also necked down to 75 feet. Topographic conditions on east side of the crossing prevent HDD crossing methods because of elevation differences between entry/exit and necessary workspace grading requirements.	Oregon Coast ESU Coho, spawning, rearing, migration habitat T, CH	Spring Chinook, Fall Chinook, Coho, Winter Steelhead, Pacific Lamprey	Cutthroat Trout, Assumed	Chinook, Coho	Spring and Fall Chinook, Coho Rearing, Migration	Jul 1 to Sep 15	Y-1i
Trib. to Middle Creek S-T02-001 (EE-SS-9073)	17100305012832 Private	25.18	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small intermittent headwater, non- fish-bearing tributary if flowing at the time of construction.	None	None	None	None	None	Jul 1 to Sep 15	Y*
Trib. to Middle Creek (BSI- 137)	BLM- Coos Bay District	27.01	Intermittent Intermediate	Dry Open-Cut	Intermittent tributary to be crossed at the same time as the crossing of Middle Creek at MP 27.04 using dry open-cut. Tributary expected to be dry at the time of construction.	None	Unknown	Unknown	None	None	Jul 1 to Sep 15	Y*
Trib. to Middle Creek (BSI- 135)	BLM- Coos Bay District	27.03	Intermittent Minor	Adjacent to centerline within ROW Level 2	Intermittent tributary not crossed by centerline.	None	Unknown	Unknown	None	None	Jul 1 to Sep 15	N

TABLE I-2 (continued)

Fish Utilization, EFH in, and Crossing Techniques and In-Water Work Windows for Waterbodies Crossed by the Proposed Route (revised April 2018)

Waterbodies Crossed and Waterbody ID	NHD Waterbody Reach Code a/ and Jurisdiction	Approximate Pipeline Milepost (MP)	Waterbody Type Size b/	Proposed Crossing Method Scour Level c/	Waterbody Crossing Rationale d/	ESA Species Present/Habitat e/	Anadromous Species Present f/	Resident Coldwater Species Present	EFH Species Present g/	EFH Component Present g/	Fishery Construction Window h/	Equipment Bridges Y=Yes, Y* = Yes if flowing at time of construction, 1o= 1 pass required outside fish window1i = 1 pass required inside fish window, i =set inside fish window, N=None
Middle Creek (BSP-133)	17100305000323 BLM-Coos Bay District	27.04	Perennial Intermediate	Dry Open-Cut Level 2 m/	Dry open-cut methods feasible/practical on creek during low flow period within fish window. A conventional bore crossing is not feasible because of topographic constraints on west side of creek because of grading/excavation requirements for bore pit. An HDD is not feasible because of topographic/geometry conditions.	Oregon Coast ESU Coho, rearing, migration habitat T, CH	Fall Chinook, Coho, Winter Steelhead, Pacific Lamprey	Cutthroat Trout	Chinook, Coho	Fall Chinook, Coho Rearing, Migration	Jul 1 to Sep 15	Y-1i
Coast Range Ecoregion, Coquille Sub-basin (HUC 17100305), East Fork Coquille River (HUC 1710030503) Fifth field Watershed 8, Coos County, Oregon												
Trib. To E. Fork Coquille (BSP-77)	7100305002504 Private	28.86	Perennial Intermediate	Dry Open-Cut (Streambed-bedrock) n/ Level 1	Dry open-cut methods feasible/practical on small incised headwater trib. Dam and pump crossing method most logical dry open-cut method based on topographic conditions to eliminate difficulties of threading pipe string under flume with associated safety risks including upsetting flume during process. Steep topographic conditions prevent a conventional bore because of bore pit grading/excavation requirements on both sides of the crossing.	Oregon Coast ESU Coho, assumed habitat T	Assumed	Cutthroat Trout	Coho Assumed	Unknown	Jul 1 to Sep 15	Y
Trib. To E. Fork Coquille (BSP-74)	17100305002598 Private	29.30	Intermittent Intermediate	Dry Open-Cut	Dry open-cut methods feasible/practical on small tributary. Steep topographic conditions prevent a conventional bore because of bore pit grading/excavation requirements on west side of the crossing.	Oregon Coast ESU Coho, assumed habitat T	Assumed	Present	Coho Assumed	Unknown	Jul 1 to Sep 15	Y*
Trib. To E. Fork Coquille (BSI-76)	17100305002647 Private	29.47	Intermittent Minor	Dry Open-Cut (Streambed-bedrock) n/	Dry open-cut methods feasible/practical on small 3-4' intermittent tributary if flowing at the time of construction.	Oregon Coast ESU Coho, assumed habitat T	Assumed	Unknown	Coho Assumed	Unknown	Jul 1 to Sep 15	Y*

TABLE I-2 (continued)

Fish Utilization, EFH in, and Crossing Techniques and In-Water Work Windows for Waterbodies Crossed by the Proposed Route (revised April 2018)

Waterbodies Crossed and Waterbody ID	NHD Waterbody Reach Code a/ and Jurisdiction	Approximate Pipeline Milepost (MP)	Waterbody Type Size b/	Proposed Crossing Method Scour Level c/	Waterbody Crossing Rationale d/	ESA Species Present/Habitat e/	Anadromous Species Present f/	Resident Coldwater Species Present	EFH Species Present g/	EFH Component Present g/	Fishery Construction Window h/	Equipment Bridges Y=Yes, Y* = Yes if flowing at time of construction, 1o= 1 pass required outside fish window1i = 1 pass required inside fish window, i =set inside fish window, N=None
East Fork Coquille River (BSP-71)	17100305000286 Private	29.85	Perennial Intermediate	Dry Open-Cut Level 1 m/	Project alignment was selected based on landowner negotiations and requirement to avoid landowner's air strip. Dry open-cut methods feasible/practical during low flow crossing period during ODFW in-water work window. Conventional bore is not practical because of significant grading/excavation requirements for bore pits. The river is deeply incised below stream banks requiring extensive pits for installation below streambed. Continued bore pit dewatering would be required to keep bore pits dry. A temporary bridge is also necessary to prevent entire spread move around. A crossing bridge will require bank grading for crossing access. An HDD is probable at the approximate crossing location based on the topography, geometry and expected geotechnical conditions. Significant HDD costs, HDD time requirements and the need for a crossing bridge were the determinants for the proposed dry-open cut crossing method.	Oregon Coast ESU Coho, spawning, rearing, migration habitat T, CH	Spring Chinook, Fall Chinook, Coho, Winter Steelhead, Pacific Lamprey	Cutthroat Trout	Chinook, Coho	Spring Chinook Rearing, Migration Fall Chinook Spawning, Rearing, Coho Rearing, Migration	Jul 1 to Sep 15	Y-1i
Trib. to E. Fork Coquille (SS-003-007A)	17100305002813 Private	30.22	Perennial Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small intermittent tributary if flowing at the time of construction	None	Unknown	Unknown	None	None	Jul 1 to Sep 15	Y*
Trib. to E. Fork Coquille (SS-003-007B)	17100305002813 Private	30.29	Perennial Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small intermittent tributary if flowing at the time of construction.	Oregon Coast ESU Coho, assumed habitat T	Assumed	Assumed	Coho Assumed	Unknown	Jul 1 to Sep 15	Y*
Trib. To E. Fork Coquille (BSI-70)	17100305018097 BLM-Coos Bay District	31.64	Intermittent Minor	Dry Open-Cut	Small 1-wide intermittent headwater tributary, dry open- cut methods feasible/practical, if flowing at time of construction.	None	Unknown	Unknown	None	None	Jul 1 to Sep 15	Y*

TABLE I-2 (continued)

Fish Utilization, EFH in, and Crossing Techniques and In-Water Work Windows for Waterbodies Crossed by the Proposed Route (revised April 2018)

Waterbodies Crossed and Waterbody ID	NHD Waterbody Reach Code a/ and Jurisdiction	Approximate Pipeline Milepost (MP)	Waterbody Type Size b/	Proposed Crossing Method Scour Level c/	Waterbody Crossing Rationale d/	ESA Species Present/Habitat e/	Anadromous Species Present f/	Resident Coldwater Species Present	EFH Species Present g/	EFH Component Present g/	Fishery Construction Window h/	Equipment Bridges Y=Yes, Y* = Yes if flowing at time of construction, 1o= 1 pass required outside fish window1i = 1 pass required inside fish window, i =set inside fish window, N=None
Elk Creek (BSP-57)	1240218431116 Private	32.40	Perennial Minor	Dry Open-Cut Level 1 m/	Dry open-cut methods feasible/practical on small 8' wide tributary. Steep topographic conditions on north side of stream prevent a conventional bore because of grading/excavation requirements for bore pit. StreamNet data indicates anadromy below crossing (~ 1 mile). Waterbody is within the ¼ mile buffer of MAMU-occupied stand (C3098). Conflicts with ODFW recommended in-water work periods are not expected based on proposed two-year construction schedule. However, proposed Year Two daily timing restrictions during construction to minimize impacts to MAMU should be waived during the stream crossing installation to minimize the duration of instream work and installation of flumes or dams/pumps.	Oregon Coast ESU Coho, assumed habitat T	Assumed	Cutthroat Trout, Assumed	Coho Assumed	Unknown	Jul 1 to Sep 15	Y
Trib. To Elk Creek S-T01-008 (BSP-55)	1239513431370 Private	32.50	Perennial Minor	Dry Open-Cut (Streambed-bedrock) n/	Dry open-cut methods feasible/practical on small 3-4' wide tributary. Waterbody is within the ¼ mile buffer of MAMU-occupied stand (C3098). Conflicts with ODFW-recommended in-water work periods are not expected based on proposed two-year construction schedule. However, proposed Year Two daily timing restrictions during construction to minimize impacts to MAMU should be waived during the stream crossing installation to minimize the duration of instream work and installation of flumes or dams/pumps.	Oregon Coast ESU Coho, assumed habitat T	Assumed	Assumed	Coho Assumed	Unknown	Jul 1 to Sep 15	Y
Trib. To Elk Creek S-T01-004 (SS-100-030)	7100305021871 Private	32.56	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small/non- fish-bearing intermittent headwater tributary if flowing at time of construction. Topographic conditions on both sides of stream limit a conventional bore because of grading/excavation requirements for bore pits.	None	Nonen	None	None	None	Jul 1 to Sep 15	Y*
Trib. To Elk Creek (BSP-49)	17100305003372 Private	33.00	Perennial Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small 10' wide tributary. Topographic conditions on both sides of stream limit a conventional bore because of grading/excavation requirements for bore pits.	None	None	None	None	None	Jul 1 to Sep 15	Y

TABLE I-2 (continued)

Fish Utilization, EFH in, and Crossing Techniques and In-Water Work Windows for Waterbodies Crossed by the Proposed Route (revised April 2018)

Waterbodies Crossed and Waterbody ID	NHD Waterbody Reach Code a/ and Jurisdiction	Approximate Pipeline Milepost (MP)	Waterbody Type Size b/	Proposed Crossing Method Scour Level c/	Waterbody Crossing Rationale d/	ESA Species Present/Habitat e/	Anadromous Species Present f/	Resident Coldwater Species Present	EFH Species Present g/	EFH Component Present g/	Fishery Construction Window h/	Equipment Bridges Y=Yes, Y* = Yes if flowing at time of construction, 1o= 1 pass required outside fish window1i = 1 pass required inside fish window, i =set inside fish window, N=None
Trib. To Elk Creek (BSP-50)	17100305003372 Private	33.02	Perennial Minor	Adjacent to centerline within ROW (Streambed-bedrock) n/	Not crossed by pipeline centerline. Small 2' wide headwater tributary expected to be dry during construction. Trib. would be crossed at the same time as BSP049 at MP 32.99.	None	None	None	None	None	Jul 1 to Sep 15	Y*
South Fork Elk Creek (CSP-5)	17100305000591 Private	34.46	Perennial Intermediate	Dry Open-Cut (Streambed-bedrock) n/ Level 2 m/	Dry open-cut methods feasible/practical on stream. Steep topographic conditions on both sides of stream prevent conventional bore crossing methods because of grading/excavation requirements for bore pits.	Oregon Coast ESU Coho, spawning, rearing habitat T, CH	Coho, Winter Steelhead	Cutthroat Trout	Coho	Coho Spawning, Rearing	Jul 1 to Sep 15	Y
Trib. To S. Fork Elk Creek (BSI-251)	17100305021783 BLM-Coos Bay District	35.51	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small 4' wide intermittent headwater tributary, if flowing at time of construction. Crossing will occur adjacent to road where existing culvert is in place. This waterbody is located within an occupied MAMU- stand (C3093). Conflicts with ODFW- recommended in-water work periods are not expected based on the proposed two- year construction schedule. However, the proposed Year Two daily timing restrictions during construction to minimize impacts to MAMU should be waived during the stream crossing installation to minimize the duration of instream work and the installation of flumes or dams/pumps.	None	None	None	None	None	Jul 1 to Sep 15	N (In existing road)

TABLE I-2 (continued)

Fish Utilization, EFH in, and Crossing Techniques and In-Water Work Windows for Waterbodies Crossed by the Proposed Route (revised April 2018)

Waterbodies Crossed and Waterbody ID	NHD Waterbody Reach Code a/ and Jurisdiction	Approximate Pipeline Milepost (MP)	Waterbody Type Size b/	Proposed Crossing Method Scour Level c/	Waterbody Crossing Rationale d/	ESA Species Present/Habitat e/	Anadromous Species Present f/	Resident Coldwater Species Present	EFH Species Present g/	EFH Component Present g/	Fishery Construction Window h/	Equipment Bridges Y=Yes, Y* = Yes if flowing at time of construction, 1o= 1 pass required outside fish window1i = 1 pass required inside fish window, i =set inside fish window, N=None
Coast Range Ecoregion, Coquille Sub-basin (HUC 17100305), Middle Fork Coquille River (HUC 1710030501) Fifth field Watershed 8, Coos County, Oregon												
Trib. to Big Creek (BLM 35.87 (CSP-2))	17100305025781 BLM-Coos Bay District	35.87	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small intermittent headwater tributary, if flowing at time of construction. Crossing occurs within Elk Creek Road (BLM 28-11-29-0) and flows through a 12” culvert which will be replaced. Waterbody is within the ¼ mile buffer of MAMU-occupied stand (C3093). Conflicts with ODFW-recommended in-water work periods are not expected based on proposed two year construction schedule. However, proposed Year Two daily timing restrictions during construction to minimize impacts to MAMU should be waived during the stream crossing installation to minimize the duration of instream work and to allow the removal of road culvert, installation of flumes or dams/pumps, and replacement of the road culvert	None	None	Unknown	None	None	Jul 1 to Sep 15	Y*
Trib. To Big Creek (BLM 36.48)	17100305026477 BLM-Coos Bay District	36.48	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small intermittent headwater tributary, if flowing at time of construction. This waterbody is located adjacent to an occupied MAMU- stand (C3073). Conflicts with ODFW- recommended in-water work periods are not expected based on the proposed two-year construction schedule. However, the proposed Year Two daily timing restrictions during construction to minimize impacts to MAMU should be waived during the stream crossing to facilitate the crossing and allow the installation/removal of flumes or dams/pumps and to minimize the duration of instream work.	None	None	Unknown	None	None	Jul 1 to Sep 15	Y*

TABLE I-2 (continued)

Fish Utilization, EFH in, and Crossing Techniques and In-Water Work Windows for Waterbodies Crossed by the Proposed Route (revised April 2018)

Waterbodies Crossed and Waterbody ID	NHD Waterbody Reach Code a/ and Jurisdiction	Approximate Pipeline Milepost (MP)	Waterbody Type Size b/	Proposed Crossing Method Scour Level c/	Waterbody Crossing Rationale d/	ESA Species Present/Habitat e/	Anadromous Species Present f/	Resident Coldwater Species Present	EFH Species Present g/	EFH Component Present g/	Fishery Construction Window h/	Equipment Bridges Y=Yes, Y* = Yes if flowing at time of construction, 1o= 1 pass required outside fish window1i = 1 pass required inside fish window, i =set inside fish window, N=None
Trib. To Big Creek (GSI-25/BSI-253)	17100305004068 BLM-Coos Bay District	36.54	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small 4' wide intermittent headwater tributary, if flowing at time of construction. No additional workspace required. ODFW fish passage barrier data reports a downstream boulder canyon with a 10-foot falls at upper end (Record ID 52488). StreamNet data indicates anadromy below crossing (~ 0.5 mile) at ODFW barrier 52488. This waterbody is located within an occupied MAMU-stand (C3073). Conflicts with ODFW- recommended in-water work periods are not expected based on the proposed two- year construction schedule. However, the proposed Year Two daily timing restrictions during construction to minimize impacts to MAMU should be waived during the stream crossing installation to minimize the duration of instream work and the installation of flumes or dams/pumps.	None	None	Unknown	None	None	Jul 1 to Sep 15	Y*
Trib. To Big Creek (BLM 36.85)	17100305025748 BLM-Coos Bay District	36.85	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small intermittent headwater tributary, if flowing at time of construction. Crossing occurs within Elk Creek Road (BLM 28-11-29-0) and flows through a 12-18" culvert which will be replaced. This waterbody is located within an occupied MAMU-stand (C3073). Conflicts with ODFW- recommended in-water work periods are not expected based on the proposed two- year construction schedule. However, the proposed Year Two daily timing restrictions during construction to minimize impacts to MAMU should be waived during the stream crossing to facilitate the crossing and allow the installation/removal of flumes or dams/pumps and to minimize the duration of instream work.	None	None	Unknown	None	None	Jul 1 to Sep 15	Y*

TABLE I-2 (continued)

Fish Utilization, EFH in, and Crossing Techniques and In-Water Work Windows for Waterbodies Crossed by the Proposed Route (revised April 2018)

Waterbodies Crossed and Waterbody ID	NHD Waterbody Reach Code a/ and Jurisdiction	Approximate Pipeline Milepost (MP)	Waterbody Type Size b/	Proposed Crossing Method Scour Level c/	Waterbody Crossing Rationale d/	ESA Species Present/Habitat e/	Anadromous Species Present f/	Resident Coldwater Species Present	EFH Species Present g/	EFH Component Present g/	Fishery Construction Window h/	Equipment Bridges Y=Yes, Y* = Yes if flowing at time of construction, 1o= 1 pass required outside fish window1i = 1 pass required inside fish window, i =set inside fish window, N=None
Trib. To Big Creek (BSI-252)	17100305004061 BLM-Coos Bay District	36.92	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small 3' wide intermittent headwater tributary, if flowing at time of construction. No additional workspace required. Alignment and trib. crossing along existing road. ODFW fish passage barrier data reports a downstream boulder canyon with a 10 foot falls at upper end (Record ID 52488). StreamNet data indicates anadromy below crossing (~ 1 mile) at ODFW barrier 52488. This waterbody is located within an occupied MAMU-stand (C3073). Conflicts with ODFW- recommended in-water work periods are not expected based on the proposed two- year construction schedule. However, the proposed Year Two daily timing restrictions during construction to minimize impacts to MAMU should be waived during the stream crossing installation to minimize the duration of instream work and the installation of flumes or dams/pumps.	None	None	Unknown	None	None	Jul 1 to Sep 15	N (In existing road)
Trib. To Big Creek (ESI-19)	17100305026126 BLM-Coos Bay District	37.32	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small 3' wide intermittent headwater tributary, if flowing at time of construction. No additional workspace required. ODFW fish passage barrier data reports a downstream boulder canyon with a 10 foot falls at upper end (Record ID 52488). StreamNet data indicates anadromy below crossing (~ 1 mile) at ODFW barrier 52488. StreamNet data indicates anadromy below crossing (~ 1 mile) at ODFW barrier 52488. This waterbody is located within an occupied MAMU- stand (C3090). Conflicts with ODFW- recommended in-water work periods are not expected based on the proposed two- year construction schedule. However, the proposed Year Two daily timing restrictions during construction to minimize impacts to MAMU should be waived during the stream crossing installation to minimize the duration of instream work and the installation of flumes or dams/pumps.	None	None	Unknown	None	None	Jul 1 to Sep 15	Y*

TABLE I-2 (continued)

Fish Utilization, EFH in, and Crossing Techniques and In-Water Work Windows for Waterbodies Crossed by the Proposed Route (revised April 2018)

Waterbodies Crossed and Waterbody ID	NHD Waterbody Reach Code a/ and Jurisdiction	Approximate Pipeline Milepost (MP)	Waterbody Type Size b/	Proposed Crossing Method Scour Level c/	Waterbody Crossing Rationale d/	ESA Species Present/Habitat e/	Anadromous Species Present f/	Resident Coldwater Species Present	EFH Species Present g/	EFH Component Present g/	Fishery Construction Window h/	Equipment Bridges Y=Yes, Y* = Yes if flowing at time of construction, 1o= 1 pass required outside fish window1i = 1 pass required inside fish window, i =set inside fish window, N=None
Trib. To Big Creek (ESP-20)	17100305000606 BLM-Coos Bay District	37.35	Perennial Intermediate	Dry Open-Cut Level 1 m/	Dry open-cut methods feasible/practical on stream. Dam and pump crossing method most logical dry open- cut method based on topographic conditions to eliminate difficulties of threading pipe string under flume with associated safety risks including upsetting flume during process. Steep topography on both sides of stream prevents conventional bore crossing methods because of grading/excavation requirements for bore pits. No additional workspace proposed. ODFW fish passage barrier data reports a downstream boulder canyon with a 10 foot falls at upper end (RecordID 52488). StreamNet data indicates anadromy below crossing (~ 1 mile) at ODFW barrier 52488. This waterbody is located within an occupied MAMU- stand (C3090). Conflicts with ODFW-recommended in-water work periods are not expected based on the proposed two- year construction schedule. However, the proposed Year Two daily timing restrictions during construction to minimize impacts to MAMU should be waived during the stream crossing installation to minimize the duration of instream work and the installation of flumes or dams/pumps.	None	None	Unknown	None	None	Jul 1 to Sep 15	Y
Big Creek	17100305000272 BLM	37.41	Perennial Intermediate	Adjacent riparian zone	Adjacent riparian zone overlaps construction ROW	Oregon Coast ESU Coho, assumed habitat T	Winter Steelhead	Assumed	Coho Assumed	Unknown	Jul 1 to Sep 15	

TABLE I-2 (continued)

Fish Utilization, EFH in, and Crossing Techniques and In-Water Work Windows for Waterbodies Crossed by the Proposed Route (revised April 2018)

Waterbodies Crossed and Waterbody ID	NHD Waterbody Reach Code a/ and Jurisdiction	Approximate Pipeline Milepost (MP)	Waterbody Type Size b/	Proposed Crossing Method Scour Level c/	Waterbody Crossing Rationale d/	ESA Species Present/Habitat e/	Anadromous Species Present f/	Resident Coldwater Species Present	EFH Species Present g/	EFH Component Present g/	Fishery Construction Window h/	Equipment Bridges Y=Yes, Y* = Yes if flowing at time of construction, 1o= 1 pass required outside fish window1i = 1 pass required inside fish window, i =set inside fish window, N=None
Upper Rock Creek (BSP-41)	17100305000252 Private	44.21	Perennial Intermediate	Dry Open-Cut Level 1	Dry open-cut methods feasible/practical on stream. Dam and pump crossing method most logical dry open- cut method based on topographic conditions to eliminate difficulties of threading pipe string under flume with associated safety risks including upsetting flume during process. Steep topography on both sides of stream prevents conventional bore crossing methods because of grading/excavation requirements for bore pits. ODFW fish passage barrier data indicated two potential downstream falls may limit passage one report as 6-8 feet (RecordID 52484). StreamNet data indicates anadromy below crossing (~ 6 miles) at ODFW barrier RecordID 52484.	None	None	Cutthroat Trout Assumed	None	None	Jul 1 to Sep 15	Y
Klamath Mountains Ecoregion, Coquille Sub-basin (HUC 17100305), Middle Fork Coquille River (HUC 1710030501) Fifth field Watershed 8, Douglas County, Oregon												
Tributary Trib. to Upper Rock Creek (S3-07 /BW-38)	17100305005585 Private	46.56	Perennial Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small non- fish-bearing headwater tributary.	None	None	None	None	None	Jul 1 to Sep 15	Y
Ditch (S3-06)	Private	48.21	Intermittent Minor	Dry Open- Cut	Dry open-cut methods feasible/practical on small intermittent road ditch if flowing at time of construction.	None	None	None	None	None	N/A	Y*
Deep Creek (BSP-257)	17100305005863 BLM-Roseburg District	48.27	Perennial Intermediate	Dry Open-Cut Level 1	Dry open-cut methods feasible/practical on broad stream and associated wetlands. ODFW fish passage barrier data (Recordid 56033) reports downstream falls on the Middle Fork Coquille River restrict anadromy at crossing.	None	None	Cutthroat Trout	None	None	Jul 1 to Sep 15	Y-1i
Ditch (BDX-32)	Private	49.94	Intermittent Minor	Adjacent to ROW	Right-of-way was necked-down to avoid the ditch.	None	None	None	None	None	Jul 1 to Sep 15	N
Ditch (BDX-31)	Private	50.02	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small intermittent field ditch if flowing at time of construction.	None	None	None	None	None	N/A	Y*

TABLE I-2 (continued)

Fish Utilization, EFH in, and Crossing Techniques and In-Water Work Windows for Waterbodies Crossed by the Proposed Route (revised April 2018)

Waterbodies Crossed and Waterbody ID	NHD Waterbody Reach Code a/ and Jurisdiction	Approximate Pipeline Milepost (MP)	Waterbody Type Size b/	Proposed Crossing Method Scour Level c/	Waterbody Crossing Rationale d/	ESA Species Present/Habitat e/	Anadromous Species Present f/	Resident Coldwater Species Present	EFH Species Present g/	EFH Component Present g/	Fishery Construction Window h/	Equipment Bridges Y=Yes, Y* = Yes if flowing at time of construction, 1o= 1 pass required outside fish window1i = 1 pass required inside fish window, i =set inside fish window, N=None
Middle Fork Coquille River (BSP-30)	17100305000232 Private	50.28	Perennial Intermediate	Dry Open-Cut (Streambed-bedrock) n/ Level 1 m/	Dry open-cut methods feasible/practical on broad stream during low flows within ODFW in-water work windows. ROW has been necked down to 75 feet and TEWAs located in existing cleared areas to minimize riparian impacts. ODFW fish passage barrier data (Recordid 56033) reports downstream falls on the Middle Fork Coquille River restrict anadromy at crossing. StreamNet data also indicates duplicates this anadromy restriction at this barrier.	None	None	Cutthroat Trout	None	None	Jul 1 to Sep 15	Y-1i
Trib. to Middle Fork Coquille (GDX-36/BSI-66/67)	17100305005874 Private	50.45	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small 1-4' wide intermittent ditched tributary in ag field if flowing at time of construction.	None	None	None	None	None	Jul 1 to Sep 15	Y*
Belieu Creek (BSP-61/GSI- 37)	17100305000706 Private	50.71	Perennial Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small 3' wide headwater tributary. Steep topography on west side of crossing prevents conventional bore because of grading/excavation requirements for a bore pit. ODFW fish passage barrier data (RecordID 56033) reports downstream falls on the Middle Fork Coquille River restrict anadromy at the crossing.	None	None	Cutthroat Trout	None	None	Jul 1 to Sep 15	Y
Trib. to Middle Fork Coquille (S1-07/GSI-38)	17100305022784 Private	51.02	Intermittent Intermediate	Dry Open-Cut	Dry open-cut methods feasible/practical on small 1-4' wide intermittent headwater tributary if flowing at time of construction. No additional workspace required.	None	None	None	None	None	Jul 1 to Sep 15	Y
Trib to Jim Belieu Creek (SS-222-006)	Private	51.71	Intermittent Minor	Adjacent to centerline within ROW	Dry open-cut methods feasible/practical on small intermittent field ditch if flowing at time of construction.	None	None	None	None	None	Jul 1 to Sep 15	Y*
Klamath Mountains Ecoregion, South Umpqua (HUC 17100302) Sub-basin, Olalla Creek-Lookingglass Creek (HUC 1710030212) Fifth field Watershed 8, Douglas County, Oregon												
Trib. to Shields Creek (BSI- 202)	17100302001821 Private	55.90	Intermittent Intermediate	Dry Open-Cut Level 1	Dry open-cut methods feasible/practical on intermittent tributary if flowing at time of construction.	Oregon Coast ESU Coho, assumed habitat T	Assumed	Assumed	Coho Assumed	Unknown	Jul 1 to Sep 15	Y*
Trib. to Shields Creek (BSI- 203)	17100302001894 Private	55.94	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small 8' wide intermittent tributary if flowing at time of construction.	None	Unknown	Unknown	None	None	Jul 1 to Sep 15	Y*
Trib. to Shields Creek (Denied Access 13)	17100302044091 Private	56.28	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small 3-4' wide intermittent tributary if flowing at time of construction.	None	None	None	None	None	Jul 1 to Sep 15	Y*

TABLE I-2 (continued)

Fish Utilization, EFH in, and Crossing Techniques and In-Water Work Windows for Waterbodies Crossed by the Proposed Route (revised April 2018)

Waterbodies Crossed and Waterbody ID	NHD Waterbody Reach Code a/ and Jurisdiction	Approximate Pipeline Milepost (MP)	Waterbody Type Size b/	Proposed Crossing Method Scour Level c/	Waterbody Crossing Rationale d/	ESA Species Present/Habitat e/	Anadromous Species Present f/	Resident Coldwater Species Present	EFH Species Present g/	EFH Component Present g/	Fishery Construction Window h/	Equipment Bridges Y=Yes, Y* = Yes if flowing at time of construction, 1o= 1 pass required outside fish window1i = 1 pass required inside fish window, i =set inside fish window, N=None
Trib. to Shields Creek (Denied Access 14)	17100302044013 Private	56.34	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small 3-4' wide intermittent tributary if flowing at time of construction.	None	None	Unknown	None	None	Jul 1 to Sep 15	Y*
Trib. to Olalla Creek S-T02-002	17100302044083 Private	56.80	Intermittent	Dry Open-Cut	Dry open-cut methods feasible/practical on small 3-4' wide intermittent tributary if flowing at time of construction.	None	None	None	None	None	Jul 1 to Sep 15	Y*
Trib. to Olalla Creek (BSI-140)	17100302048489 Private	57.11	Intermittent Minor	Dry Open-Cut (Streambed – bedrock) n/	Dry open-cut methods feasible/practical on small intermittent tributaries if flowing at time of construction.	None	None	Unknown	None	None	Jul 1 to Sep 15	Y*
Trib. to Olalla Creek (BSI-140)	17100302048489 Private	57.14	Intermittent Minor	Dry Open-Cut (Streambed – bedrock) n/	Dry open-cut methods feasible/practical on small intermittent tributaries if flowing at time of construction.	None	None	Unknown	None	None	Jul 1 to Sep 15	Y*
Trib. to Olalla Creek (BSI-138)	17100302002187 Private	57.31	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small 5' wide intermittent tributary if flowing at time of construction. ROW has been necked down to 75 feet and TEWAs located in existing cleared areas to minimize riparian impacts.	Oregon Coast ESU Coho, assumed habitat T	Unknown	Present	Coho Assumed	Unknown	Jul 1 to Sep 15	Y*
Trib. to Olalla Creek (BSI-147/EE-12)	17100302002221 Private	57.84	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small 4' wide intermittent tributary if flowing at time of construction. ROW has been necked down to 75 feet and TEWAs located in existing cleared areas to minimize riparian impacts.	None	Unknown	Unknown	None	None	Jul 1 to Sep 15	Y*
Irrigation Canal (BDX148)	Private	57.97	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small intermittent field ditch if flowing at time of construction.	None	None	None	None	None	N/A	Y*
Trib. to Olalla Creek (BSI-151)	17100302002311 Private	58.20	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small 3' wide intermittent tributary if flowing at time of construction. ROW has been necked own to 75 feet and TEWAs located in existing cleared areas to minimize riparian impacts.	None	None	None	None	None	Jul 1 to Sep 15	Y*
Ditch (BDX-157)	Private	58.30 58.51	Intermittent Minor	Adjacent to centerline within ROW and TEWA	Dry open-cut methods feasible/practical on small intermittent field ditch if flowing at time of construction.	None	None	None	None	None	N/A	Y*
Trib. to Olalla Creek (BSP- 159)	17100302002420 Private	58.55	Perennial Intermediate	Dry Open-Cut (Streambed-bedrock) n/	Dry open-cut methods feasible/practical on small 10' wide tributary. ROW has been necked down to 75 feet and TEWA located in existing cleared area to minimize riparian impacts.	None	None	None	None	None	Jul 1 to Sep 15	Y

TABLE I-2 (continued)

Fish Utilization, EFH in, and Crossing Techniques and In-Water Work Windows for Waterbodies Crossed by the Proposed Route (revised April 2018)

Waterbodies Crossed and Waterbody ID	NHD Waterbody Reach Code a/ and Jurisdiction	Approximate Pipeline Milepost (MP)	Waterbody Type Size b/	Proposed Crossing Method Scour Level c/	Waterbody Crossing Rationale d/	ESA Species Present/Habitat e/	Anadromous Species Present f/	Resident Coldwater Species Present	EFH Species Present g/	EFH Component Present g/	Fishery Construction Window h/	Equipment Bridges Y=Yes, Y* = Yes if flowing at time of construction, 1o= 1 pass required outside fish window1i = 1 pass required inside fish window, i =set inside fish window, N=None
Olalla Creek (BSP-155)	17100302000047 Private	58.78	Perennial Intermediate	Dry Open-Cut Level 2 m/	Dry open-cut methods feasible/practical on broad stream during low flows within ODFW in-water work windows. (USGS Gage station 1431120 reports Mean of monthly discharge recording period 1956 to 1973 of 2.0, 0.52 & 0.77 cfs, respectively for Jul, Aug & Sep). TEWAs have been located in existing cleared areas to minimize riparian impacts.	Oregon Coast ESU Coho, spawning, rearing, migration habitat T, CH	Coho, Winter Steelhead, Pacific Lamprey	Cutthroat Trout	Coho	Coho Spawning, Rearing,	Jul 1 to Sep 15	Y-1i
Ditch - Trib. to Olalla Creek (BDX-153)	17100302002576 Private	59.02	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small intermittent field ditch if flowing at time of construction.	None	None	None	None	None	N/A	Y*
Trib. to Olalla Creek (BSI-132)	17100302002635 Private	59.29	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small 9' wide intermittent tributary if flowing at time of construction.	None	Unknown	Unknown	None	None	Jul 1 to Sep 15	Y*
Trib. to Olalla Creek (BSI-129)	17100302000705 Private	59.65	Intermittent Intermediate	Dry Open-Cut	Dry open-cut methods feasible/practical on small intermittent tributary if flowing at time of construction.	Oregon Coast ESU Coho, assumed habitat T	Assumed	Unknown	Coho Assumed	Unknown	Jul 1 to Sep 15	Y*
Trib. to McNabb Creek (NSP-14)	17100302002838 Private	60.13	Perennial Minor	Dry Open-Cut (Streambed-bedrock) n/	Dry open-cut methods feasible/practical on small 6' wide tributary. Extensive grading/excavation requirements limit feasibility of conventional bore methods.	None	None	None	None	None	None	Y
McNabb Creek (NSP-13)	17100302002924 Private	60.48	Perennial Minor	Dry Open-Cut (Streambed-bedrock) n/ Level 1	Dry open-cut methods feasible/practical on tributary. TEWAs located in existing cleared areas to minimize riparian impacts.	Oregon Coast ESU Coho, spawning, rearing habitat T, CH	Coho, Winter Steelhead,	Cutthroat Trout, Assumed	Coho	Coho Spawning, Rearing	Jul 1 to Sep 15	Y
Klamath Mountains Ecoregion, South Umpqua (HUC 17100302) Sub-basin, Clark Branch-South Umpqua River (HUC 1710030211) Fifth field Watershed 8, Douglas County, Oregon												
Kent Creek (BSP-240)	17100302000075 Private	63.97	Perennial Intermediate	Dry Open-Cut Level 1	Dry open-cut methods feasible/practical on broad stream during low flows within ODFW in-water work windows. Steep topographic conditions on both sides of the stream prevent conventional bore methods because of extensive grading/excavation requirements for bore pits	Oregon Coast ESU Coho, spawning, rearing habitat T, CH	Coho, Winter Steelhead,	Cutthroat Trout	Coho	Coho Spawning, Rearing	Jul 1 to Sep 15	Y
Trib. to Kent Creek (BSI-241)	17100302003968 Private	63.97	Intermittent Minor	Adjacent to centerline within ROW Level 1	Not crossed by centerline. Small intermittent tributary expected to be dry during construction and will be restored to approximate original contour and grade during restoration.	None	Unknown	Unknown	None	None	Jul 1 to Sep 15	N (can be avoided)

TABLE I-2 (continued)

Fish Utilization, EFH in, and Crossing Techniques and In-Water Work Windows for Waterbodies Crossed by the Proposed Route (revised April 2018)

Waterbodies Crossed and Waterbody ID	NHD Waterbody Reach Code a/ and Jurisdiction	Approximate Pipeline Milepost (MP)	Waterbody Type Size b/	Proposed Crossing Method Scour Level c/	Waterbody Crossing Rationale d/	ESA Species Present/Habitat e/	Anadromous Species Present f/	Resident Coldwater Species Present	EFH Species Present g/	EFH Component Present g/	Fishery Construction Window h/	Equipment Bridges Y=Yes, Y* = Yes if flowing at time of construction, 1o= 1 pass required outside fish window1i = 1 pass required inside fish window, i =set inside fish window, N=None
Rice Creek (S2-04; BSP-227)	17100302000079 Private	65.76	Perennial Intermediate	Dry Open-Cut (Streambed-bedrock) n/ Level 1	Dry open-cut methods feasible/practical during low flows periods within ODFW in- water work windows. Alignment is defined by residential development in immediate area. ROW has been necked down to 75 feet and TEWAs located in cleared areas to minimize riparian disturbances.	Oregon Coast ESU Coho, spawning, rearing habitat T, CH	Coho, Winter Steelhead,	Cutthroat Trout	Coho	Coho Spawning, Rearing	Jul 1 to Sep 15	Y
Trib to Rice Creek BSI-228	17100302044765 Private	65.83	Intermittent	Adjacent riparian zone	Adjacent riparian zone overlaps construction ROW	None	None	None	None	None	Jul 1 to Sep 15	
Trib. to Willis Creek (BSI-230)	17100302004832 Private	66.87	Intermittent N/A	Adjacent to centerline within ROW (Streambed-bedrock) n/	Not crossed by centerline, 2' wide intermittent tributary expected to be dry during summer construction period. Tributary will be restored to approximate original contour and grade during restoration.	None	None	None	None	None	Jul 1 to Sep 15	N
Willis Creek (BSP-168)	17100302000083 Private	66.95	Perennial Intermediate	Dry Open-Cut (Streambed-bedrock) n/ Level 1	Dry open-cut methods feasible/practical during low flows periods within ODFW in- water work windows. ROW has been necked down to 75 feet and TEWAs located in cleared areas to minimize riparian disturbances.	Oregon Coast ESU Coho, spawning, rearing habitat T, CH	Coho, Winter Steelhead	Cutthroat Trout	Coho	Coho Spawning, Rearing	Jul 1 to Sep 15	Y-1i
Trib. to Willis Creek (BSI-169)	17100302048422 Private	67.00	Intermittent Intermediate	Dry Open-Cut (Streambed-bedrock) n/	Dry open-cut methods feasible/practical on small intermittent tributary, if flowing at time of construction.	None	None	None	None	None	Jul 1 to Sep 15	Y*
Trib. to South Umpqua River SS-004-004 SS-100-012)	17100302005610 Private	69.29	Perennial Minor	Dry Open-Cut	Dry open-cut methods feasible/practical during low flows periods within ODFW in- water work windows. No TEWAs are proposed to minimize riparian and landowner impacts.	None	None	Unknown	None	None	Jul 1 to Sep 15	Y*
Trib. to South Umpqua River (SS-004-005 SS-100-013)	17100302000727 Private	69.35	Perennial Intermediate	Dry Open-Cut	Dry open-cut methods feasible/practical during low flows periods within ODFW in- water work windows. No TEWAs are proposed to minimize landowner impacts.	None	None	Unknown	None	None	Jul 1 to Sep 15	Y*
Trib. to South Umpqua River (SS-004-006 SS-100-014)	17100302005693 Private	69.57	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on 2'to 3' foot wide headwater tributary which is expected to be dry at the time of construction. If flowing, crossing would be completed during low flows periods within ODFW in- water work windows.	None	None	None	None	None	Jul 1 to Sep 15	Y*
Trib. to South Umpqua River (SS-999-001)	17100302046930 Private	70.79	Intermittent	Adjacent riparian zone	Adjacent riparian zone overlaps construction ROW	None	None	None	None	None	Jul 1 to Sep 15	
Trib. to South Umpqua River (SS-005-006/SS-100-015)	17100302006216 Private	71.08	Intermittent N/A	Adjacent In TEWA 71.01- N	Tributary is within required laydown area for the Direct Pipe crossing of the South Umpqua River.	None	None	Unknown	None	None	Jul 1 to Sep 15	Y*

TABLE I-2 (continued)

Fish Utilization, EFH in, and Crossing Techniques and In-Water Work Windows for Waterbodies Crossed by the Proposed Route (revised April 2018)

Waterbodies Crossed and Waterbody ID	NHD Waterbody Reach Code a/ and Jurisdiction	Approximate Pipeline Milepost (MP)	Waterbody Type Size b/	Proposed Crossing Method Scour Level c/	Waterbody Crossing Rationale d/	ESA Species Present/Habitat e/	Anadromous Species Present f/	Resident Coldwater Species Present	EFH Species Present g/	EFH Component Present g/	Fishery Construction Window h/	Equipment Bridges Y=Yes, Y* = Yes if flowing at time of construction, 1o= 1 pass required outside fish window1i = 1 pass required inside fish window, i =set inside fish window, N=None
South Umpqua River (BSP- 26)	17100302000086 Private	71.27	Perennial Major	Direct Pipe Level 2 m/	The Direct Pipe crossing method has been evaluated and determined to be feasible at the proposed crossing location. The proposed alignment has been rerouted to facilitate the crossings of I-5, South Umpqua River, Dole Road, and the railroad using a single Direct Pipe crossing. Because of subsurface geotechnical conditions the HDD crossing method has been determined to be infeasible. This crossing method/location avoids the need to use a diverted open cut to cross the South Umpqua River on the 2009 FEIS route or an open cut crossing on Reroute 67.6.	Oregon Coast ESU Coho, migration habitat T, CH	Spring Chinook, Fall Chinook, Coho, Winter Steelhead, Pacific Lamprey	Present, unspecified	Chinook, Coho	Spring Chinook- Migration Fall Chinook Spawning, Rearing, Migration	Jul 1 to Aug 31	N
Trib. to South Umpqua River (SS-005-007)	17100302035572 Private	71.34	Intermittent N/A	Adjacent to potential Roth Pipe Yard	Ditch is avoided.	None	None	None	None	None	Jul 1 to Sep 15	N
Trib. to South Umpqua River (SS-005-08 SS-100-16)	17100302006366 Private	71.35 71.57	Intermittent N/A	Direct Pipe	Crossed by the Direct Pipe installation associated with the South Umpqua River and I-5 Crossing	None	None	None	None	None	Jul 1 to Sep 15	N
Trib. to South Umpqua River (SS-100-017)	17100302047304 Private	71.69	Intermittent N/A	Adjacent to centerline within ROW	Not crossed by centerline. Small intermittent headwater tributary expected to be dry during construction and will be restored to approximate original contour and grade during restoration.	None	None	None	None	None	Jul 1 to Sep 15	N
Trib. to South Umpqua River (SS-005-009 SS-100-019)	17100302006590 Private	73.04	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on 2'to 3' foot wide headwater tributary which is expected to be dry at the time of construction. If flowing, crossing would be completed during low flows periods within ODFW in- water work windows.	None	None	Unknown	None	None	Jul 1 to Sep 15	Y*
Trib. to South Umpqua River (SS-005-013 SS-100-020)	17100302050160 Private	73.51	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on 2'to 3' foot wide headwater tributary which is expected to be dry at the time of construction. If flowing, crossing would be completed during low flows periods within ODFW in- water work windows.	None	None	Unknown	None	None	Jul 1 to Sep 15	Y*
Trib. to South Umpqua River (SS-005-011 & -12 SS-100- 021)	17100302049674 Private	73.56	Intermittent Intermediate	Dry Open-Cut	Dry open-cut methods feasible/practical on 2'to 3' foot wide headwater tributary which is expected to be dry at the time of construction. If flowing, crossing would be completed during low flows periods within ODFW in- water work windows.	None	None	Unknown	None	None	Jul 1 to Sep 15	Y*

TABLE I-2 (continued)

Fish Utilization, EFH in, and Crossing Techniques and In-Water Work Windows for Waterbodies Crossed by the Proposed Route (revised April 2018)

Waterbodies Crossed and Waterbody ID	NHD Waterbody Reach Code a/ and Jurisdiction	Approximate Pipeline Milepost (MP)	Waterbody Type Size b/	Proposed Crossing Method Scour Level c/	Waterbody Crossing Rationale d/	ESA Species Present/Habitat e/	Anadromous Species Present f/	Resident Coldwater Species Present	EFH Species Present g/	EFH Component Present g/	Fishery Construction Window h/	Equipment Bridges Y=Yes, Y* = Yes if flowing at time of construction, 1o= 1 pass required outside fish window1i = 1 pass required inside fish window, i =set inside fish window, N=None
Trib. to Richardson Creek S-T-03-002	Private	73.70	Intermittent	Adjacent to centerline within ROW	Ditch is avoided by centerline	None	None	Unknown	None	None	Jul 1 to Sep 15	Y*
Trib to Richardson Creek (SS-005-010)	Private	73.73	Perennial Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small 2' to 3' foot wide headwater tributary that is expected to be dry at the time of the crossing. If flowing, crossing would be completed during low flow periods within ODFW in-water work window.	None	None	Unknown	None	None	Jul 1 to Sep 15	Y
Klamath Mountains Ecoregion, South Umpqua (HUC 17100302) Sub-basin, Myrtle Creek (HUC 1710030210) Fifth field Watershed 8, Douglas County, Oregon												
Rock Creek (EE-SS-9032)	17100302007335 Private	75.33	Perennial Intermediate	Dry Open-Cut	Dry open-cut methods feasible/practical on non- fish-beargin stream within steep incised drainage. Dam and pump would be the most logical method based on topographic conditions to eliminate difficulties of threading pipe string under flume with associated safety risks, including upsetting flume during process. Topographic conditions on both sides of stream prevent a conventional bore because of grading/excavation requirements for bore pits.	Oregon Coast ESU Coho, assumed habitat T	Assumed	Unknown	Coho Assumed	Unknown	Jul 1 to Sep 15	Y
Trib. to Rock Creek (EE-SS-9033)	17100302001061 Private	75.34	Perennial Intermediate	Dry Open-Cut	Dry open-cut methods feasible/practical on non-fish-bearing stream within steep incised drainage. Dam and pump would be the most logical method based on topographic conditions to eliminate difficulties of threading pipe string under flume with associated safety risks, including upsetting flume during process. Topographic conditions on both sides of stream prevent a conventional bore because of grading/excavation requirements for bore pits.	Oregon Coast ESU Coho, assumed habitat T	Assumed	Unknown	Coho Assumed	Unknown	Jul 1 to Sep 15	Y
Bilger Creek S-T02-004 BSP-1)	17100302000605 Private	76.38	Perennial Minor	Dry Open-Cut Level 1	Dry open-cut methods feasible/practical on small 6' wide tributary. ROW necked down and TEWAs set in existing cleared areas to minimize riparian impacts. ODFW fish passage barrier data indicate two potential downstream barriers (RecordID 2571 & 2603).	Oregon Coast ESU Coho, spawning, rearing habitat T, CH	Coho, Winter Steelhead,	Cutthroat Trout	Coho	Coho Spawning, Rearing	Jul 1 to Sep 15	Y

TABLE I-2 (continued)

Fish Utilization, EFH in, and Crossing Techniques and In-Water Work Windows for Waterbodies Crossed by the Proposed Route (revised April 2018)

Waterbodies Crossed and Waterbody ID	NHD Waterbody Reach Code a/ and Jurisdiction	Approximate Pipeline Milepost (MP)	Waterbody Type Size b/	Proposed Crossing Method Scour Level c/	Waterbody Crossing Rationale d/	ESA Species Present/Habitat e/	Anadromous Species Present f/	Resident Coldwater Species Present	EFH Species Present g/	EFH Component Present g/	Fishery Construction Window h/	Equipment Bridges Y=Yes, Y* = Yes if flowing at time of construction, 1o= 1 pass required outside fish window1i = 1 pass required inside fish window, i =set inside fish window, N=None
Little Lick (BSP-6)	17100302001073 Private	77.71	Perennial Minor	Dry Open-Cut Level 1	Dry open-cut methods feasible/practical on small 7' wide tributary. No additional workspace required. Steep topographic conditions make a conventional bore impractical because of extensive grading/excavation requirements as well as subsequent riparian disturbance.	None	None	Unknown	None	None	Jul 1 to Sep 15	Y
Trib. to Little Lick Creek (BSI-8)	17100302008039 Private	77.93	Intermittent Intermediate	Dry Open-Cut	Dry open-cut methods feasible/practical intermittent tributary if flowing at time of construction. The tributary within the TEWA would be matted and silt fenced installed as necessary to minimize disturbance and the potential for sedimentation.	None	None	None	None	None	Jul 1 to Sep 15	Y*
Trib. to Little Lick Creek (BSI-10)	17100302008047 Private	78.02	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical small 2' wide intermittent tributary if flowing at time of construction. The tributary within the TEWA would be matted and silt fenced installed as necessary to minimize disturbance and the potential for sedimentation.	None	None	None	None	None	Jul 1 to Sep 15	Y*
North Myrtle Creek (NSP-37)	17100302000541 Private	79.12	Perennial Intermediate	Dry Open-Cut (Streambed-bedrock) n/ Level 2 m/	Dry open-cut methods feasible/practical during low flow periods within ODFW in- water work window. (USGS Gage Station 14311000 records mean monthly flow as 5.8, 3.5 & 5.1 cfs respectively for Jul, Aug & Sep). ROW necked down to 75' to minimize riparian impacts.	Oregon Coast ESU Coho, spawning, rearing habitat T, CH	Coho, Winter Steelhead,	Cutthroat Trout, Assumed	Coho	Coho Spawning, Rearing	Jul 1 to Sep 15	Y
Trib. to North Myrtle Creek (NSP-38)	17100302008397 Private	79.15	Perennial Minor	Dry Open-Cut (Streambed-bedrock) n/	Dry open-cut methods feasible/practical on small 8.0' wide trib. if flowing at time of construction.	None	None	None	None	None	Jul 1 to Sep 15	Y
Trib. to N. Myrtle Creek (EE-SS-9038)	17100302045565 Private	79.17	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small interpreted non-fish-bearing tributary if present and flowing at time of construction.	None	None	None	None	None	Jul 1 to Sep 15	Y*
Trib. to N. Myrtle Creek (EE-SS-9039)	17100302045117 Private	79.19	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small interpreted non-fish-bearing tributary if present and flowing at time of construction.	None	None	None	None	None	Jul 1 to Sep 15	Y*

TABLE I-2 (continued)

Fish Utilization, EFH in, and Crossing Techniques and In-Water Work Windows for Waterbodies Crossed by the Proposed Route (revised April 2018)

Waterbodies Crossed and Waterbody ID	NHD Waterbody Reach Code a/ and Jurisdiction	Approximate Pipeline Milepost (MP)	Waterbody Type Size b/	Proposed Crossing Method Scour Level c/	Waterbody Crossing Rationale d/	ESA Species Present/Habitat e/	Anadromous Species Present f/	Resident Coldwater Species Present	EFH Species Present g/	EFH Component Present g/	Fishery Construction Window h/	Equipment Bridges Y=Yes, Y* = Yes if flowing at time of construction, 1o= 1 pass required outside fish window1i = 1 pass required inside fish window, i =set inside fish window, N=None
South Myrtle Creek S-T02-003 (BSP-172)	7100302000521 Private	81.20	Perennial Intermediate	Dry Open-Cut (Streambed-bedrock) n/ Level 2 m/	Dry open-cut methods feasible/practical during low flow periods within ODFW in- water work window. (USGS Gage Station 14310700 records mean monthly flow as 5.6, 3.2 & 5.0 cfs, respectively for Jul, Aug & Sep). ROW necked down to 75' and TEWAs placed in existing cleared areas where feasible to minimize riparian impacts. Conventional bore not feasible/practical because of grading/excavation requirements on north side of stream.	Oregon Coast ESU Coho, spawning, rearing, migration habitat T, CH	Coho, Winter Steelhead,	Cutthroat Trout	Coho	Coho Spawning, Rearing	Jul 1 to Sep 15	Y-1i
Trib. to S. Myrtle Creek (SS-100-023)	17100302008772 Private	81.45	Intermittent N/A	Dry Open-Cut	Dry open-cut methods feasible/practical on small intermittent tributary expected to be dry during construction and will be restored to approximate original contour and grade during restoration.	None	None	None	None	None	Jul 1 to Sep 15	N
Trib. to S. Myrtle Creek (EE-SS-9074)	17100302008917 Private	81.93	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small interpreted non-fish-bearing tributary if present and flowing at time of construction.	None	None	None	None	None	Jul 1 to Sep 15	Y*
Klamath Mountains Ecoregion, South Umpqua (HUC 17100302) Sub-basin, Days Creek-South Umpqua River (HUC 1710030205) Fifth field Watershed 8, Douglas County, Oregon												
Wood Creek (BSP-226)	17100302001104 Private	84.17	Perennial Minor	Dry Open-Cut (Streambed-bedrock) n/ Level 1 m/	Dry open-cut methods feasible/practical on small 8' wide stream. Steep topographic conditions on either side of waterbody prevent conventional bore. Dam and pump crossing method most logical dry open- cut method based on topographic conditions to eliminate difficulties of threading pipe string under flume with associated safety risks including upsetting flume during process. StreamNet data indicates anadromy below crossing (~ 1 mile).	None	None	Present	None	None	Jul 1 to Sep 15	Y
Trib. to Wood Creek (EE-SS-9040)	17100302009813 Private	85.38	Intermittent Intermediate	Dry Open-Cut	Dry open-cut methods feasible/practical on an interpreted non-fish-bearing intermittent tributary if present and flowing at time of construction. The crossing occurs along a sidehill alignment.	None	None	None	None	None	Jul 1 to Sep 15	Y*
Trib. to Wood Creek (EE-SS-9041)	17100302009881 Private	85.69	Intermittent Intermediate	Dry Open-Cut	Dry open-cut methods feasible/practical on an interpreted non-fish-bearing intermittent tributary if flowing at time of construction.	None	Unknown	Present	None	None	Jul 1 to Sep 15	Y*

TABLE I-2 (continued)

Fish Utilization, EFH in, and Crossing Techniques and In-Water Work Windows for Waterbodies Crossed by the Proposed Route (revised April 2018)

Waterbodies Crossed and Waterbody ID	NHD Waterbody Reach Code a/ and Jurisdiction	Approximate Pipeline Milepost (MP)	Waterbody Type Size b/	Proposed Crossing Method Scour Level c/	Waterbody Crossing Rationale d/	ESA Species Present/Habitat e/	Anadromous Species Present f/	Resident Coldwater Species Present	EFH Species Present g/	EFH Component Present g/	Fishery Construction Window h/	Equipment Bridges Y=Yes, Y* = Yes if flowing at time of construction, 1o= 1 pass required outside fish window1i = 1 pass required inside fish window, i =set inside fish window, N=None
Trib. to Wood Creek (EE-SS-9042)	17100302001103 Private	85.71	Perennial Intermediate	Dry Open-Cut	Dry open-cut methods feasible/practical on an interpreted non-fish-bearing intermittent tributary if flowing at time of construction.	None	None	None	None	None	Jul 1 to Sep 15	Y*
Trib. to Wood Creek (EE-SS-9044)	17100302036276 Private	86.07	Intermittent Intermediate	Dry Open-Cut	Dry open-cut methods feasible/practical on an interpreted non-fish-bearing intermittent tributary if present and flowing at time of construction.	None	None	None	None	None	Jul 1 to Sep 15	Y*
Trib. to Wood Creek (EE-SS-9045)	17100302036276 Private	86.10	Intermittent N/A	Adjacent to centerline within ROW	Dry open-cut methods feasible/practical on an interpreted non-fish-bearing intermittent tributary if present and flowing at time of construction.	None	None	None	None	None	Jul 1 to Sep 15	Y*
Trib. to Fate Creek (BSI-236)	17100302036007 Private	88.20	Intermittent Minor	Dry Open-Cut (Streambed-bedrock) n/	Dry open-cut methods feasible/practical on small intermittent road ditched tributary if flowing at time of construction. Appropriate BMPs would be installed to minimize disturbance/ sedimentation if flowing at the time of construction. Crossing is also co-located with Fate Creek Rd.	None	None	None	None	None	Jul 1 to Sep 15	Y*
Trib. to Fate Creek (BSI-238 (MOD))	17100302036007 Private	88.23	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on a small non-fish-bearing intermittent tributary if present and flowing at time of construction. Crossing is also co-located with Fate Creek Rd.	None	None	None	None	None	Jul 1 to Sep 15	Y*

TABLE I-2 (continued)

Fish Utilization, EFH in, and Crossing Techniques and In-Water Work Windows for Waterbodies Crossed by the Proposed Route (revised April 2018)

Waterbodies Crossed and Waterbody ID	NHD Waterbody Reach Code a/ and Jurisdiction	Approximate Pipeline Milepost (MP)	Waterbody Type Size b/	Proposed Crossing Method Scour Level c/	Waterbody Crossing Rationale d/	ESA Species Present/Habitat e/	Anadromous Species Present f/	Resident Coldwater Species Present	EFH Species Present g/	EFH Component Present g/	Fishery Construction Window h/	Equipment Bridges Y=Yes, Y* = Yes if flowing at time of construction, 1o= 1 pass required outside fish window1i = 1 pass required inside fish window, i =set inside fish window, N=None
Fate Creek (BSP-232)	17100302001124 Private	88.48	Perennial Intermediate	Dry Open-Cut (Streambed-bedrock) n/ Level 1 m/	Dry open-cut methods feasible/practical on 12' wide stream. Stream flow expected to be insignificant during low flow periods within ODFW in- water work period. TEWAs placed in existing cleared areas and alignment selected to minimize riparian impacts. ODFW fish passage barrier data indicates that immediately downstream of crossing (RecordID 2602): "Gabion below forms pool and creates a probable impassable juvenile barrier. Adults may pass at higher flows. Additional STEP work above culvert" A conventional bore is probable based on topography and geometry but geotechnical investigations have not been completed to confirm. A bridge is required at the crossing which would require bank grading for access. Significant costs, time requirements and the need for a bridge were the determinants for the proposed dry open-cut crossing method. Significant cultural resource sites occur in the area and a dry open-cut crossing will minimize excavation/grading disturbance compared to conventional bore. Dry open-cut methods feasible/practical on stream during low flow periods within ODFW in-water work window. (USGS Gage Station 14308700 records mean monthly flow as 2.2, 1.0 & 1.5 cfs, respectively for Jul, Aug & Sep). The ROW has been necked down to 75' and TEWAs located in previously disturbed areas to minimize riparian impacts.	Oregon Coast ESU Coho, spawning, rearing habitat T, CH	Coho, Winter Steelhead	Cutthroat Trout	Coho	Coho Spawning, Rearing	Jul 1 to Sep 15	Y

TABLE I-2 (continued)

Fish Utilization, EFH in, and Crossing Techniques and In-Water Work Windows for Waterbodies Crossed by the Proposed Route (revised April 2018)

Waterbodies Crossed and Waterbody ID	NHD Waterbody Reach Code a/ and Jurisdiction	Approximate Pipeline Milepost (MP)	Waterbody Type Size b/	Proposed Crossing Method Scour Level c/	Waterbody Crossing Rationale d/	ESA Species Present/Habitat e/	Anadromous Species Present f/	Resident Coldwater Species Present	EFH Species Present g/	EFH Component Present g/	Fishery Construction Window h/	Equipment Bridges Y=Yes, Y* = Yes if flowing at time of construction, 1o= 1 pass required outside fish window1i = 1 pass required inside fish window, i =set inside fish window, N=None
Days Creek (BSP-233)	17100302000511 Private	88.60	Perennial Intermediate	Dry Open-Cut (Streambed-bedrock) n/ Level 1 m/	A conventional bore is probable based on topography and geometry but geotechnical investigations have not been completed to confirm. A bridge is required at the crossing which would require bank grading for access. Significant costs, time requirements and the need for a bridge were the determinants for the proposed dry open-cut crossing method. Significant cultural resource sites occur in the area and a dry open-cut crossing will minimize excavation/grading disturbance compared to conventional bore.	Oregon Coast ESU Coho, spawning, rearing habitat T, CH	Coho, Winter Steelhead,	Cutthroat Trout	Coho	Coho Spawning, Rearing	Jul 1 to Sep 15	Y-1i
Cascades Ecoregion, South Umpqua (HUC 17100302) Sub-basin, Days Creek-South Umpqua River (HUC 1710030205) Fifth field Watershed 8, 9, Douglas County, Oregon												
Saint John Creek (ASP-303)	17100302011280 Private	92.62	Perennial Intermediate	Dry Open-Cut Level 1	Dry open-cut methods feasible/practical during low flow periods within ODFW in- water work window. Steep topographic conditions on either side of creek prevent conventional bore. Dam and pump crossing method most logical dry open-cut method based on topographic conditions to eliminate issues/risk of threading pipe string under flume within the incised valley.	Oregon Coast ESU Coho, spawning, rearing habitat T, CH	Coho, Winter Steelhead	Cutthroat Trout	Coho	Coho Spawning, Rearing	Jul 1 to Sep 15	Y-1i
H3-01	Private	94.60	Pond	Not Crossed Pond adjacent to Milo Yard	N/A – pond avoided by potential yard footprint.	None	None	Unknown	None	None	None	N –to be avoided
H3-02	Private	94.60	Pond	Not Crossed Pond adjacent to Milo Yard	N/A – pond avoided by potential yard footprint.	None	None	Unknown	None	None	None	N –to be avoided

TABLE I-2 (continued)

Fish Utilization, EFH in, and Crossing Techniques and In-Water Work Windows for Waterbodies Crossed by the Proposed Route (revised April 2018)

Waterbodies Crossed and Waterbody ID	NHD Waterbody Reach Code a/ and Jurisdiction	Approximate Pipeline Milepost (MP)	Waterbody Type Size b/	Proposed Crossing Method Scour Level c/	Waterbody Crossing Rationale d/	ESA Species Present/Habitat e/	Anadromous Species Present f/	Resident Coldwater Species Present	EFH Species Present g/	EFH Component Present g/	Fishery Construction Window h/	Equipment Bridges Y=Yes, Y* = Yes if flowing at time of construction, 1o= 1 pass required outside fish window1i = 1 pass required inside fish window, i =set inside fish window, N=None
H3-03	Private	94.60	Pond	Not Crossed Pond in Milo Yard	N/A – pond within yard, but would be avoided by potential yard activities. Diverted open-cut methods feasible/practical during low flow periods within ODFW in-water work window. (USGS Gage Station 143308600 records mean monthly flow as 168, 91 & 110 cfs, respectively for Jul, Aug & Sep). ROW and TEWAs locations primarily affect shrub vegetation. Temporary bridge required at crossing because the existing bridge at Milo is not expected to handle project weight limits. Heavy equipment access from the south is restricted by topographic constraints therefore temporary bridge at crossing is critical to facilitate construction (i.e., movement of materials and equipment along ROW).	None	None	Unknown	None	None	None	N–to be avoided
South Umpqua River (ASP- 196)	17100302011516 Private	94.73	Perennial Major	Diverted Open-Cut Level 2 m/	Because of geometry and topographic conditions, the only feasible HDD alignment required the alignment to pass immediately adjacent to the north side of the Milo Academy. From the exit point on the east side of the academy the route then needed to circle back to the west passing immediately adjacent to the south side of the academy. The HDD alignment ultimately required the academy to be encircled by the pipeline on three sides. This alignment would extensively encumber the academy and was determined to be impractical. A conventional bore is feasible based on topography and geometry but geotechnical investigations have not been completed to confirm. If subsoils are similar as surface conditions (cobbles), a bore would be infeasible. Because a bridge is required at the crossing which would require bank grading for access the diverted open- cut crossing method was selected as most appropriate crossing method based on feasibility/practicality and the method with the least risk.	Oregon Coast ESU Coho, spawning, rearing, migration habitat T, CH	Spring Chinook, Fall Chinook, Coho, Winter Steelhead, Pacific Lamprey	Cutthroat Trout	Chinook, Coho	Spring Chinook Migration Fall Chinook Spawning, Rearing, Migration Coho Rearing, Migration	Jul 1 to Aug 31	Y-1i with mid- stream support

TABLE I-2 (continued)

Fish Utilization, EFH in, and Crossing Techniques and In-Water Work Windows for Waterbodies Crossed by the Proposed Route (revised April 2018)

Waterbodies Crossed and Waterbody ID	NHD Waterbody Reach Code a/ and Jurisdiction	Approximate Pipeline Milepost (MP)	Waterbody Type Size b/	Proposed Crossing Method Scour Level c/	Waterbody Crossing Rationale d/	ESA Species Present/Habitat e/	Anadromous Species Present f/	Resident Coldwater Species Present	EFH Species Present g/	EFH Component Present g/	Fishery Construction Window h/	Equipment Bridges Y=Yes, Y* = Yes if flowing at time of construction, 1o= 1 pass required outside fish window1i = 1 pass required inside fish window, i =set inside fish window, N=None
Trib. to South Umpqua River (ASI-193 / ASI-191)	17100302011517 Private	94.85	Intermittent Intermediate	Dry Open-Cut	Dry open-cut methods feasible/practical on small intermittent tributary if flowing at the time of construction.	None	None	None	None	None	Jul 1 to Sep 15	Y*
Trib. to South Umpqua River (ASI-193 / ASI-191)	17100302011517 Private	95.03	Intermittent Intermediate	Dry Open-Cut	Dry open-cut methods feasible/practical on small intermittent tributary if flowing at the time of construction.	None	None	None	None	None	Jul 1 to Sep 15	Y*
Trib. to South Umpqua (ASI-190)	17100302038007 BLM-Roseburg District	98.46	Intermittent Minor	Dry Open-Cut (Streambed-bedrock) n/	Dry open-cut methods feasible/practical on small 2-4' wide intermittent tributary (ditch) if flowing at the time of construction	None	None	None	None	None	Jul 1 to Sep 15	Y*
Cascades Ecoregion, South Umpqua (HUC 17100302) Sub-basin, Upper Cow Creek (HUC 1710030206) Fifth field Watershed 8, Douglas County, Oregon												
Ditch (Beaver Creek) (CDX- 50)	Forest Service – Umpqua NF	105.41	Intermittent Intermediate	Dry Open-Cut	Dry open-cut methods feasible/practical on small 1-4' wide intermittent roadside ditch within right-of-way if flowing at the time of construction.	None	None	None	None	None	N/A	Y*
Ditch (CDX-49)	Forest Service – Umpqua NF	106.77	Intermittent N/A	Adjacent to centerline within ROW	N/A - small 1-4' wide intermittent roadside ditch within right-of-way if flowing at the time of construction.	None	None	None	None	None	N/A	Y*
Roadside Ditch (CDX-47)	Forest Service – Umpqua NF	108.08	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small 1-3' wide intermittent roadside ditch within right-of-way if flowing at the time of construction.	None	None	None	None	None	N/A	Y*
Roadside Ditch (CDX-48)	Forest Service – Umpqua NF	108.40	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small 1-3' wide intermittent roadside ditch within right-of-way if flowing at the time of construction.	None	None	None	None	None	N/A	Y*
Ditch (GDX-15)	17100302034497 Forest Service – Umpqua NF	109.13	Intermittent N/A	Adjacent to centerline within TEWA	Dry open-cut methods feasible/practical on small headwater wetland/tributary-if flowing at the time of construction.	None	None	None	None	None	Jul 1 to Sep 15	Y*
Trib. to East Fork Cow Creek (GSI-16/FS-HF-F)	17100302013838 Forest Service – Umpqua NF	109.33	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small 3' wide headwater intermittent tributary if flowing at the time of construction.	None	None	None	None	None	Jul 1 to Sep 15	Y*
East Fork Cow Creek (GSP-19/ASP-297/FS-HF-G)	17100302013839 Forest Service – Umpqua NF	109.47	Perennial Intermediate	Dry Open-Cut (Streambed-bedrock) n/	Dry open-cut methods feasible/practical on small headwater stream during low flow periods within ODFW in- water work period. No additional work areas proposed.	None	Unknown	Unknown	None	None	Jul 1 to Sep 15	Y
East Fork Cow Creek S-T09-002 (GSP-22 ASP-297/FS-HF-M)	17100302013839 Forest Service – Umpqua NF	109.68	Perennial Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small headwater stream during low flow periods within ODFW in- water work period. No additional work areas proposed.	None	None	Unknown	None	None	Jul 1 to Sep 15	Y

TABLE I-2 (continued)

Fish Utilization, EFH in, and Crossing Techniques and In-Water Work Windows for Waterbodies Crossed by the Proposed Route (revised April 2018)

Waterbodies Crossed and Waterbody ID	NHD Waterbody Reach Code a/ and Jurisdiction	Approximate Pipeline Milepost (MP)	Waterbody Type Size b/	Proposed Crossing Method Scour Level c/	Waterbody Crossing Rationale d/	ESA Species Present/Habitat e/	Anadromous Species Present f/	Resident Coldwater Species Present	EFH Species Present g/	EFH Component Present g/	Fishery Construction Window h/	Equipment Bridges Y=Yes, Y* = Yes if flowing at time of construction, 1o= 1 pass required outside fish window1i = 1 pass required inside fish window, i =set inside fish window, N=None
Trib to East Fork Cow Creek S-T09-001(FS-HF-M)	17100302013840 Forest Service – Umpqua NF	109.74	Perennial Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small 2-4' wide headwater stream during low flow periods within ODFW in- water work period. No additional work areas proposed.	None	None	Unknown	None	None	Jul 1 to Sep 15	Y
Cascades Ecoregion, Upper Rogue (HUC 17100307) Sub-basin, Trail Creek (HUC 1710030706) Fifth field Watershed 8, Jackson County, Oregon												
Pond Trib. to W. Fork Trail Creek (EW-69)	Forest Service – Umpqua NF	110.57	Intermittent Pond	Within Peavine Quarry TEWA 110.73	Small ponded area within Peavine Quarry and TEWA; drainage expected to be dry during construction.	None	None	None	None	None	N/A	N
Trib. to W. Fork Trail Creek (ESI-68) (EW-68)	17100307018629 Forest Service – Umpqua NF	110.57	Intermittent Minor	Within Pevine Quarry Adjacent to centerline within TEWA 110.73	Small 1-2' wide ephemeral drainage located Peavine Quarry within TEWA; drainage to be avoided by construction; drainage expected to be dry during construction.	None	None	None	None	None	N/A	N –to be avoided
Cascades Ecoregion, South Umpqua Sub-basin (HUC 17100302), Upper Cow Creek (HUC 1710030206) Fifth field Watershed 8, Jackson County, Oregon												
Trib. to E. Fork Cow Creek (FS-HF-N /ESI-68)	17100302034587 Forest Service – Umpqua NF	110.96	Intermittent Intermediate	Dry Open-Cut	Dry open-cut methods feasible/practical on small 2-4' headwater tributary. Right-of- way necked down to 75' and no TEWAs utilized to minimize riparian impacts.	None	None	None	None	None	Jul 1 to Sep 15	Y*
Klamath Mountains Ecoregion, Upper Rogue (HUC 17100307) Sub-basin, Trail Creek (HUC 1710030706) Fifth field Watershed 8, Jackson County, Oregon												
Trib. to West Fork Trail Creek (SS-100-032)	17100307015563 Private	118.80	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small intermittent headwater tributary if flowing at the time of construction.	None	None	None	None	None	Jun 15 to Sep 15	Y*
West Fork Trail Creek (ASP-202)	17100307000492 Private	118.89	Perennial Intermediate	Dry Open-Cut (Streambed-bedrock) n/ Level 2 m/	Dry open-cut methods practical/feasible during low flow periods during ODFW in- water work window. ROW necked down to 75' and TEWAs located in previously disturbed areas to minimize riparian impacts.	SONCC Coho, spawning, rearing habitat T, CH	Coho, Summer Steelhead, Winter Steelhead	Trout, unspecified	Coho	Coho Spawning, Rearing	Jun 15 to Sep 15	Y
Trib. to Trail Creek (S1-06 (DA-16 (MOD))	17100307002143 Private	119.84	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small intermittent headwater tributary if flowing at the time of construction (Denied Access).	None	None	None	None	None	Jun 15 to Sep 15	Y*
Canyon Creek (NSP-11)	17100307000501 BLM-Medford District	120.45	Perennial Minor	Dry Open-Cut (Streambed-bedrock) n/ Level 1	Dry open-cut methods feasible/practical on small 7' wide tributary during low flow periods within ODFW in-water work window. Only UCSAs utilized at crossing to minimize impacts to riparian areas.	SONCC Coho, spawning, rearing habitat T, CH	Coho, Summer Steelhead	Trout, unspecified	Coho	Coho Spawning, Rearing	Jun 15 to Sep 15	Y
Trib. to Trail Creek (ASI-205)	17100307009101 Private	120.90	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small 6' wide intermittent headwater tributary if flowing at the time of construction. No additional workspace required.	None	None	None	None	None	Jun 15 to Sep 15	Y*

TABLE I-2 (continued)

Fish Utilization, EFH in, and Crossing Techniques and In-Water Work Windows for Waterbodies Crossed by the Proposed Route (revised April 2018)

Waterbodies Crossed and Waterbody ID	NHD Waterbody Reach Code a/ and Jurisdiction	Approximate Pipeline Milepost (MP)	Waterbody Type Size b/	Proposed Crossing Method Scour Level c/	Waterbody Crossing Rationale d/	ESA Species Present/Habitat e/	Anadromous Species Present f/	Resident Coldwater Species Present	EFH Species Present g/	EFH Component Present g/	Fishery Construction Window h/	Equipment Bridges Y=Yes, Y* = Yes if flowing at time of construction, 1o= 1 pass required outside fish window1i = 1 pass required inside fish window, i =set inside fish window, N=None
Trib. to Trail Creek (ASI-206)	17100307002356 Private	121.57	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on 12' wide intermittent tributary if flowing at the time of construction. No additional workspace required.	SONCC Coho, spawning, rearing habitat T, CH	Coho	Unknown	Coho	Coho Spawning, Rearing	Jun 15 to Sep 15	Y*
Klamath Mountains Ecoregion, Upper Rogue (HUC 17100307) Sub-basin, Shady Cove-Rogue River (HUC 1710030707) Fifth field Watershed 8, Jackson County, Oregon												
Trib. to Cricket Creek (ESI- 71)	Private	121.87	Intermittent N/A	Adjacent to centerline within ROW	Small 1' wide ephemeral stream expected to be dry during construction when the Rogue River HDD pullback would cross this tributary. Rollers would be used to span tributary with HDD pullback string.	None	None	None	None	None	Jun 15 to Sep 15	Y*
Trib. to Cricket Creek (ESI- 73)	Private	121.91	Intermittent N/A	Adjacent to centerline within ROW	Within TEWA associated with HDD pull back.	None	None	None	None	None	Jun 15 to Sep 15	Y*
Trib. to Cricket Creek (ESI- 72)	17100307002397 Private	121.96	Intermittent N/A	Adjacent to centerline within ROW	Small 2' wide ephemeral stream expected to be dry during construction when the Rogue River HDD pullback would occur, however this drainage would be avoided by construction activities.	None	None	None	None	None	Jun 15 to Sep 15	Y*
Trib. to Cricket Creek (ESI- 74)	17100307019333 Private	122.04	Intermittent N/A	Adjacent to centerline within ROW	Small 2' wide ephemeral stream expected to be dry during construction when the Rogue River HDD pullback would occur, however this drainage would be avoided by construction activities.	None	None	None	None	None	Jun 15 to Sep 15	Y*
Cricket Creek (ESI-70)	17100307002397 Private	122.07	Intermittent N/A	Adjacent to centerline within ROW	Small 2' wide ephemeral stream expected to be dry during construction when the Rogue River HDD pullback would occur.	None	None	None	None	None	Jun 15 to Sep 15	Y*
Rogue River (ASP-235)	17100307000156 Private	122.65	Perennial Major	HDD Level 2 m/	HDD feasible based on geometry, topography and geotechnical conditions along proposed alignment. Primary HDD activities are significantly set back from crossing and would not be visible from the highway or the river Conventional bore not feasible/practical because highway and topographic constraints on the west side of the crossing Dry open-cut or diverted open- cut methods not practical/feasible based on flow and channel characteristics (USGS Gage Station 14339000 records mean monthly flow as 2,170, 2,160 and 1,710 respectively for Jul, Aug & Sep).	SONCC Coho, rearing, migration habitat T, CH	Spring Chinook, Fall Chinook, Coho, Summer Steelhead, Winter Steelhead, Pacific Lamprey	Trout, unspecified	Chinook, Coho	Spring, Fall Chinook and Coho Rearing Migration	Jun 15 to Aug 31	N

TABLE I-2 (continued)

Fish Utilization, EFH in, and Crossing Techniques and In-Water Work Windows for Waterbodies Crossed by the Proposed Route (revised April 2018)

Waterbodies Crossed and Waterbody ID	NHD Waterbody Reach Code a/ and Jurisdiction	Approximate Pipeline Milepost (MP)	Waterbody Type Size b/	Proposed Crossing Method Scour Level c/	Waterbody Crossing Rationale d/	ESA Species Present/Habitat e/	Anadromous Species Present f/	Resident Coldwater Species Present	EFH Species Present g/	EFH Component Present g/	Fishery Construction Window h/	Equipment Bridges Y=Yes, Y* = Yes if flowing at time of construction, 1o= 1 pass required outside fish window1i = 1 pass required inside fish window, i =set inside fish window, N=None
Trib. to Indian Creek (ASI-223)	17100307014756 Private	125.91	Intermittent Major	Dry Open-Cut	Dry open-cut methods feasible/practical on small <5' wide intermittent headwater tributary if flowing at the time of construction.	None	None	None	None	None	Jun 15 to Sep 15	Y*
Trib. to Indian Creek (ASI-222)	17100307016576 Private	125.98	Intermittent Major	Dry Open-Cut	Dry open-cut methods feasible/practical on small 1' wide intermittent headwater tributary if flowing at the time of construction.	None	None	None	None	None	Jun 15 to Sep 15	Y*
Trib. to Indian Creek (RS-4)	17100307008662 BLM-Medford District	126.53	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small 1' wide intermittent headwater tributary if flowing at the time of construction.	None	None	None	None	None	Jun 15 to Sep 15	Y*
Trib. to Indian Creek (ASI-221)	17100307008662 BLM-Medford District	126.56	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small 5' wide intermittent headwater tributary if flowing at the time of construction.	None	None	None	None	None	Jun 15 to Sep 15	Y*
Ditch (ADX-287)	17100307015921 Private	127.21	Intermittent N/A	Adjacent to ROW & TEWA	NA – avoided.	None	None	None	None	None	Jun 15 to Sep 15	N - avoided
Ditch (ADX-285)	17100307015921 Private	127.33	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small intermittent steam if flowing during construction.	None	None	None	None	None	Jun 15 to Sep 15	Y*
Deer Creek (ASP-307)	17100307006079 Private	128.49	Perennial Intermediate	Dry Open-Cut (Streambed-bedrock) n/	Dry open-cut methods feasible/practical during low flow periods within ODFW in- water work window. No additional workspace required. Coho spawn 950 feet below crossing.	None	Unknown	Unknown	None	None	Jun 15 to Sep 15	Y
Indian Creek (AW-278)	17100307003031 Private	128.61	Perennial Minor	Dry Open-Cut Level 1 m/	Dry open-cut methods feasible/practical small < 10' wide stream low flow periods within ODFW in-water work window. Stream located in heavily grazed irrigated pasture and riparian vegetation consists of emergent pasture species. Coho spawn 600 feet below crossing.	SONCC Coho assumed habitat T	Assumed	Present, unspecified	Coho Assumed	Unknown	Jun 15 to Sep 15	Y
Trib. To Indian Creek (ASP- 310)	17100307017016 Private	128.68	Perennial Minor	Dry Open-Cut (Streambed-bedrock) n/	Dry open-cut methods feasible/practical small 5' wide ditch tributary located in heavily grazed irrigated pasture. Coho spawn 600 feet below crossing.	None	Unknown	Unknown	None	None	Jun 15 to Sep 15	Y
Trib. To Indian Creek (ASI- 400)	BLM-Medford District	129.13	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small 3-4' wide intermittent headwater trib. if flowing at the time of construction.	None	Unknown	Unknown	None	None	Jun 15 to Sep 15	Y*
Trib. To Indian Creek (ASI- 306)	BLM-Medford District	129.21	Intermittent N/A	Adjacent to centerline within ROW	Not crossed by centerline. Small headwater tributary expected to be dry at the time of construction and would be restored to approximate original contour and grade during restoration.	None	Unknown	Unknown	None	None	Jun 15 to Sep 15	N

TABLE I-2 (continued)

Fish Utilization, EFH in, and Crossing Techniques and In-Water Work Windows for Waterbodies Crossed by the Proposed Route (revised April 2018)

Waterbodies Crossed and Waterbody ID	NHD Waterbody Reach Code a/ and Jurisdiction	Approximate Pipeline Milepost (MP)	Waterbody Type Size b/	Proposed Crossing Method Scour Level c/	Waterbody Crossing Rationale d/	ESA Species Present/Habitat e/	Anadromous Species Present f/	Resident Coldwater Species Present	EFH Species Present g/	EFH Component Present g/	Fishery Construction Window h/	Equipment Bridges Y=Yes, Y* = Yes if flowing at time of construction, 1o= 1 pass required outside fish window1i = 1 pass required inside fish window, i =set inside fish window, N=None
Trib. to Indian Creek (ASI-277)	71003070174 44Private	129.46	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small 3-4' wide intermittent headwater trib. if flowing at the time of construction.	None	Unknown	Unknown	None	None	Jun 15 to Sep 15	Y*
Klamath Mountains Ecoregion, Upper Rogue (HUC 17100307) Sub-basin, Big Butte Creek (HUC 1710030704) Fifth field Watershed 8, Jackson County, Oregon												
Trib. to Neil Creek (SS-201-014a (AW-244))	17100307010117 Private	130.81	Intermittent Minor	Adjacent to centerline within ROW	Not crossed by centerline. Small tributary expected to be dry at the time of construction and would be restored to approximate original contour and grade during restoration.	None	None	None	None	None	Jun 15 to Sep 15	Y*
Trib. to Neil Creek (SS-201-14b (AW-244))	17100307010117 Private	130.83	Intermittent Minor	Dry Open-Cut (Streambed-bedrock) n/	Dry open-cut methods feasible/practical on small < 10' wide intermittent headwater trib. if flowing at the time of construction.	None	None	None	None	None	Jun 15 to Sep 15	Y*
Trib. to Neil Creek (ASI-251)	17100307018233 BLM-Medford District	131.37	Intermittent N/A	Adjacent to within TEWA	Small tributary expected to be dry at the time of construction and would be restored to approximate original contour and grade during restoration.	None	None	None	None	None	Jun 15 to Sep 15	N - avoided
Irrigation Ditch (Trib. to Neil Creek) (S2-02/(ADX-253)	Private	132.03	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small 1-2' wide intermittent non-fish- bearing ditch if flowing at the time of construction.	None	None	None	None	None	N/A	Y*
Neil Creek (ASP-252)	17100307006088 Private	132.12	Perennial Minor	Dry Open-Cut (Streambed-bedrock) n/ Level 1	Dry open-cut methods feasible/practical during low flow within ODFW in-water work window. ROW narrowed to 75 feet and TEWAs placed in pasture to minimize riparian impacts.	SONCC Coho, spawning, rearing habitat T, CH	Coho, Summer Steelhead	Trout, unspecified	Coho	Coho Spawning, Rearing	Jun 15 to Sep 15	Y
Ditch (EDX-75)	Private	132.26	Intermittent Minor	Dry Open-Cut (Streambed – bedrock) f/	Dry open-cut methods feasible/practical on small 1-2' wide intermittent non-fish- bearing ditch if flowing at the time of construction.	None	None	None	None	None	N/A	Y*
Trib. to Quartz Creek (S5-01/ ASI-265)	17100307000857 Private	132.75	Intermittent Minor	Dry Open-Cut (Streambed-bedrock) n/	Dry open-cut methods feasible/practical on small intermittent stream/wetland, if flowing at the time of construction. ROW necked down to 75' and	None	None	None	None	None	Jun 15 to Sep 15	Y*
Quartz Creek (S5-02 / AW- 264)	17100307000857 Private	132.77	Intermittent Minor	Dry Open-Cut (Streambed-bedrock) n/	Dry open-cut methods feasible/practical on small 2' wide intermittent stream if flowing at the time of construction.	SONCC Coho, spawning, rearing habitat T, CH	Coho, Summer Steelhead	Trout, unspecified	Coho	Coho Spawning, Rearing	Jun 15 to Sep 15	Y*
Trib. to Quartz Creek (ASP- 241)	BLM-Medford District	133.35	Perennial Intermediate	Dry Open-Cut	Tributary, which originates from seepage from the Medford Aqueduct, will likely be crossed with the bore of the Medford Aqueduct.	None	Unknown	Unknown	None	None	Jun 15 to Sep 15	Y*

TABLE I-2 (continued)

Fish Utilization, EFH in, and Crossing Techniques and In-Water Work Windows for Waterbodies Crossed by the Proposed Route (revised April 2018)

Waterbodies Crossed and Waterbody ID	NHD Waterbody Reach Code a/ and Jurisdiction	Approximate Pipeline Milepost (MP)	Waterbody Type Size b/	Proposed Crossing Method Scour Level c/	Waterbody Crossing Rationale d/	ESA Species Present/Habitat e/	Anadromous Species Present f/	Resident Coldwater Species Present	EFH Species Present g/	EFH Component Present g/	Fishery Construction Window h/	Equipment Bridges Y=Yes, Y* = Yes if flowing at time of construction, 1o= 1 pass required outside fish window1i = 1 pass required inside fish window, i =set inside fish window, N=None
Medford Aqueduct - Ditch 3 (ASP-240)	17100307006008 BLM-Medford District	133.38	Perennial Intermediate	Conventional Bore	Proposed conventional bore feasible/practical based on flow volume, channel geometry and potential risk in disturbing man-made aqueduct. Dry open cut feasible	None	None	None	None	None	N/A	Y
Klamath Mountains Ecoregion, Upper Rogue (HUC 17100307) Sub-basin, Little Butte Creek (HUC 1710030708) Fifth field Watershed 8, Jackson County, Oregon												
Whiskey Creek (ASI-207)	17100307000892 Private	137.48	Intermittent Intermediate	Dry Open-Cut	Dry open-cut methods feasible/practical on small 10' wide intermittent headwater stream if flowing at the time of construction. ROW necked down to 75' and TEWAs set back to minimize riparian impacts.	None	None	None	None	None	Jun 15 to Sep 15	Y*
Trib. To Whiskey Creek SS-200-006	17100307016378 Private	137.50	Intermittent Intermediate	Dry Open-Cut	Dry open-cut methods feasible/practical on small braided intermittent headwater stream if flowing at the time of construction. ROW necked down to 75' and TEWAs set back to minimize riparian impacts	None	None	None	None	None	Jun 15 to Sep 15	Y*
Trib. To Whiskey Creek SS-200-008	Private	137.60	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small 2' wide intermittent stream if flowing at the time of construction.	None	None	None	None	None	Jun 15 to Sep 15	Y*
Trib. to Lick Creek (ASI-208)	17100307012488 Private	138.26	Intermittent Intermediate	Dry Open-Cut	Dry open-cut methods feasible/practical on small 10' wide intermittent headwater stream if flowing at the time of construction.	None	None	None	None	None	Jun 15 to Sep 15	Y*
Trib. to Lick Creek (SS-GM- 9)	17100307020234 Private	138.36	Intermittent Intermediate	Dry Open-Cut	Dry open-cut methods feasible/practical on small 1-2' wide intermittent non-fish- bearing ditch if flowing at the time of construction.	None	None	None	None	None	Jun 15 to Sep 15	Y*
Trib. to Lick Creek (SS-GM- 10)	17100307003986 Private	138.44	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small 1-2' wide intermittent non-fish- bearing ditch if flowing at the time of construction.	None	None	None	None	None	Jun 15 to Sep 15	Y*
Trib. to Lick Creek (ASI-210)	17100307003986 Private	138.50	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small <10' wide intermittent headwater stream if flowing at the time of construction.	None	None	None	None	None	Jun 15 to Sep 15	Y*
Trib. to Lick Creek (SS-GM- 11)	17100307000884 Private	138.55	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small 1-2' wide intermittent non-fish- bearing ditch if flowing at the time of construction.	None	None	None	None	None	Jun 15 to Sep 15	Y*
Trib. to Lick Creek (SS-GM- 12)	Private	138.57	Intermittent N/A	Adjacent to centerline within ROW	Not crossed by centerline. Small headwater tributary expected to be dry at the time of construction and would be restored to approximate original contour and grade during restoration.	None	None	None	None	None	Jun 15 to Sep 15	N

TABLE I-2 (continued)

Fish Utilization, EFH in, and Crossing Techniques and In-Water Work Windows for Waterbodies Crossed by the Proposed Route (revised April 2018)

Waterbodies Crossed and Waterbody ID	NHD Waterbody Reach Code a/ and Jurisdiction	Approximate Pipeline Milepost (MP)	Waterbody Type Size b/	Proposed Crossing Method Scour Level c/	Waterbody Crossing Rationale d/	ESA Species Present/Habitat e/	Anadromous Species Present f/	Resident Coldwater Species Present	EFH Species Present g/	EFH Component Present g/	Fishery Construction Window h/	Equipment Bridges Y=Yes, Y* = Yes if flowing at time of construction, 1o= 1 pass required outside fish window1i = 1 pass required inside fish window, i =set inside fish window, N=None
Trib. to Lick Creek (ASI-211)	17100307008460 Private	138.71	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small 7' wide intermittent headwater stream if flowing at the time of construction. No additional workspace required.	None	None	None	None	None	Jun 15 to Sep 15	Y*
Trib. to Lick Creek (SS-GM- 13)	Private	138.74	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small incised intermittent non-fish- bearing ditch if flowing at the time of construction.	None	None	None	None	None	Jun 15 to Sep 15	Y*
Trib. to Lick Creek S-T04-002A (SS-GM-14)	17100307008463 Private	139.07	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small intermittent non-fish-bearing ditch if flowing at the time of construction.	None	None	None	None	None	Jun 15 to Sep 15	Y*
Ditch S-T04-002A	Private	139.10	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small non- fish-bearing ditch if flowing at the time of construction.	None	None	None	None	None	Jun 15 to Sep 15	Y*
Trib. to Lick Creek S-T04-006 (SS-GM-15)	Private	139.21	Intermittent Intermediate	Dry Open-Cut	Dry open-cut methods feasible/practical on small intermittent non-fish-bearing ditch if flowing at the time of construction.	None	None	None	None	None	Jun 15 to Sep 15	Y*
Trib. to Lick Creek S-T04-007 (SS-GM-16)	Private	139.28	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small intermittent non-fish-bearing ditch if flowing at the time of construction.	None	None	None	None	None	Jun 15 to Sep 15	Y*
Trib. to Lick Creek S-T04-008 (ASI-217)	Private	139.42	Intermittent Intermediate	Dry Open-Cut	Dry open-cut methods feasible/practical on small intermittent headwater stream if flowing at the time of construction. No additional workspace required.	None	None	None	None	None	Jun 15 to Sep 15	Y*
Trib. to Lick Creek (ASI-226)	17100307019116 Private	139.59	Intermittent Minor	Dry Open-Cut (Streambed-bedrock) n/	Dry open-cut methods feasible/practical on small 7' wide intermittent headwater stream if flowing at the time of construction. ROW necked down to 75 feet and TEWAs located in existing disturbed pasture to minimize riparian impacts.	None	None	None	None	None	Jun 15 to Sep 15	Y*
Trib. to Lick Creek (ASI-227)	Private	139.63	Intermittent Intermediate	Dry Open-Cut (Streambed-bedrock) n/	Dry open-cut methods feasible/practical on small 1-2' wide intermittent headwater stream if flowing at the time of construction. ROW necked down to 75 feet and no TEWAs utilized to minimize riparian impacts.	None	None	None	None	None	Jun 15 to Sep 15	Y*
Trib. to Lick Creek (ASI-228)	Private	139.68	Intermittent Intermediate	Dry Open-Cut	Dry open-cut methods feasible/practical on small 1-2' wide intermittent headwater drainage if flowing at the time of construction.	None	None	None	None	None	Jun 15 to Sep 15	Y*
Trib. to Lick Creek SS-GM- 43 (AW-230))	Private	139.75	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small 4' wide intermittent headwater drainage if flowing at the time of construction.	None	None	None	None	None	Jun 15 to Sep 15	Y*

TABLE I-2 (continued)

Fish Utilization, EFH in, and Crossing Techniques and In-Water Work Windows for Waterbodies Crossed by the Proposed Route (revised April 2018)

Waterbodies Crossed and Waterbody ID	NHD Waterbody Reach Code a/ and Jurisdiction	Approximate Pipeline Milepost (MP)	Waterbody Type Size b/	Proposed Crossing Method Scour Level c/	Waterbody Crossing Rationale d/	ESA Species Present/Habitat e/	Anadromous Species Present f/	Resident Coldwater Species Present	EFH Species Present g/	EFH Component Present g/	Fishery Construction Window h/	Equipment Bridges Y=Yes, Y* = Yes if flowing at time of construction, 1o= 1 pass required outside fish window1i = 1 pass required inside fish window, i =set inside fish window, N=None
Trib. to Lick Creek (SS-GM- 19)	Private	139.91	Intermittent N/A	Adjacent to centerline within ROW	Not crossed by centerline. Small headwater tributary expected to be dry at the time of construction and would be restored to approximate original contour and grade during restoration.	None	None	None	None	None	Jun 15 to Sep 15	Y*
Lick Creek (ASI-233)	17100307000130 BLM-Medford District	140.27	Intermittent Intermediate	Dry Open-Cut Level 1	Dry open-cut methods feasible/practical on intermittent drainage if flowing at the time of construction. Dam and pump crossing method most logical dry open- cut method based on topographic conditions to eliminate difficulties of threading pipe string under flume with associated safety risks including upsetting flume during process. ROW necked down to 75' and TEWAs set back to minimize riparian impacts. StreamNet data indicates anadromy below crossing (~ 2 miles)	None	None	Trout, unspecified	None	None	Jun 15 to Sep 15	Y*
Ditch Trib. to Lick Creek (ADX- 234)	17100307001378 BLM-Medford District	140.32	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small 1-2' wide intermittent road ditch if flowing at the time of construction.	None	None	Unknown	None	None	Jun 15 to Sep 15	Y*
Trib. to Lick Creek (ASI-189)	17100307009921 Private	140.58	Intermittent Minor	Dry Open-Cut (Streambed-bedrock) n/	Dry open-cut methods feasible/practical on small 3' wide intermittent headwater trib. if flowing at the time of construction. No additional workspace required.	None	None	None	None	None	Jun 15 to Sep 15	Y*
Ditch Trib. to Lick Creek (ADX- 186)	17100307001383 BLM-Medford District	140.94	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small 1-2' wide intermittent ditch if flowing at the time of construction.	None	None	None	None	None	N/A	Y*
Star Lake Reservoir (Edge- 1)	17100307005853 Private	141.01	Perennial N/A	Adjacent to TEWA 140.98 Water Source	N/A – water source.	None	None	None	None	None	N/A	N
Trib. to Salt Creek (ASI-187)	17100307014303 BLM-Medford District	141.18	Intermittent Minor	Dry Open-Cut (Streambed-bedrock) n/	Dry open-cut methods feasible/practical on small 3' wide intermittent headwater trib. if flowing at the time of construction. No additional workspace required.	None	None	None	None	None	Jun 15 to Sep 15	Y*
Trib. to Salt Creek (ASI-188)	17100307004291 BLM-Medford District	141.48	Intermittent Minor	Dry Open-Cut (Streambed-bedrock) n/	Dry open-cut methods feasible/practical on small intermittent headwater trib. if flowing at the time of construction.	None	None	None	None	None	Jun 15 to Sep 15	Y*
Trib. to Salt Creek (RS-17)	17100307004291 BLM-Medford District	141.49	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small 4' wide intermittent headwater trib., if flowing at the time of construction.	None	None	None	None	None	Jun 15 to Sep 15	Y*

TABLE I-2 (continued)

Fish Utilization, EFH in, and Crossing Techniques and In-Water Work Windows for Waterbodies Crossed by the Proposed Route (revised April 2018)

Waterbodies Crossed and Waterbody ID	NHD Waterbody Reach Code a/ and Jurisdiction	Approximate Pipeline Milepost (MP)	Waterbody Type Size b/	Proposed Crossing Method Scour Level c/	Waterbody Crossing Rationale d/	ESA Species Present/Habitat e/	Anadromous Species Present f/	Resident Coldwater Species Present	EFH Species Present g/	EFH Component Present g/	Fishery Construction Window h/	Equipment Bridges Y=Yes, Y* = Yes if flowing at time of construction, 1o= 1 pass required outside fish window1i = 1 pass required inside fish window, i =set inside fish window, N=None
Trib. to Salt Creek (ESI-30)	17100307014306 Private	141.95	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small 6' wide intermittent headwater trib. if flowing at the time of construction. No additional workspace required.	None	None	None	None	None	Jun 15 to Sep 15	Y*
Ditch (EDX-32)	Private	142.28	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small 1-2' wide intermittent ditch if flowing at the time of construction.	None	None	None	None	None	Jun 15 to Sep 15	Y*
Trib. to Salt Creek (ESI-31)	17100307018645 Private	142.32 142.35	Intermittent Intermediate	Dry Open-Cut	Dry open-cut methods feasible/practical on small intermittent headwater trib. if flowing at the time of construction. Altered trib. part of pasture irrigation system.	None	None	None	None	None	Jun 15 to Sep 15	Y*
Salt Creek (ESP-34)	17100307000121 Private	142.57	Perennial Intermediate	Dry Open-Cut Level 1	Dry open-cut methods feasible/practical on creek during low flow period within ODFW in- water work window. ROW necked down to 75' and TEWAs located in existing disturbed pasture to minimize riparian impacts. Bore not practical because both bore pits would be located in wetland likely requiring significant dewatering efforts to access bore pits.	SONCC Coho, spawning, rearing habitat T, CH	Coho, Summer Steelhead, Winter Steelhead	Trout, unspecified	Coho	Coho Spawning, Rearing	Jun 15 to Sep 15	Y
Pasture Ditch (EDX-36)	Private	142.65	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small 1-2' wide intermittent ditch if flowing at the time of construction.	None	None	None	None	None	N/A	Y*
Trib. to Salt Creek (ESI-37)	17100307014301 Private	143.12	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small 4' wide intermittent headwater trib. if flowing at the time of construction.	None	None	None	None	None	Jun 15 to Sep 15	Y*
Trib. to Long Branch Creek (ESI-38)	17100307009770 Private	143.51	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small 2' wide intermittent headwater trib. if flowing at the time of construction.	None	None	None	None	None	Jun 15 to Sep 15	Y*
Trib. to Long Branch Creek (ESI-39)	17100307011758 Private	143.74	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small 3' wide intermittent headwater trib. if flowing at the time of construction.	None	None	None	None	None	Jun 15 to Sep 15	Y*
Stock Pond (EL-41)	Private	143.76	Stock Pond N/A	Adjacent to centerline within ROW	Man-made pond expected to be dry at the time of construction and the pond will be reestablished after construction	None	None	None	None	None	N/A	N
Trib. to Long Branch Creek (ESI-38)	17100307009083 Private	143.76	Intermittent N/A	Adjacent to centerline within ROW	Not crossed by centerline. Intermittent drainage on very edge of TEWA; likely can be avoided during construction.	None	None	None	None	None	Jun 15 to Sep 15	Y*

TABLE I-2 (continued)

Fish Utilization, EFH in, and Crossing Techniques and In-Water Work Windows for Waterbodies Crossed by the Proposed Route (revised April 2018)

Waterbodies Crossed and Waterbody ID	NHD Waterbody Reach Code a/ and Jurisdiction	Approximate Pipeline Milepost (MP)	Waterbody Type Size b/	Proposed Crossing Method Scour Level c/	Waterbody Crossing Rationale d/	ESA Species Present/Habitat e/	Anadromous Species Present f/	Resident Coldwater Species Present	EFH Species Present g/	EFH Component Present g/	Fishery Construction Window h/	Equipment Bridges Y=Yes, Y* = Yes if flowing at time of construction, 1o= 1 pass required outside fish window1i = 1 pass required inside fish window, i =set inside fish window, N=None
Trib. to Long Branch Creek (ESI-40)	17100307009083 Private	143.77	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small 3' wide intermittent headwater trib. if flowing at the time of construction.	None	None	None	None	None	Jun 15 to Sep 15	Y*
Long Branch Creek (ESI-38)	17100307000921 Private	144.11	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small 2' wide intermittent headwater trib. if flowing at the time of construction.	SONCC Coho, assumed habitat T	Summer Steelhead	Present	Coho Assumed	Unknown	Jun 15 to Sep 15	Y*
Hanley North Canal Irrigation Ditch (EDX-42)	17100307006072 Private	144.14	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small 1-2' wide intermittent ditch if flowing at the time of construction.	None	None	Unknown	None	None	N/A	Y*
Trib. to S. Fork Long Branch (GSP-5/ESP-48)	17100307004586 Private	144.70	Perennial Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small 3' wide intermittent headwater trib. if flowing at the time of construction.	None	None	Unknown	None	None	Jun 15 to Sep 15	Y
South Fork Long Branch Cr (GSI-6/ESP-59)	17100307004616 Private	145.27	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small 3' wide intermittent headwater trib. if flowing at the time of construction.	None	None	Unknown	None	None	Jun 15 to Sep 15	Y*
Irrigation Ditch (NDX-107)	17100307001458 Private	145.32	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small 1-2' wide intermittent ditch if flowing at the time of construction.	None	None	Unknown	None	None	N/A	Y*
Irrigation Ditch (NDX-56)	Private	145.37	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small 1-2' wide intermittent ditch if flowing at the time of construction.	None	None	Unknown	None	None	N/A	Y*
Trib. to S. Fork Long Branch (ESI-61)	17100307004636 Private	145.54	Intermittent Intermediate	Dry Open-Cut	Dry open-cut methods feasible/practical on small intermittent trib. if flowing at the time of construction.	None	None	Unknown	None	None	Jun 15 to Sep 15	Y*
Irrigation Ditch (EDX-64)	Private	145.57	Intermittent Minor	Dry Open-Cut (Bored)	Dry open-cut methods feasible/practical on small 1-2' wide intermittent ditch road if flowing at the time of construction. This ditch may likely be bored with Highway 140.	None	None	Unknown	None	None	N/A	Y*
North Fork Little Butte Creek (ESP-66)	17100307000113 Private	145.69	Perennial Intermediate	Dry Open-Cut Level 2 m/	Dry open-cut methods feasible/practical on stream during ODFW in-water work window. USGS Gage Station 1434300 reports that mean monthly flow are 89, 111, 105 and 67 for Jun, Jul, Aug and Sep, respectively. Flows in Jul and Aug are highest yearly flow periods for creek. TEWA set back and located primarily in previously disturbed (pastures) areas to minimize riparian impacts.	SONCC Coho, spawning, rearing Habitat T, CH	Fall Chinook, Coho, Summer Steelhead, Winter Steelhead	Trout, unspecified	Coho	Fall Chinook Spawning Coho Spawning, Rearing	Jun 15 to Sep 15	Y-1i with mid- stream support

TABLE I-2 (continued)

Fish Utilization, EFH in, and Crossing Techniques and In-Water Work Windows for Waterbodies Crossed by the Proposed Route (revised April 2018)

Waterbodies Crossed and Waterbody ID	NHD Waterbody Reach Code a/ and Jurisdiction	Approximate Pipeline Milepost (MP)	Waterbody Type Size b/	Proposed Crossing Method Scour Level c/	Waterbody Crossing Rationale d/	ESA Species Present/Habitat e/	Anadromous Species Present f/	Resident Coldwater Species Present	EFH Species Present g/	EFH Component Present g/	Fishery Construction Window h/	Equipment Bridges Y=Yes, Y* = Yes if flowing at time of construction, 1o= 1 pass required outside fish window1i = 1 pass required inside fish window, i =set inside fish window, N=None
Trib. to N. Fork Little Butte Creek (ESI-56)	17100307004681 Private	146.05	Intermittent Intermediate	Dry Open-Cut	Dry open-cut methods feasible/practical on small 4' wide intermittent trib, if flowing at the time of construction. No additional workspace required.	SONCC Coho assumed habitat T	Assumed	Unknown	Coho Assumed	Unknown	Jun 15 to Sep 15	Y*
Trib. to N. Fork Little Butte Creek (ESI-55)	17100307004702 Private	146.38	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small 2' wide intermittent trib. if flowing at the time of construction.	None	None	None	None	None	Jun 15 to Sep 15	Y*
Hanley South Canal Irrigation Ditch (EDX-51)	17100307001489 Private	146.80	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small intermittent ditch if flowing at the time of construction.	None	None	None	None	None	N/A	Y*
Cascades Ecoregion, Upper Rogue (HUC 17100307) Sub-basin, Little Butte Creek (HUC 1710030708) Fifth field Watershed 8, 9, Jackson County, Oregon												
South Fork Little Butte Creek (ASP-165)	17100307000108 Forest Service- Rogue River-Siskiyou NF	162.45	Perennial Intermediate	Dry Open-Cut Level 1	Dry-open cut feasible and practical on creek. ODFW fish passage barrier data (RecordID 51163) indicates that downstream irrigation diversion dam/barrier (~ 0.5 miles): is unladdered and impassible. USGS Gage Station 14339500 – located below diversion reports monthly mean flow of 14, 12 and 11 cfs, respectively for Jul, Aug & Sep. ROW necked down to 75 feet and TEWAs set back to minimize riparian impacts.	None	None	Trout, unspecified	None	None	Jun 15 to Sep 15	Y-1i with mid- stream support
Daley Creek (ESI-76/ ESI-84)	17100307000107 Forest Service- Rogue River-Siskiyou NF	166.21	Intermittent Intermediate	Dry Open-Cut	Dry open-cut methods feasible/practical on small headwater intermittent trib. if flowing at the time of construction.	None	None	Trout, Unspecified	None	None	Jun 15 to Sep 15	Y*
Trib to South Fork Little Butte Creek	17100307005730 Forest Service- Rogue River-Siskiyou NF	167.80	Intermittent Minor	Bore	Trenchless (bore) crossing; proposed to avoid stream and Pacific Crest Trail Crossing	None	None	Unknown	None	None	Jun 15 to Sep 15	Y
Eastern Cascades Slopes and Foothills Ecoregion, Upper Klamath River (HUC 18010206) Sub-basin, Spencer Creek (HUC 1801020601) Fifth field Watershed 8, 9, Klamath County, Oregon												
Spencer Creek (WWW-001- 013/ EW-85)	18010206000968 Forest Service-Winema NF	171.07	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small < 10' wide stream with associated wetland. ROW necked down 75 feet and TEWAs set back or located to the edge of existing road disturbance to minimize riparian and wetland impacts. Conventional bore not practical because of topographic conditions and grading/excavation requirements on the south side of creek.	None	None	Unknown	None	None	Aug 1 to Sep 30	Y
Trib. to Spencer Creek SS-201-001 (GSP-7)	18010206005900 Forest Service-Winema NF	171.57	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small < 2' wide intermittent trib/wetland. if flowing at the time of construction.	None	None	Unknown	None	None	Aug 1 to Sep 30	Y*

TABLE I-2 (continued)

Fish Utilization, EFH in, and Crossing Techniques and In-Water Work Windows for Waterbodies Crossed by the Proposed Route (revised April 2018)

Waterbodies Crossed and Waterbody ID	NHD Waterbody Reach Code a/ and Jurisdiction	Approximate Pipeline Milepost (MP)	Waterbody Type Size b/	Proposed Crossing Method Scour Level c/	Waterbody Crossing Rationale d/	ESA Species Present/Habitat e/	Anadromous Species Present f/	Resident Coldwater Species Present	EFH Species Present g/	EFH Component Present g/	Fishery Construction Window h/	Equipment Bridges Y=Yes, Y* = Yes if flowing at time of construction, 1o= 1 pass required outside fish window1i = 1 pass required inside fish window, i =set inside fish window, N=None
Trib. to Spencer Creek (ESI-106a)	18010206000678 Forest Service-Winema NF	173.74	Intermittent Intermediate	Dry Open-Cut	Dry open-cut methods feasible/practical on small < 5' wide ephemeral trib. if flowing at the time of construction.	None	None	Unknown	None	None	Aug 1 to Sep 30	Y
Trib. to Spencer Creek (ESI-69)	18010206000677 BLM-Lakeview District	176.54	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small < 4' wide intermittent trib. if flowing at the time of construction.	None	None	Unknown	None	None	Aug 1 to Sep 30	Y*
Trib. to Spencer Creek (GSI-10)	18010206000677 BLM-Lakeview District	176.56	Intermittent N/A	Adjacent to centerline within ROW	Not crossed by centerline. Small headwater tributary expected to be dry at the time of construction and would be restored to approximate original contour and grade during restoration.	None	None	Unknown	None	None	Aug 1 to Sep 30	Y*
Clover Creek (SS-502-EW- 103/ EW-103)	18010206000330 Private	177.76	Intermittent Minor	Dry Open-Cut Level 1	Dry open-cut methods feasible/practical on small < 10' wide intermittent trib. if flowing at the time of construction. No additional workspace required.	None	None	Redband Trout	None	None	Aug 1 to Sep 30	Y*
Clover Creek (GSI-11)	18010206000330 Private	177.76	Intermittent Minor	Dry Open-Cut Level 1	Dry open-cut methods feasible/practical on small 1-2 ' wide intermittent tributary if flowing at the time of construction. No additional workspace required.	None	None	Redband Trout	None	None	Aug 1 to Sep 30	Y*
Eastern Cascades Slopes and Foothills Ecoregion, Upper Klamath River (HUC 18010206) Sub-basin, John C Boyle Reservoir-Klamath River (HUC 1801020602) Fifth field Watershed 8, Klamath County, Oregon												
Trib. to Klamath River (ESI-97)	18010206002774 Private	186.61	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small 3' wide intermittent trib. if flowing at the time of construction. Intermittent stream feeds stock pond.	None	None	Unknown	None	None	Jul 1 to Jan 31	Y*
Trib. to Klamath River (ESI-99)	18010206000682 Private	186.65	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small 3' wide intermittent trib. if flowing at the time of construction.	None	None	Unknown	None	None	Jul 1 to Jan 31	Y*
Trib. to Klamath River S-T03-001 (ESI-100)	18010206000682 Private	186.74	Intermittent Minor	Dry Open-Cut	Small 2' wide intermittent tributary that runs adjacent to centerline within ROW. Tributary expected to be dry during construction and would be restored to approximate original contour and grade during restoration.	None	None	Unknown	None	None	Jul 1 to Jan 31	Y*
Eastern Cascades Slopes and Foothills Ecoregion, Lost (HUC 18010204) Sub-basin, Lake Ewauna-Upper Klamath River (HUC 1801020412) Fifth field Watershed 8, Klamath County, Oregon												
Trib. To Klamath River (SS-001-001/SS-100-025)	18010204003103 Private	188.90	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small 4' wide intermittent trib. if flowing at the time of construction.	None	None	None	None	None	Jul 1 to Jan 31	Y*
Irrigation Ditch (S2-07 (ADX-63 (MOD))	18010204003315 Private	192.67	Intermittent Intermediate	Dry Open-Cut	Dry open-cut methods feasible/practical on intermittent ditch if flowing at the time of construction.	None	None	Unknown	None	None	N/A	Y*

TABLE I-2 (continued)

Fish Utilization, EFH in, and Crossing Techniques and In-Water Work Windows for Waterbodies Crossed by the Proposed Route (revised April 2018)

Waterbodies Crossed and Waterbody ID	NHD Waterbody Reach Code a/ and Jurisdiction	Approximate Pipeline Milepost (MP)	Waterbody Type Size b/	Proposed Crossing Method Scour Level c/	Waterbody Crossing Rationale d/	ESA Species Present/Habitat e/	Anadromous Species Present f/	Resident Coldwater Species Present	EFH Species Present g/	EFH Component Present g/	Fishery Construction Window h/	Equipment Bridges Y=Yes, Y* = Yes if flowing at time of construction, 1o= 1 pass required outside fish window1i = 1 pass required inside fish window, i =set inside fish window, N=None
Irrigation Canal (NDX-66)	180102040033481 Private	192.81	Intermittent N/A	Adjacent to centerline within TEWA	N/A - not within right-of-way.	None	None	None	None	None	N/A	Y*
Ditch (ADX-67)	18010204003314 Private	192.99	Intermittent Intermediate	Dry Open-Cut	Dry open-cut methods feasible/practical on intermittent ditch if flowing at the time of construction.	None	None	None	None	None	N/A	Y*
Ditch (ADX-69)	Private	193.07	Intermittent Intermediate	Dry Open-Cut	Dry open-cut methods feasible/practical on intermittent ditch if flowing at the time of construction.	None	None	None	None	None	N/A	Y*
Ditch (ADX-72)	Private	193.25	Intermittent N/A	Adjacent to centerline within TEWA	N/A - not within right-of-way.	None	None	None	None	None	N/A	Y*
Ditch (ADX-73)	Private	193.47	Intermittent N/A	Adjacent to centerline within TEWA	N/A - not within right-of-way.	None	None	None	None	None	N/A	Y*
Irrigation Ditch SS-201-003 (WW-001-010/(ADX-78)	18010204003303 Private	194.64	Intermittent Major	Dry Open-Cut	Dry open-cut methods feasible/practical on intermittent irrigation ditch if flowing at the time of construction.	None	None	None	None	None	N/A	Y*
Ditch (NDX-83)	Private	195.46	Intermediate	Dry Open-Cut	Dry open-cut methods feasible/practical on intermittent irrigation ditch if flowing at the time of construction.	None	None	None	None	None	N/A	Y*
Ditch (NDX-84)	Private	195.46	Intermittent N/A	Adjacent to centerline within ROW	Road borrow ditch that runs adjacent to centerline within ROW. Ditch expected to be dry during construction and would be restored to approximate original contour and grade during restoration.	None	None	None	None	None	N/A	Y*
ADX-32	Private	196.67	Intermediate	Dry Open-Cut	Dry open-cut methods feasible/practical on irrigation ditch if flowing at the time of construction.	Unknown	None	Unknown	None	None	Jul 1 to Jan 31	Y

TABLE I-2 (continued)

Fish Utilization, EFH in, and Crossing Techniques and In-Water Work Windows for Waterbodies Crossed by the Proposed Route (revised April 2018)

Waterbodies Crossed and Waterbody ID	NHD Waterbody Reach Code a/ and Jurisdiction	Approximate Pipeline Milepost (MP)	Waterbody Type Size b/	Proposed Crossing Method Scour Level c/	Waterbody Crossing Rationale d/	ESA Species Present/Habitat e/	Anadromous Species Present f/	Resident Coldwater Species Present	EFH Species Present g/	EFH Component Present g/	Fishery Construction Window h/	Equipment Bridges Y=Yes, Y* = Yes if flowing at time of construction, 1o= 1 pass required outside fish window1i = 1 pass required inside fish window, i =set inside fish window, N=None
Irrigation Ditch (EE-9000-06)	Private	195.86	Intermediate	Dry Open-Cut	Dry open-cut methods feasible/practical on irrigation ditch if flowing at the time of construction.	Unknown	None	Unknown	None	None	Jul 1 to Jan 31	Y
Irrigation Ditch (EE-9000-12)	Private	196.35	Intermediate	Adjacent to centerline within ROW	Road borrow ditch that runs adjacent to centerline within TEWA. Ditch expected to be dry during construction and would be restored to approximate original contour and grade during restoration	None	None	None	None	None	N/A	Y*
Irrigation Ditch (NDX-85)	Private	196.61	N/A	Adjacent to centerline within ROW	Road borrow ditch that runs adjacent to centerline within TEWA. Ditch expected to be dry during construction and would be restored to approximate original contour and grade during restoration	None	None	None	None	None	N/A	Y*
Irrigation Ditch (ADX-33)	Private	196.73	N/A	Adjacent to centerline within TEWA	Road borrow ditch that runs adjacent to centerline within TEWA. Ditch expected to be dry during construction and would be restored to approximate original contour and grade during restoration	None	None	None	None	None	N/A	Y*
Irrigation Ditch (ADX-40)	Private	197.08	Intermittent Intermediate	Dry Open-Cut	Dry open-cut methods feasible/practical on intermittent irrigation ditch if flowing at the time of construction.	None	None	None	None	None	N/A	Y*
Irrigation Ditch (DX-GM-1)	Private	197.22	Intermittent Minor	Adjacent to centerline within ROW	Not crossed by centerline. Small field ditch expected to be dry at the time of construction and would be restored to approximate original contour and grade during restoration.	None	None	None	None	None	N/A	Y*
Irrigation Ditch (DX-GM-3)	Private	197.28	Intermittent Minor	Adjacent to centerline within ROW	Not crossed by centerline. Small field ditch expected to be dry at the time of construction and would be restored to approximate original contour and grade during restoration.	None	None	None	None	None	N/A	Y*
Klamath River (ASP-151)	18010204002564 State	199.38	Perennial Major	HDD Level 1	HDD feasible/practical based on river crossing width (~ 1000') flow volumes, topography, geotechnical and geometry conditions. Dry open-cut infeasible because of width and flow volume. USGS Gage Station 11507501 records mean monthly discharge of 1,190, 1,060, 1,120 cfs respectively for Jul, Aug, Sep.	Lost River Sucker E, CH Shortnose Sucker E, CH	Pacific Lamprey	Redband Trout, Endemic Klamath Fish Species	None	None	N/A Jul 1 to Jan 31	N
Irrigation Canal (ADX-293)	Private	200.41	Intermittent N/A	Adjacent to centerline within ROW	Not crossed by centerline. Irrigation ditch expected to be dry at the time of construction and would be restored to approximate original contour and grade during restoration	None	None	None	None	None	N/A	Y*

TABLE I-2 (continued)

Fish Utilization, EFH in, and Crossing Techniques and In-Water Work Windows for Waterbodies Crossed by the Proposed Route (revised April 2018)

Waterbodies Crossed and Waterbody ID	NHD Waterbody Reach Code a/ and Jurisdiction	Approximate Pipeline Milepost (MP)	Waterbody Type Size b/	Proposed Crossing Method Scour Level c/	Waterbody Crossing Rationale d/	ESA Species Present/Habitat e/	Anadromous Species Present f/	Resident Coldwater Species Present	EFH Species Present g/	EFH Component Present g/	Fishery Construction Window h/	Equipment Bridges Y=Yes, Y* = Yes if flowing at time of construction, 1o= 1 pass required outside fish window1i = 1 pass required inside fish window, i =set inside fish window, N=None
Irrigation Canal (No. 1 Drain) (ADX-294)	18010204003246 BOR	200.54	Intermittent Intermediate	Bore	Bureau of Reclamation facility to be bored.	Unknown	None	None	None	None	N/A	Y
Irrigation Ditch SS-201-007 (ADX-96) (C-4-E Lateral)	1217823421646 BOR	201.63	Intermittent Intermediate	Bore	Bureau of Reclamation facility to be bored	Unknown	None	None	None	None	N/A	Y
Roadside Ditch (ADX-99)	Private	203.97	Intermittent Intermediate	Dry Open-Cut	Dry open-cut methods feasible/practical on intermittent irrigation ditch if flowing at the time of construction.	None	None	None	None	None	N/A	Y*
Irrigation Canal (C-4 Lateral) (ADX-100)	18010204001225 BOR	204.12	Intermittent Intermediate	Bore	Bureau of Reclamation facility to be bored.	Unknown	None	None	None	None	N/A	Y
Irrigation Canal (C-4-F Lateral) (ADX-101)	18010204001222 BOR	204.33	Intermittent Intermediate	Bore	Bureau of Reclamation facility to be bored.	Unknown	None	None	None	None	N/A	Y
Ditch (ADX-103)	Private	204.50	Intermittent N/A	Adjacent to centerline within TEWA	On edge of TEWA and will be avoided.	None	None	None	None	None	N/A	Y*
Ditch No. 3 Drain (ADX-105)	18010204003757 BOR	204.74	Intermittent Intermediate	Bore	Bureau of Reclamation facility to be bored.	Unknown	None	None	None	None	N/A	Y
Irrigation Canal (ADX-106)	Private	204.91	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on intermittent irrigation ditch if flowing at the time of construction.	None	None	None	None	None	N/A	Y*
Ditch (C-4-C Lateral) (ADX-109)	18010204001218 BOR	205.50	Intermittent Intermediate	Bore	Bureau of Reclamation facility to be bored.	Unknown	None	None	None	None	N/A	Y
Eastern CascadesSlopes and Foothills Ecoregion, Lost (HUC 18010204) Sub-basin, Mills Creek-Lost River (HUC 1801020409) Fifth field Watershed 8, Klamath County, Oregon												
Ditch (ADX-110)	Private	205.94	Intermittent Minor	Bore	Likely bored with BOR C Canal (ADX-111); potentially a dry- open cut crossing if flowing at the time of construction to facilitate bore of C canal.	Unknown	None	None	None	None	N/A	Y
Canal (C Canal) (ADX-111)	18010204004021 BOR	205.96	Intermittent Intermediate	Bore	Bureau of Reclamation facility to be bored.	Unknown	None	None	None	None	N/A	Y
Wetland Ditch (ADX-112)	18010204009070 Private	205.97	Intermittent Intermediate	Bore	To be bored with C Canal.	Unknown	None	None	None	None	N/A	Y
Irrigation Ditch (D-2 Lateral) (ADX-113)	BOR	206.51	Intermittent Intermediate	Bore	Bureau of Reclamation facility to be bored.	Unknown	None	None	None	None	N/A	Y
Roadside Drainage Ditch (5-A Drain) (ADX-115)	18010204004039 BOR	207.26	Intermittent Intermediate	Bore	Bureau of Reclamation facility to be bored.	Unknown	None	None	None	None	N/A	Y
Irrigation Lateral (C-4-7 Lateral) (ADX-116)	18010204001229 BOR	207.40	Intermittent Intermediate	Bore	Bureau of Reclamation facility to be bored.	Unknown	None	None	None	None	N/A	Y
Irrigation Drain 5-A Drain (ADX-117)	18010204001237 BOR	207.42	Intermittent Intermediate	Bore	Bureau of Reclamation facility to be bored.	Unknown	None	None	None	None	N/A	Y
Irrigation Drain (5-A Drain) (ADX-118)	18010204001237 BOR	207.60	Intermittent Intermediate	Bore	Bureau of Reclamation facility to be bored.	Unknown	None	None	None	None	N/A	Y
Irrigation Drain (5-A Drain) (ADX-119)	18010204001237 BOR	207.99	Intermittent Intermediate	Bore	Bureau of Reclamation facility to be bored.	Unknown	None	None	None	None	N/A	Y
Irrigation Ditch (ADX-120)	Private	208.07	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on intermittent irrigation ditch if flowing at the time of construction.	Unknown	None	None	None	None	N/A	Y

TABLE I-2 (continued)

Fish Utilization, EFH in, and Crossing Techniques and In-Water Work Windows for Waterbodies Crossed by the Proposed Route (revised April 2018)

Waterbodies Crossed and Waterbody ID	NHD Waterbody Reach Code a/ and Jurisdiction	Approximate Pipeline Milepost (MP)	Waterbody Type Size b/	Proposed Crossing Method Scour Level c/	Waterbody Crossing Rationale d/	ESA Species Present/Habitat e/	Anadromous Species Present f/	Resident Coldwater Species Present	EFH Species Present g/	EFH Component Present g/	Fishery Construction Window h/	Equipment Bridges Y=Yes, Y* = Yes if flowing at time of construction, 1o= 1 pass required outside fish window1i = 1 pass required inside fish window, i =set inside fish window, N=None
Irrigation Ditch (ADX-121)	Private	208.07	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on intermittent irrigation ditch if flowing at the time of construction.	Unknown	None	None	None	None	N/A	Y
Drainage Ditch Irrigation Drain (5-A Drain) (ADX-123)	18010204001237 BOR	208.18	Intermittent Intermediate	Bore	Bureau of Reclamation facility to be bored.	Unknown	None	None	None	None	N/A	Y
Ditch (ADX-124)	Private	208.23	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on intermittent irrigation ditch if flowing at the time of construction.	Unknown	None	None	None	None	N/A	Y
Irrigation Ditch (ADX-125)	Private	208.28	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on intermittent irrigation ditch if flowing at the time of construction.	None	None	None	None	None	N/A	Y*
Irrigation Ditch (ADX-126)	Private	208.29	Intermittent Intermediate	Dry Open-Cut	Dry open-cut methods feasible/practical on intermittent irrigation ditch if flowing at the time of construction.	None	None	None	None	None	N/A	Y*
Roadside Drainage Ditch (ADX-128)	Private	208.78	Intermittent Intermediate	Bored	Bored with Railroad and Highway 39.	Unknown	None	None	None	None	N/A	N
Roadside Drainage Ditch (ADX-129)	Private	208.85	Intermittent Intermediate	Dry Open-Cut	Dry open-cut methods feasible/practical on intermittent irrigation ditch if flowing at the time of construction.	None	None	None	None	None	N/A	Y*
Irrigation Drain 5-K Drain (ADX-130)	18010204001229 BOR	209.02	Intermittent Intermediate	Bore	Bureau of Reclamation facility to be bored.	Unknown	None	None	None	None	N/A	Y
Roadside Drainage Ditch (ADX-131)	Private	209.05	Intermittent Intermediate	Bore	Bored with Reclamation's 5-K Drain.	Unknown	None	None	None	None	N/A	Y*
Roadside Drainage Ditch (ADX-133)	Private	209.15	Intermittent Minor	Bore	Bored with Reclamation's C-9 Lateral.	Unknown	None	None	None	None	N/A	Y*
Irrigation C-9 Lateral (ADX- 134)	BOR	209.15	Intermittent Intermediate	Bore	Bureau of Reclamation facility to be bored.	Unknown	None	None	None	None	N/A	Y
Irrigation Ditch (ADX-135)	Private	209.16	Intermittent Minor	Bore	Bored with Reclamation's C-9 Lateral.	Unknown	None	None	None	None	N/A	Y
Roadside Ditch (ADX-142)	Private	210.16	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on intermittent irrigation ditch if flowing at the time of construction.	None	None	None	None	None	N/A	Y*
Irrigation Ditch (No. 5 Drain) (Trib. to Lost River) (ADX-143/ SS-003-001)	18010204004367 BOR	210.26	Intermittent Intermediate	Bore	Bureau of Reclamation facility to be bored.	Unknown	None	None	None	None	N/A	Y
Irrigation Ditch 5-H Drain (Trib. to Lost River) (ADX-260)	18010204015577 BOR	210.85	Intermittent Intermediate	Bore	Bureau of Reclamation facility to be bored.	Unknown	None	None	None	None	N/A	Y
Irrigation Ditch (ADX-261)	Private	210.87	Intermittent Intermediate	Dry Open-Cut	Likely to be bored with Reclamation's 5-H Drain.	None	None	None	None	None	N/A	Y*
Ditch (NDX-29/SS-003-002)	Private	211.32	Intermittent Intermediate	Dry Open-Cut	Dry open-cut methods feasible/practical on intermittent irrigation ditch if flowing at the time of construction.	None	None	None	None	None	N/A	Y*

TABLE I-2 (continued)

Fish Utilization, EFH in, and Crossing Techniques and In-Water Work Windows for Waterbodies Crossed by the Proposed Route (revised April 2018)

Waterbodies Crossed and Waterbody ID	NHD Waterbody Reach Code a/ and Jurisdiction	Approximate Pipeline Milepost (MP)	Waterbody Type Size b/	Proposed Crossing Method Scour Level c/	Waterbody Crossing Rationale d/	ESA Species Present/Habitat e/	Anadromous Species Present f/	Resident Coldwater Species Present	EFH Species Present g/	EFH Component Present g/	Fishery Construction Window h/	Equipment Bridges Y=Yes, Y* = Yes if flowing at time of construction, 1o= 1 pass required outside fish window1i = 1 pass required inside fish window, i =set inside fish window, N=None
Ditch SS-003-003 (NDX-30)	Private	211.34	Intermittent N/A	Dry Open-Cut	Dry open-cut methods feasible/practical on intermittent irrigation ditch if flowing at the time of construction.	None	None	None	None	None	N/A	Y*
Ditch (NDX-92)	Private	211.52	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on intermittent irrigation ditch if flowing at the time of construction.	None	None	None	None	None	N/A	Y*
Irrigation Ditch (SS-003-004 (NDX-93))	Private	211.53 211.68	Intermittent Intermediate	Dry Open-Cut	Dry open-cut methods feasible/practical on intermittent irrigation ditch if flowing at the time of construction.	None	None	None	None	None	N/A	Y*
Lost River (NSP001)	18010204004545 State	212.07	Perennial Major	Dry Open-Cut Level 1	Dry open-cut methods feasible/practical during low flow periods during ODFW in- water work window. An HDD and conventional bore are likely probable at the approximate crossing location based on the topography, geometry and expected geotechnical conditions. Landowner restricted access for geotechnical investigations. Significant costs, time requirements were the determinants for the proposed dry open-cut method.	Lost River Sucker E Shortnose Sucker E	None	Redband Trout, Endemic Klamath Fish Species	None	None	Jul 1 to Mar 31	Y-1i with mid-stream support
Irrigation Ditch (ADX-318 EDX-55/EDX-90))	18010204004940 Private	213.23	Intermittent Intermediate	Dry Open-Cut	Dry open-cut methods feasible/practical on intermittent irrigation ditch if flowing at the time of construction.	None	None	None	None	None	N/A	Y*
Irrigation Ditch (ADX 318)	18010204004940 Private	213.45	Intermittent N/A	Adjacent to ROW	On edge of TEWA – should be avoided during construction.	None	None	None	None	None	N/A	Y*
Irrigation Ditch (ADX-274)	BOR	213.85	Intermittent Intermediate	Bore	Bureau of Reclamation facility to be bored.	Unknown	None	None	None	None	N/A	Y*
G Canal (G Canal) (ADX-275)	18010204001228 BOR	213.87	Intermittent Intermediate	Bore	Bureau of Reclamation facility to be bored.	Unknown	None	None	None	None	N/A	Y*
Pond (Edge-2)	Private	214.28	Intermittent Pond	Adjacent to centerline within ROW & TEWA	N/A – standing water in feedlot.	None	None	None	None	None	N/A	Y*
Unnamed Creek (ASI-51)	18010204004618 Private	216.10	Intermittent Intermediate	Dry Open-Cut	Dry open-cut methods feasible/practical on small 6-12' wide intermittent trib. if flowing at the time of construction.	None	None	Unknown	None	None	Jul 1 to Mar 31	Y *
Unnamed Creek (ASI-52)	18010204004618 Private	216.11	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small 3' wide intermittent trib. if flowing at the time of construction.	None	None	Unknown	None	None	Jul 1 to Mar 31	Y *
Unnamed Creek (ASI-50)	18010204004617 Private	216.30	Intermittent Intermediate	Dry Open-Cut	Dry open-cut methods feasible/practical on intermittent trib. if flowing at the time of construction.	None	None	Unknown	None	None	Jul 1 to Mar 31	Y *

TABLE I-2 (continued)

Fish Utilization, EFH in, and Crossing Techniques and In-Water Work Windows for Waterbodies Crossed by the Proposed Route (revised April 2018)

Waterbodies Crossed and Waterbody ID	NHD Waterbody Reach Code a/ and Jurisdiction	Approximate Pipeline Milepost (MP)	Waterbody Type Size b/	Proposed Crossing Method Scour Level c/	Waterbody Crossing Rationale d/	ESA Species Present/Habitat e/	Anadromous Species Present f/	Resident Coldwater Species Present	EFH Species Present g/	EFH Component Present g/	Fishery Construction Window h/	Equipment Bridges Y=Yes, Y* = Yes if flowing at time of construction, 1o= 1 pass required outside fish window1i = 1 pass required inside fish window, i =set inside fish window, N=None
Unnamed Creek (ASI-49)	18010204004627 Private	216.44	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small 6' wide intermittent trib. if flowing at the time of construction.	None	None	Unknown	None	None	Jul 1 to Mar 31	Y *
Trib. to D Canal (ASI-136)	18010204001993 Private	218.09	Intermittent Intermediate	Dry Open-Cut	Dry open-cut methods feasible/practical on intermittent trib. if flowing at the time of construction.	None	None	Unknown	None	None	Jul 1 to Mar 31	Y *
Trib. to D Canal (ASI-137)	18010204004701 Private	218.46	Intermittent Minor	Dry Open-Cut (Streambed-bedrock) n/	Dry open-cut methods feasible/practical on small 3' wide intermittent trib. if flowing at the time of construction.	None	None	Unknown	None	None	Jul 1 to Mar 31	Y *
Trib. to D Canal (ASI-291)	18010204004701 Private	219.69	Intermittent Minor	Dry Open-Cut Level 1	Dry open-cut methods feasible/practical on small 1' wide intermittent trib. if flowing at the time of construction.	None	None	Unknown	None	None	Jul 1 to Mar 31	Y *
Excavated Pond (NL-116)	18010204001267 Private	219.70	Excavated Pond N/A	Off ROW – Temp Extra Workspace	Pond will not be disturbed by construction activities. The pond may be used for a water source for dust control.	None	None	None	None	None	Jul 1 to Mar 31	Y *
Trib. to V Canal (SS-502-012)	Private	220.72	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small 4' wide intermittent trib. if flowing at the time of construction.	None	None	Unknown	None	None	Jul 1 to Mar 31	Y *
Trib. to V Canal SS-502-013	18010204004906 Private	221.15	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small 4' wide intermittent trib. if flowing at the time of construction.	None	None	Unknown	None	None	Jul 1 to Mar 31	Y *
Trib. to V Canal SS-502-013b	18010204004906 Private	221.15	Intermittent Minor	Adjacent to centerline within ROW	Not crossed by centerline. Small intermittent stream expected to be dry at the time of construction and would be restored to approximate original contour and grade during restoration.	None	None	Unknown	None	None	Jul 1 to Mar 31	Y *
Trib. to V Canal SS-502-014	18010204004906 Private	221.30	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small 4' wide intermittent trib. if flowing at the time of construction.	None	None	Unknown	None	None	Jul 1 to Mar 31	Y *
Trib. to V Canal SS-502.016	Private	221.72	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small 6' wide intermittent trib. if flowing at the time of construction.	None	None	Unknown	None	None	Jul 1 to Mar 31	Y *
Trib. to V Canal SS-502-003b	Private	222.79	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small 4' wide intermittent trib. if flowing at the time of construction.	None	None	Unknown	None	None	Jul 1 to Mar 31	Y *
Trib. to V Canal SS-502-003a	Private	222.80	Intermittent Minor	Adjacent to centerline within ROW	ot crossed by centerline. Small intermittent stream expected to be dry at the time of construction and would be restored to approximate original contour and grade during restoration.	None	None	Unknown	None	None	Jul 1 to Mar 31	Y *

TABLE I-2 (continued)

Fish Utilization, EFH in, and Crossing Techniques and In-Water Work Windows for Waterbodies Crossed by the Proposed Route (revised April 2018)

Waterbodies Crossed and Waterbody ID	NHD Waterbody Reach Code a/ and Jurisdiction	Approximate Pipeline Milepost (MP)	Waterbody Type Size b/	Proposed Crossing Method Scour Level c/	Waterbody Crossing Rationale d/	ESA Species Present/Habitat e/	Anadromous Species Present f/	Resident Coldwater Species Present	EFH Species Present g/	EFH Component Present g/	Fishery Construction Window h/	Equipment Bridges Y=Yes, Y* = Yes if flowing at time of construction, 1o= 1 pass required outside fish window1i = 1 pass required inside fish window, i =set inside fish window, N=None
Trib. to V Canal SS-502-004	18010204004894 Private	222.99	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small 5' wide intermittent trib. if flowing at the time of construction.	None	None	Unknown	None	None	Jul 1 to Mar 31	Y *
Trib. to V Canal SS-502.005	Private	223.08	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small 4' wide intermittent trib. if flowing at the time of construction.	None	None	Unknown	None	None	Jul 1 to Mar 31	Y *
Trib. to V Canal SS-502-006	Private	223.12	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small 4' wide intermittent trib. if flowing at the time of construction.	None	None	Unknown	None	None	Jul 1 to Mar 31	Y *
Trib. to V Canal SS-502.023	Private	223.39	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small 4' wide intermittent trib. if flowing at the time of construction.	None	None	Unknown	None	None	Jul 1 to Mar 31	Y *
Trib. to V Canal SS-502-011	Private	223.54	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small 7' wide intermittent trib. if flowing at the time of construction.	None	None	Unknown	None	None	Jul 1 to Mar 31	Y *
Trib. to V Canal SS-502-009a	Private	224.03	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small 5' wide intermittent trib. if flowing at the time of construction.	None	None	Unknown	None	None	Jul 1 to Mar 31	Y *
Trib. to V Canal SS-502-009	Private	224.04	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small 4' wide intermittent trib. if flowing at the time of construction.	None	None	Unknown	None	None	Jul 1 to Mar 31	Y *
Trib. to V Canal SS-502-008	Private	224.17	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small 4' wide intermittent trib. if flowing at the time of construction.	None	None	Unknown	None	None	Jul 1 to Mar 31	Y *
Trib. to V Canal SS-502-007	Private	224.21	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small 5' wide intermittent trib. if flowing at the time of construction.	None	None	Unknown	None	None	Jul 1 to Mar 31	Y *
Trib. to V Canal SS-502-021	Private	224.44	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small 4' wide intermittent trib. if flowing at the time of construction.	None	None	Unknown	None	None	Jul 1 to Mar 31	Y *
Trib. to V Canal (SS-502-025 (ASI-140))	18010204001318 Private	225.96	Intermittent Intermediate	Dry Open-Cut Level 1	Dry open-cut methods feasible/practical on intermittent trib. if flowing at the time of construction.	None	None	Unknown	None	None	Jul 1 to Mar 31	Y *
Trib. to V Canal SS-502-024	18010204004977 Private	225.99	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small 4' wide intermittent trib. if flowing at the time of construction.	None	None	Unknown	None	None	Jul 1 to Mar 31	Y *
Trib. to V Canal SS-502-020	Private	227.14	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small 4' wide intermittent trib. if flowing at the time of construction.	None	None	Unknown	None	None	Jul 1 to Mar 31	Y *

TABLE I-2 (continued)

Fish Utilization, EFH in, and Crossing Techniques and In-Water Work Windows for Waterbodies Crossed by the Proposed Route (revised April 2018)

Waterbodies Crossed and Waterbody ID	NHD Waterbody Reach Code a/ and Jurisdiction	Approximate Pipeline Milepost (MP)	Waterbody Type Size b/	Proposed Crossing Method Scour Level c/	Waterbody Crossing Rationale d/	ESA Species Present/Habitat e/	Anadromous Species Present f/	Resident Coldwater Species Present	EFH Species Present g/	EFH Component Present g/	Fishery Construction Window h/	Equipment Bridges Y=Yes, Y* = Yes if flowing at time of construction, 1o= 1 pass required outside fish window1i = 1 pass required inside fish window, i =set inside fish window, N=None
Trib. to V Canal SS-502-017	Private	227.57	Intermittent Minor	Dry Open-Cut	Dry open-cut methods feasible/practical on small 4' wide intermittent trib. if flowing at the time of construction.	None	None	Unknown	None	None	Jul 1 to Mar 31	Y *
Agricultural Pond (AL-288)	Private	228.13	Excavated pond N/A	Off ROW Within TEWA	Pond will not be disturbed by construction activities. The pond may be used for a water source for dust control.	None	None	None	None	None	Jul 1 to Mar 31	Y *

a/ FERC waterbody definitions:
Minor = less than or equal to 10 feet wide
Intermediate = greater than 10 feet wide but less than or equal to 100 feet wide Major = greater than 100 feet wide

b/ Level 1 and 2 waterbodies have been identified; all others are Level 0. According to GeoEngineers 2013 Channel Migration and Scour Analysis for the PCGP Project, channel migration is defined as the lateral movement, over time, of an entire channel segment perpendicular to the direction of stream flow; channel avulsion is the sudden abandonment of an active channel for a newly created or previously abandoned channel located on the floodplain; channel widening is defined as erosion and subsequent recession of one or both stream banks that widens the channel without changing the channel location; streambed scour is erosion of the streambed resulting in the development of deep pools and/or the systematic lowering of the channel floor elevation.
Level 0 = streams not likely subject to migration, avulsion and/or scour
Level 1 = streams with a moderate potential for migration, avulsion and/or scour Level 2 = streams with a high potential for migration, avulsion and/or scour

c/ Dry open-cut crossing methods include Flume or Dam and Pump procedures. Dam and Pump methods would be utilized where streambed blasting is anticipated to eliminate blasting around the flume. The Dam and Pump crossing method is the preferred crossing procedure in steep incised drainage valleys where worker safety may be compromised when placing ("threading") the pipe string under the flume pipe and where there is a risk of upsetting the flume during this operation. The Dam and Pump crossing method is also the preferred crossing method on small streams under low flow conditions during the ODFW recommended in-water work period. PCGP requests permission for temporary/short-term fish passage restriction when completing Dam and Pump crossings within the ODFW recommended in-water work period.

d/ FWS, NMFS, and StreamNet. T = Threatened, E = Endangered, CH = Critical Habitat

e/ ODFW, 2012 (Oregon Department of Fish and Wildlife. 2012. Fish Distribution Data, 1:24,000 Scale. Oregon Department of Fish and Wildlife Natural Resources Information Management Program. Online: https://nrimp.dfw.state.or.us/nrimp/default.aspx?pn=fishdistdata).

f/ PFMC, 1999; ODFW, 2012.

g/ PCGP understands that fisheries' construction windows only apply to those waterbodies flowing at the time of construction and that the windows do not apply to HDD crossings.

h/ USGS Hydrologic Unit Codes.

i/ Key Watershed.

j/ ODFW's recommended in-water work window is from October 1 through February 15. Because PCGP's Coos Bay HDD footprint overlaps with the LNG Terminal facilities, the HDD needs to be completed prior to construction of the LNG terminal to prevent construction conflicts and delays; therefore PCGP may complete the HDD outside the ODFW recommended in-water work window.

k/ ODFW's recommended in-water work window is from October 1 through February 15. Because of the extensive wetland located on the east side of Coos Bay within Kentuck Slough, PCGP plans to schedule the HDD outside the in-water work window to minimize surface impacts within the saturated floodplain wetland.

l/ ODFW's recommended in-water work window is from October 1 through February 15. Because of the extensive wetland location on the south side of the Coos River, PCGP has scheduled the HDD during the dry season outside the in-water work window between August 1 and September 30 to minimize surface impacts within the saturated floodplain wetland.

m/ These sites were field reviewed and analyzed for potential migration, avulsion and/or scour (see GeoEngineers 2013 Channel Migration and Scour Analysis).

n/ Streambed bedrock based on PCGP's Wetland and Waterbody delineation surveys. Streambed bedrock may require special construction techniques to ensure pipeline design depth. Special construction techniques may include rock hammering, drilling and hammering, or blasting. The need for blasting would be determined by the contractor and would only be initiated after ODFW blasting permits are obtained.

TABLE I-3

Special Status Marine Mammal and Terrestrial Wildlife Species That May Occur Near the Jordan Cove Energy Project

Common Name and/or Scientific Name	Status a/ Federal	State	BLM	Forest Service	Expected Habitat	Documented or Suspected Occurrence b/ County	BLM	Forest Service	Within Vicinity of Project Area c/	Effect of Impact d/	Impact Reasoning
Mammals											
Hoary bat *Lasiurus cinereus*		S			Usually associated with montane boreal forests, although during spring and autumn migrations, species has been located in arid shrub-steppe. Forages over water, roads, and forest openings.	Douglas Jackson Klamath	CB-D	UMP-D RRS-D FW-D	CB (2008) 0.4mi E of MP 13.4BR; RRS (2008) 0.08mi S of MP 161.7; RRS (2009) 0.9mi N of MP 161.36; RRS (2008) 370ft S of MP 161.75;	MIIH	Modification of habitat, potential for injury, death, and disturbance.
Pallid bat *Antrozous pallidus pacificus*		S	SEN	SEN	Arid regions, open forest types, desert vegetation types. Uses cliff faces, caves, mines, bridges, tree cavities, or buildings for roosts.	Douglas Jackson Klamath	CB-S LV-D MD-D RO-D	UMP-D RRS-D FW-D	PV (H, 1983) 1.0mi NE of MP 56.0; PV (H-1983, 1994) 0.9mi N and 2.7mi N of MP 64.75; PV (1994) 0.9mi N of MP 67.2; PV (1994) 1.0mi NE of MP 68.0; UMP (H-1923) 1.6mi S of MP 110.1	MIIH	Modification of foraging habitat and disturbance to foraging bats; potential for injury or death if roosting in fell tree or snag, or in rock outcrops removed for pipe.
Pacific Townsend's big-eared bat *Corynorhinus (Plecotus) townsendii townsendii*		SC	SEN	SEN	Forested regions of the Cascade Mountains. Roosts in buildings, caves, mines, buildings, and bridges.	Coos Douglas Jackson Klamath	CB-D LV-D MD-D RO-D	UMP-D RRS-D F-W-D	CB (1999) 3mi E of MP 32.7; Ben Irving Reservoir/RB (H-1993) 1.2mi S of MP 57.13; PV (H-1983) hibernaculum / Tenmile Mountain Cave approximately 0.9mi NW of MP 58.13; PV (1994) 0.1 mi N of MP 68.99; MD (1976) historic breeding site in large basalt cave 2.5mi NE of MP 126.3; MD (2000) breeding site 1.9mi E of MP 133.05; MD (1972) 0.12mi N of MP 153.2; MD (1996) 1.5me W of Rogue Aggregates Pipeyard; RRS (1974) 0.76mi N of MP 154.2; RRS (1972) 1.1mi N of MP 157.5; RRS (2008) 0.9mi N of MP 161.	MIIH	Potential disturbance to roosting or foraging bats.
Silver-haired bat *Lasionycteris noctivagans*		S			Forested areas, especially older Douglas-fir (*Pseudotsuga menziesii*)/western hemlock (*Tsuga heterophylla*) forests. Also in ponderosa pine (*Pinus ponderosa*) forests. Forages over ponds and streams in the woods, finds a day roost under a flap of loose bark.	Coos Douglas Jackson Klamath		UMP-D RRS-D F-W-D	PV (2002) 0.3mi N of MP 38.5; RRS (2009) 0.27mi S of Rock Source Rum Rye (MP 160.41); RRS (2008) 0.07mi S of MP 161.75; RRS (2009) 2.1mi NE of MP 158.6; RRS (2009) 0.9mi N of MP 161.36; RRS (2009) 0.5mi W of TEWA 161.40; RRS (2008) 370ft S of MP 161.75; F-W (2002) 1.6mi NE of MP 170.0; F-W (2002) 1.5mi NE of MP 173.W	MIIH	Disturbance, modification of habitat.
California myotis *Myotis californicus*		S			Occupy a variety of habitats including shrub-steppe, shrub desert, juniper, sagebrush, ponderosa pine forest, and Douglas fir forest.	Coos Douglas Jackson Klamath	MD-D	UMP-D RRS-D F-W-D	MD (T39S, R5E, Historical), MD (T33S, R1W, 1993); RRS (2008) 400ft S of MP 161.7; RRS (2009) 0.27mi S of Rock Source Rum Rye (MP 160.41); RRS (2007) 2.1mi NE of MP 158.6; RRS (2009) 0.9mi N of MP 161.36;	MIIH	Modification of habitat, potential for injury, death, and disturbance.
Fringed myotis *Myotis thysanodes*		S	SEN	SEN	Wide range of habitats, prefers forested or riparian areas. Within flying distance of forested areas. Roosts in decadent trees and snags, sometimes buildings.	Coos Douglas Jackson Klamath	CB-D LV-D MD-D RO-D	UMP-D RRS-D F-W-D	CB (2004) 1.7 miles SW of MP 33.77; PV (2002) 0.3mi NE of MP 38.54; PV (H-1983) 2.7mi S of MP 48.1; MD (H-1976) 1.4mi W of MP 127.3; RRS (2010) 0.27mi S and 1.7mi SE of Rock Source Rum Rye (MP 160.41); RRS (2009) 2.1mi NE of MP 158.6; RRS (2009) 0.9mi N of MP 161.36; F-W (2010) 1.8mi NE of MP 158.1; F-W (2010) 0.8mi N of MP 161.3; RRS (2009) 0.5mi W of TEWA 161.40; RRS (2008) 370ft S of MP 161.75; F-W (2002) 1.6mi NE of MP 170.0; PV (2002) 1.2mi NE of MP 173.1.W	MIIH	Modification of foraging habitat, disturbance to foraging bats; potential for injury or death if roosting in fell tree or snag.
Long-legged myotis *Myotis volans*		S			Coniferous forests, including Douglas-fir, true fir, Sitka spruce (*Picea sitchensis*), lodgepole pine (*Pinus contorta*), and ponderosa pine forests. Roosts in cliff faces, abandoned buildings, caves, mines.	Coos Douglas Jackson Klamath	CB-D RO-D	UMP-D RRS-D F-W-D	PV (2002) 0.3mi NE of MP 23.05; PV (2004) 3.3mi W of MP 33.77; CB (2004) 1.7mi SW of MP 33.77; PV (2002) 0.3mi NE of MP 38.5; PV (1993) 1.3mi NE of MP 55.92; RO (1994) 1.4mi S of MP 58.4; PV (1994) 0.75mi NE of MP 67.4; RRS NF (2009) 0.7mi S of Rock Source Rum Rye MP 160.41; RRS (2009) 2.1mi NE of MP 158.6; RRS (2006) 0.9mi N of MP 161.36; F-W (2002) 1.6mi NE of MP 170.0; F-W (2002) 1.5mi NE of MP 173.	MIIH	Disturbance, modification of habitat.
Spotted bat *Euderma maculatum*		S	SEN	SEN	Wide variety of habitat types ranging from ponderosa pine forests to desert water holes. Nests in cliff crevices.	Klamath	LV-S		No documented occurrences within 3mi of project area.	NI	Very rare vagrant in Oregon, does not occur in Project vicinity.
Pygmy rabbit *Brachylagus idahoensis*	SOC	S	SEN	SEN	Tall dense clumps of sagebrush, also in greasewood. Deep, friable soils for burrows.	Klamath	LV-D	F-W-S	Klamath Falls (H-1972) ~3mi N of MP 200; PV (2002) 2.6mi NE of MP 224.	MIIH	Modification of habitat, disturbance, potential for injury or death from vehicle collision or burrow collapse and crushing.

TABLE I-3 (continued)

Special Status Marine Mammal and Terrestrial Wildlife Species That May Occur Near the Jordan Cove Energy Project

Common Name and/or Scientific Name	Status a/ Federal	State	BLM	Forest Service	Expected Habitat	Documented or Suspected Occurrence b/ County	BLM	Forest Service	Within Vicinity of Project Area c/	Effect of Impact d/	Impact Reasoning
Oregon red tree vole (not the north Oregon coast DPS) *Arborimus longicaudus*		S		S&M-C	Dense, moist, coniferous and mixed hardwood-coniferous forests with Douglas-fir component.	Coos Douglas Jackson	CB-D RO-D MD-D	UMP-D	Observed in Coos Bay BLM, Roseburg BLM, Medford BLM, and Umpqua NF within ROW and 500ft of ROW; see Survey and Manage stand-alone report (appendix F.5 of this EIS).	MIIH	Modification of habitat, disturbance, potential for injury or death if in fell tree or snag. However, remaining sites would provide a reasonable assurance of species persistence.
Gray wolf *Canis lupus*	E				Habitat generalist.	Coos Douglas Jackson Klamath	RO-D MD-D LV-D	UMP-D RRS-D F-W-D	Rogue pack area of known wolf activity, south of Crater Lake: 7.1-9.0 miles NE of MP 131.76; Keno use area: SW of Pipeline but overlaps MP 173.93-176.41.	NLAA	Potential disturbance.
Kit Fox *Vulpes macrotis*		T	SEN		Open desert, shrub or shrub-grassland, salt bush, greasewood, sagebrush in Great Basin.	Klamath	LV-D		Historic (1972) and outside of expected range (eastern Klamath County); MP 193.35 – MP 198.70.	NI	Does not occur in Project vicinity.
Ringtail *Bassariscus astutus*		S			Woodlands containing tanoak (*Notholithocarpus densiflorus*) near rocky areas and rivers. In coniferous forests, especially riparian areas.	Coos Douglas Jackson Klamath	RO-D	UMP-D RRS-D F-W-D	RO (1995) 0.83mi SW of MP 46.8; PV (1986) 0.5mi N of MP 73.75.	MIIH	Disturbance, modification of habitat.
Pacific marten (Coastal DPS) *Martes caurina caurina*	PT		SEN	SEN	Forested habitats. Prefer mature forests with closed canopies, , although one remnant population occupies coastal dune forest in central Oregon.	Coos Douglas	CB-D MD-S	RRS-D	PRV (2011) 0.24mi S of TEWA 3.09-W; CB (H-1991) 0.6mi NE of MP 24.98; PV (1991) 1.4mi NE of MP 26.04; PV (1991) within ROW at MP 29.9; RRS (1978) 2.0mi NE of MP 167.15; RRS (1980) 0.5mi SW of MP 167.15.	LAA/NJ/MIIH	Construction of the LNG terminal would result in removal of suitable habitat, as well as disruption if individuals are present. The loss of habitat is at the southern edge of the central coastal Oregon extant population area.
Pacific marten (interior population) *Martes caurina caurina*		S			Structurally complex late-seral forests as well as lower productivity forests with high shrub densities, including areas associated with serpentine soils.	Douglas Jackson Klamath	LV-D	F-W-D	F-W (1991) 2.0mi NE of MP 168.3; F-W (1997) 0.9mi NE of MP 169.08; F-W (1991) 1.5mi NE of MP 170.94; BLM (1999) 1.2mi SW of MP 171.2; LV (1999) 2.6mi SW of MP 173.07; LV (1999) 2.6mi SW of MP 174.65; LV (2000) 1.5mi SW of MP 174.65; LV (1999) 2.5mi SW of MP 176.5.	MIIH	Disturbance, modification of habitat.
Pacific fisher *Pekania pennanti* (West Coast DPS)	PT	SC	SEN	SEN	Mature, closed canopy coniferous forests with some deciduous component. Frequently along riparian corridors. Sometimes in clearcuts.	Coos Douglas Jackson Klamath	CB-D MD-D RO-D	RRS-D UMP-D F-W-D	CB (1991) 1.4mi E of MP 10.37; F-W (2016) 0.3mi S of MP 171.4; F-W (2012) 1.7mi NE of TEWA 168.85 (water source); Buck Lake (1978) 0.4mi SW of MP 172.58; LV (2015) 0.37mi SW of MP 173.4.	LAA/NJ/MIIH	Construction of the Project would result in removal of suitable habitat, as well as disruption if individuals are present.
Wolverine *Gulo gulo*	PT	T	SEN	SEN	Alpine, tundra, conifer forests, grassland, and shrubland/chaparral.	Douglas Jackson Klamath		UMP-S RRS-S F-W-S	No documentation. Potential disperser, Oregon at southern periphery of range.	NE	Does not occur in Project vicinity.
Columbian white-tailed deer *Odocoileus virginianus leucurus*		SC	SEN		Restricted to a few islands in the Columbia River and white-oak (*Quercus garryana*) woodlands near Roseburg.	Douglas	RO-D		Historical locations N/S of MP 66.9.	NI	Does not occur in Project vicinity.
Sierra Nevada red fox *Vulpes vulpes necator*		S		SEN	Open conifer woodlands and mountain meadows near treeline.	Douglas Jackson Klamath		RRS-D UMP-D F-W-D	No documented occurrences within 3 mi of Project area.	NI	Does not occur in Project vicinity.
Sea Otter *Enhydra lutris*	T	T			Marine mammal in coastal waters/shallows with kelp beds and abundant shellfish.	Coos	CB-S			NE	Assumed to be extirpated from the Oregon coast.
Blue whale *Balaenoptera musculus*	E	E			Worldwide in coastal waters and offshore.	Coos				LAA	Increased risk of ship strike and potential adverse effects from underwater noise.
Fin whale *Balaenoptera physalus*	E	E			Found in waters of all major oceans; concentrates in mixing zones between coastal and oceanic waters associated with the continental shelf.	Coos				LAA	Increased risk of ship strike and potential adverse effects from underwater noise.
Gray whale *Eschrichtius robustus*	E (Western North Pacific Stock)	E (Eastern North Pacific stock)			Found mainly in shallow coastal waters in the North Pacific Ocean.	Coos				NLAA/MIIH	With avoidance and minimization, potential injury and/or mortality due to ship strikes and potential adverse effects from vessel underwater noise are expected to be minimal.

TABLE I-3 (continued)

Special Status Marine Mammal and Terrestrial Wildlife Species That May Occur Near the Jordan Cove Energy Project

Common Name and/or Scientific Name	Status a/ Federal	State	BLM	Forest Service	Expected Habitat	Documented or Suspected Occurrence b/ County	BLM	Forest Service	Within Vicinity of Project Area c/	Effect of Impact d/	Impact Reasoning
Humpback whale *Megaptera novaeangliae* (Central American and Mexican DPSs)	E, T, PCH	E			Feeds in cold, productive, shallow coastal waters. Calving grounds are commonly in shallow waters near offshore reef systems, islands, or continental shores. During migration, humpbacks stay near the surface of the ocean.	Coos				LAA	Increased risk of ship strike and potential adverse effects from underwater noise.
Killer whale *Orchinus orca* Eastern North Pacific Southern Resident stock	E, CH/PCH				Found in all oceans, in both open seas and coastal waters. The Southern Resident stock tends to spend more time in deeper water or waters where there is more salmon abundance.	Coos				NLAA	With avoidance and minimization, potential injury and/or mortality due to ship strikes and potential adverse effects from vessel underwater noise are expected to be minimal.
North Pacific right whale *Eubalaena glacialis*	E	E			Primarily occur in coastal or shelf waters, although movements over deep waters are known.					NLAA	With avoidance and minimization, potential injury and/or mortality due to ship strikes and potential adverse effects from vessel underwater noise are expected to be minimal.
Sei whale *Balaenoptera borealis*	E	E			Sei whales are found a great distance from shore in temperate waters and do not appear to approach coastal areas.	Coos				NLAA	With avoidance and minimization, potential injury and/or mortality due to ship strikes and potential adverse effects from vessel underwater noise are expected to be minimal.
Sperm whale *Physeter macrocephalus*	E	E			Primarily inhabit deep water.	Coos				NLAA	With avoidance and minimization, potential injury and/or mortality due to ship strikes and potential adverse effects from vessel underwater noise are expected to be minimal.
Birds											
Marbled murrelet *Brachyramphus marmoratus*	T/CH	T			Nesting sites almost exclusively within old-growth coniferous forests, usually Douglas-fir stands in Oregon. Uncommon to rare year-round resident on the Oregon coast.	Coos Douglas	CB-D MD-S RO-D	RRS-D	Occupied stands, federally-designated critical habitat, and documented birds within project area.	LAA	Disturbance, loss of habitat, and habitat fragmentation.
Short-tailed albatross *Phoebastria (Diomedea) albatrus* Pacific Coast Population	E	E			Nests on flat or sloped sites with sparse or full vegetation on isolated windswept offshore islands with limited human access.				Off the Oregon coast in the vicinity of Coos Bay.	NLAA	Does not breed in project vicinity; individuals expected to avoid LNG marine traffic.
Western snowy plover *Charadrius nivosus nivosus*	T/CH (Pacific Coast Population)	T	SEN (Outside Pacific Coast Populati on)		Winters along the coast beaches, mudflats, marsh edges; nests on sand spits near river outlets and on level sandy beaches.	Coos Douglas Klamath	LV-D		Coos Bay and Estuary vicinity; largest and most consistent nesting area in the vicinity of Oregon Dunes National Recreational Area 2.2mi SW/S of TEWA 0.10 (HDD pullback); historic nest 785 feet W of MP 1.1 on spoils pile (1990). Project is 2.6 mi NE of Critical Habitat.	NLAA/MIIH	With avoidance and minimization, potential increase in predation and disturbance would be minimal.
Red-necked grebe *Podiceps grisegena*		SC	SEN	SEN	Breeds in lakes and ponds, mostly in forested areas. Winter habitat consists of estuaries and protected waters along the coast.	Coos Douglas Jackson Klamath	CB-D LV-S	UMP-D F-W-D	MD (T38S,R4E; Historical) Modoc Point BBS (16.3 mi)	MIIH	Disturbance and modification of foraging habitat.
Horned grebe *Podiceps auritus*			SEN	SEN	Open water surrounded with emergent vegetation.	Coos Douglas Klamath	CB-D LV-D	UMP-D	On Merril BBS (centerline), Ingalls BBS (41.9 mi), Dorris BBS (3.5 mi), Macdoel BBS (10,9 mi), Iron Gate BBS (19.7 mi), Modoc Point BBS (16.3 mi).	MIIH	Loss and modification of habitat, disturbance.
American white pelican *Pelecanus erythrorhynchos*		S	SEN	SEN	Inland lakes and marshes during breeding season. Nests on predator-free islands. May occur on most bodies of water during nonbreeding.	Klamath	LV-D	RRS-D F-W-D	F-W (1990s) 0.75-2.0 miles of TEWA 168.85. Klamath Lake (Historical). On Iron Gate BBS (19.7), Clear Lake Reservoir BBS (20.4 mi.) Modoc Point BBS (16.3 miles), Bly BBS (31 miless), Merril BBS (on ROW), Dorris BBS (3.5 miles), MacDoel BBS (10.9 miles), Clear Lake Reservoir BBS (20.4 miles) Documented in BCR-5 and BCR- 9.	MIIH	Disturbance.

TABLE I-3 (continued)

Special Status Marine Mammal and Terrestrial Wildlife Species That May Occur Near the Jordan Cove Energy Project

Common Name and/or Scientific Name	Status a/				Expected Habitat	Documented or Suspected Occurrence b/				Effect of Impact d/	Impact Reasoning
	Federal	State	BLM	Forest Service		County	BLM	Forest Service	Within Vicinity of Project Area c/		
California Brown Pelican *Pelecanus occidentalis californicus*		E	SEN	SEN	Marine nearshore habitats in bays, sounds, and estuarine tidal river mouths.	Coos Douglas	CB-D		Coos Bay and Estuary below RM 6 to open ocean – feeding and roosting. Coos Bay Estuary (Coos Bay CBC; 1997-2016).	MIIH	In-water work period will avoid and minimize potential effects; potential disturbance not likely to exceed existing disturbance.
Snowy egret *Egretta thula*		S	SEN		Marshy areas, especially in Coos Bay in the winter. Cattail and bulrush marshes in breeding seasons.	Klamath	LV-D		On Clear Lake Reservoir BBS (20.4 mi), Dorris BBS (3.5 mi)	MIIH	Potential disturbance and habitat loss.
Greater sandhill crane *Grus canadensis tabida*		S			Nests in marshes and wet meadows or in drier grasslands and pastures.	Jackson Klamath		RRS-D	Several documentations RRS (1990s) <1.0mi N/S of route from 156.6-161.0; RRS (1992) pair 0.4mi NW of TEWA 161.40. Documented in BCR-5 and BCR- 9 (Modoc, Bly, Merrrill, Chinchalo, Ingalls, Dorris, MacDoel, Clear Lake Reservoir BBS) and during CBC counts.RR	MIIH	Potential disturbance.
Trumpeter swan *Cygnus buccinator*		S			Nests on the shores of large inland lakes and marshes. Species has a limited range within Oregon.	Klamath	LV-D		No documented occurrences within 3mi of project area.	NI	Does not occur in Project vicinity.
Tule goose *Anser albifrons elgasi*			SEN	SEN	Breeds along tundra wetlands. Winters in agricultural fields, marshes, bays, and lakes	Klamath	LV-S		No documented occurrences within 3mi of project area.	NI	Does not occur in Project vicinity.
Aleutian Canada (cackling) goose *Branta hutchinsii leucopareia*			SEN		Migrates along the entire Oregon coast to California wintering grounds, also winters in Oregon. Forages in pastures. During migration, may be seen in the Willamette Valley or Goat Rock (Oregon Islands National Wildlife Refuge). Some winter exclusively in the Semidi Islands, near Pacific City. In the spring, several thousand congregate in the Langlois area of southern coastal Oregon.	Coos	CB-D		Coos Bay (1993) 3mi SW of MP 1.0.	MIIH	Disturbance and potential effects to coastal wintering grounds.
Black Brant *Branta bernicla nigricans*		S (Coast Range)			In Oregon, estuaries with abundant eelgrass and little human disturbance. Coos Bay used during migration only. Breeds in small, scattered colonies in the low arctic of Alaska.	Coos			Coos Bay (2009, 2017).	MIIH	Disturbance, loss or modification of habitat.
Harlequin duck *Histrionicus histrionicus*		S	SEN	SEN	Breeds along low-gradient, fast-flowing reaches of mountain streams in forested areas. Uses swift waters and rapids during other seasons.	Coos Douglas Klamath	CB-S RO-D	UMP-D RRS-D	Coos Bay and Coquille Valley CBC (1997-2016).	MIIH	Modification of habitat and disturbance.
Bufflehead *Bucephala albeola*			SEN	SEN	Near mountain lakes surrounded by open woodlands containing snags. Nests in aspen (*Populus tremuloides*), ponderosa pine, or Douglas-fir.	Coos Douglas Jackson Klamath	CB-D LV-D RO-D	F-W-D UMP-D RRS-D	On Dorris BBS (3.5 mi), Clear Lake Reservoir BBS (20.4 mi), Crowder Flat BBS (31.7 mi), Modoc Point BBS (16.3 mi), Lapham Reservoir BBS 25 mi), and CBC counts (1997-2016).	MIIH	Disturbance.
Yellow rail *Coturnicops noveboracensis*	SOC	SC	SEN	SEN	Freshwater and coastal estuary marshes. Requires areas with shallow water and vegetative cover.	Klamath	LV-D	F-W-D UMP-S	Documented in BCR 9 on Chinchalo BBS (37.6 mi).	NI	Does not currently occur in Project vicinity.
Black oystercatcher *Haematopus bachmani*		S			Intertidal environment. Nests either on offshore islands or rocky shorelines and cliffs.	Coos			Coos Bay and Coquille Valley CBC (1997-2016)	MIIH	Potential for displacement if species is present.
Upland sandpiper *Bartramia longicauda*	SOC		SEN	SEN	Nests in dry or wet meadows and grasslands, often with a fringe of trees in the middle of sagebrush or lodgepole pine communities.	Klamath	LV-S	F-W-S	North Spit (vagrant).	MIIH	Modification of habitat and disturbance.
Long-billed curlew *Numenius americanus*		S			Nests in open grasslands, prairies, and meadows, often near scattered shrubs and usually near water or wet meadows.	Klamath			On Chinchalo BBS (37.6 mi), Ingalls BBS (41.9 mi), Dorris BBS (3.5 mi), Mcdoel BBS (10.9 mi), Merrilll BBS (centerline) and CBC (1997-2016).	MIIH	Modification of habitat and disturbance.
Franklin's gull *Leucophaeus pipixcan* (*Larus pipixcan*)			SEN		Seacoasts, bays, estuaries, lakes, marshes, and irrigated croplands.	Klamath	LV-D		On Dorris BBS (3.5 mi), Mcdoel BBS (10.9 mi), Modoc Point BBS (16.3 mi).	MIIH	Potential disturbance.
Tufted puffin *Fratercula cirrhata*		SC	SEN		Burrows on slopes or turf-covered headlands of offshore islands and coastal bluffs. May nest in rock crevices. Forages in the marine environment.	Coos			On Coos Bay CBC (1997-2016).	MIIH	Disturbance.

TABLE I-3 (continued)

Special Status Marine Mammal and Terrestrial Wildlife Species That May Occur Near the Jordan Cove Energy Project

Common Name and/or Scientific Name	Status a/ Federal	State	BLM	Forest Service	Expected Habitat	Documented or Suspected Occurrence b/ County	BLM	Forest Service	Within Vicinity of Project Area c/	Effect of Impact d/	Impact Reasoning
White-tailed kite *Elanus leucurus*			SEN	SEN	Lower-elevation grasslands, agricultural areas, meadows, oak and riparian woodlands, marshes, and wetlands. Requires trees or tall shrubs for nesting.	Coos Douglas Jackson	CB-D MD-D RO-D	RRS-S	On Umpqua BBS (18.4 mi), Emigrant Lake BBS (7.7 mi) and several CBC (1997-2016).	MIIH	Disturbance.
Bald eagle *Haliaeetus leucocephalus*	BGEPA		SEN	SEN	Nests and roosts along coasts, rivers, bays, and lakes with large trees (e.g., pine, spruce, cottonwood [*Populus* spp.], oak).	Coos Douglas Jackson Klamath	CB-D LV-D MD-D RO-D	UMP-D RRS-D F-W-D	Documented in BCR-5 and BCR-9 and during CBC count; Occupied/historic nest sites occur within 3 miles of Project on BLM, Forest Service, and Private; the majority occur <3mi of MPs 186-198 near Klamath River. Nest (PRV, 2007) 0.48mi W of MP 10.15R; Nest (PRV, 2013) 0.6 mi SW of Winchester Pipe Yard; Nest (MD, 2013) ~1mi S of MP 123.2/<0.5mi from EAR 123.8 and improvements; Nest (RRS, 2007) 0.4-0.6mi E of TEWA 161.40; Nest (F-W, 2014) 0.9mi W of TEWA 168.85; Nest (F-W, 2016) 1 mi S of MP 171.6; Nest(s) (PRV, 2003) 1.25mi N/W of MP 189.3; Nest(s) (PRV, 2007) 0.7/1.0mi NW/N of TEWA 184.30; Nest (PRV, 2000) ~ 1mi NE of Rogue Aggregates Pipe Yard; Nest (LV, 2016) 0.5mi SW of MP 178.6; Nest (LV, 2016) ~ 1.0mi S of TEWA 184.30. WRRWRRW	MIIH	Disturbance, loss or modification of habitat.
Northern goshawk *Accipiter gentilis*		S			Coniferous forests, sometimes in aspen groves on desert mountain ranges. Prefers large patches of late-successional forests with large trees and canopy closure.	Coos Douglas Jackson Klamath	RO-D MD-D LV-D	UMP-D RRS-D F-W-D	Documented in BCR-5 and BCR-9 and during CBC; Nest locations: RO (2007) 2.4mi SW of MP 82; MD (2001) 2.3mi E of MP 114.3; MD (2001) 2.3mi NE of MP 115.5; MD (2008) 0.75mi W of MP 121.25; RRS (2015) 0.26mi NE of MP 164.5; F-W (1992) 3mi NE of MP 168; F-W (1995) 0.57mi NE of MP 168.4; F-W (2006, 1994) 1.5mi and 2mi SW of MP 169.7; F-W (1996) 0.5mi SW of MP 170.36; LV (1998) 2.9mi SW of MP 170; F-W (1992, 1995) 1.4mi N of MP 172.6; F-W (1996) 2.5mi NE of MP 173; LV (1996-2004) 1.2- 1.7mi SW of MP 178.4; LV (2007) 1.2mi SW of MP 178.5; LV (2001) 1.7mi SW of MP 178.7; LV (1994) 1.5mi SW of MP 179.WWWWWWWWWW	MIIH	Modification of habitat and disturbance. Injury or mortality if nest tree is felled.
Swainson's hawk *Buteo swainsoni*		S			Grasslands, sagebrush flats, juniper woodlands, larger meadows, and grasslands with forested mountains. Requires trees for nesting.				BCR-9 on Ingalls BBS (41.9 mi), Dorris BBS (3.5 mi), Mcdoel BBS (10.9 mi), Medicine Mountain BBS (28.5 mi), Iron Gate BBS (19.7).	MIIH	Minor potential for disturbance if present.
American peregrine falcon *Falco peregrinus anatum*		S	SEN	SEN	Typically nests on cliffs overlooking fairly open areas with an ample food supply, such as along coasts, lakes, and marshes, but may nest on buildings or in stick nests constructed by other raptors.	Coos Douglas Jackson Klamath	CB-D LV-D MD-D RO-D	RRS-D UMP-D F-W-D	Documented in BCR-5 and BCR-9 and during CBC (1997-2016); Nest sites: PV (2013) 0.2mi N of MP 1.2 (North Bend Bridge); PV (2013) 2.5mi NE of MP 29.7; CB/PV (2013) 1.0mi N of MP 35.2; CB (2013) 2.9mi NE of MP 46; UMP (2003) 0.1mi SW of MP 112.64; PV (2003) 2.2mi SW of MP 119.54; PV (2003) 1.8mi N of MP 152.15. Several documentations within Coos Bay area – foraging, flying, roosting.	MIIH	Disturbance.
Arctic peregrine falcon *Falco peregrinus tundrius*			SEN		Migratory habitat on coast – cliffs or bluffs near large bodies of water or open fields for hunting.	Coos Douglas			Documented on the North Spit and in the Klamath Basin.	MIIH	Disturbance.
Greater sage-grouse *Centrocercus urophasianus*		S	SEN	SEN	Big sagebrush, preferring areas where big sagebrush cover is 15-50%. Leks in open areas.	Klamath	LV-D	F-W-D	Clear Lake Reservoir BBS (20.4 mi).	MIIH	Modification of habitat and disturbance.
Northern spotted owl *Strix occidentalis caurina*	T/CH	T			Closely associated with old-growth coniferous forests or mature forests with old-growth characteristics such as standing snags, closed canopy, and downed logs.	Coos Douglas Jackson Klamath	CB-D LV-D MD-D RO-D	RRS-D UMP-D F-W-D	Multiple locations along route within 3 mi of route. Designated critical habitat within project area.	LAA	Disturbance, habitat loss or modification, and habitat fragmentation.
Flammulated owl *Otus flammeolus*		S			Open forests with ponderosa pine. Roosts in large trees adjacent to grasslands.	Douglas Jackson Klamath	MD-D	F-W-D	MD (2002) 1.9mi W of MP 121; MD (2003) 0.6mi NE of MP 124.32; MD (1996) 1.7mi NE of MP 140.45; PV (1994) 2.6mi E of MP 141.89; MD (1997) 0.25mi S of TEWA 153.24-W; F-W (2007) single documented near MP 169.4 and 0.3mi NE of MP 169.2.	MIIH	Modification of habitat, disturbance, and potential for injury or death if roosting or nesting in fell tree or snag.

TABLE I-3 (continued)

Special Status Marine Mammal and Terrestrial Wildlife Species That May Occur Near the Jordan Cove Energy Project

Common Name and/or Scientific Name	**Status a/**				**Expected Habitat**	**Documented or Suspected Occurrence b/**				**Effect of Impact d/**	**Impact Reasoning**
	Federal	**State**	**BLM**	**Forest Service**		**County**	**BLM**	**Forest Service**	**Within Vicinity of Project Area c/**		
Western burrowing owl *Athene cunicularia hypugea*	SOC				Open deserts, grasslands, fields, pastures, and sagebrush steppe.	Coos Douglas Jackson Klamath			Burrows at North Bend Airport (2011); burrows on north spit (1996). Documented at Medford CBC (1997-2016).	MIIH	Disturbance.
Great gray owl *Strix nebulosa*		S		S&M-C	Forages over open areas. Found in mixed coniferous, ponderosa pine, and lodgepole pine forests. Often in old-growth forests on north-facing slopes.	Douglas Jackson Klamath	RO-D MD-D	UMP-D RRS-D F-W-D	Documented in BCR-5 and BCR-9 and during CBC count; Nest locations: RO (2008) 0.37mi N of MP 85.9; RO (2003) 1.7mi NE of MP 87.7; RO (2007) 0.22mi W of MP 90.05; MD (2008) 0.07mi E of MP 115.75; MD (2008) 0.04mi W of MP 119.39; MD (2008) 0.13mi E of MP 133.28; MD (2007) 0.29mi SW of MP 133.5; MD (2007) 0.65mi W of MP 133.8 and MD (1999) 0.78mi NE of MP 136.65; MD (1999) 0.83mi SW of MP 137.1; MD (2005) 2.7mi SW of MP 116.3; MD (2000) 0.53mi SW of MP 133.85; MD (1996, 2000) 0.86mi E of MP 134.43; MD (2008) 0.83mi SW of MP 136.4; MD (2003) 0.45mi NE of MP 136.5; MD (2000) 0.83mi SW of MP 137.1; PV (1998) 0.24mi SW of MP 137.05; MD (2001) 1.2mi NE of MP 137.27; MD (2005) 1.0mi NE of MP 138.5; MD (2001) 1.8mi N of MP 153; MD (1997) 1.9mi SW of MP 154.8; RRS (1998) 2.3mi SW of MP 154.8; RRS (2008) 0.13mi N of MP 156.22; RRS (2008) 0.23mi E of MP 162.6; RRS (2007) 0.18mi NE of MP 164.5; see Survey and Manage stand-alone report (appendix F.5 of this EIS).RRRRRRW	MIIH	Disturbance, loss or modification of habitat, and potential for injury or death if roosting or nesting in fell tree or snag. However, remaining sites would provide a reasonable assurance of species persistence.
Black Swift *Cypseloides niger*		S	SEN	SEN	Nests next to or behind waterfalls, wet cliffs, sea caves; nests in small colonies.	Coos Douglas	RO-S	UMP-D	No documented occurrences within 3mi of project area.	NI	No suitable habitat in Project area.
Acorn woodpecker *Melanerpes formicivorus*		S			White oak communities; other coniferous and broad-leaved trees usually present.	Coos Douglas Jackson Klamath			On Umpqua BBS (18.4 mi), Days Creek BBS (3.7 mi), Darby BBS (centerline), Emigrant Lake BBS 7.7 mi), Sams Valley BBS (centerline), Prospect BBS (centerline), MacDoel BBS (10.9 mi) and CBC (1997-2016).	MIIH	Disturbance.
White-headed woodpecker *Picoides albolarvatus*	SOC	SC	SEN	SEN	Ponderosa pine or pine-mixed conifer forests. Requires large trees for foraging and snags for nesting.	Douglas Jackson Klamath	LV-D MD-D RO-D	UMP-D RRS-D F-W-D	F-W (1995) 1.5mi NW of TEWA 168.85; LV (1999) 2.1mi SW of MP 174.65.Modoc Point BBS (16.3 mi), Bly BBS (31 mi), Lapham Reservoir BBS (25 mi), Picture Flat BBS (39 mi), Chinchalo BBS (37.6 mi).	MIIH	Modification of habitat, disturbance, and potential for injury or death if roosting/nesting in fell tree or snag.
Lewis' woodpecker *Melanerpes lewis*		SC	SEN	SEN	Open forests at lower elevations. Nests in white oak woodlands, ponderosa pine woodlands, mixed oak-pine woodlands, and cottonwood riparian woodlands in eastern Oregon.	Coos Douglas Jackson Klamath	LV-D MD-D RO-D	UMP-D RRS-D F-W-D	PV (T36S,R2E,S7; 1995): 1.1mi SW of MP 142.54, Modoc Point BBS (16.3 mi), Lapham Reservoir BBS (25 mi), Merrill BBS (centerline), MacDoel BBS (10.9 mi), Clear Lake Reservoir BBS (20.4 mi).	MIIH	Modification of habitat, disturbance, and potential for injury or death if roosting/nesting in fell tree or snag.
Olive-sided flycatcher *Contopus cooperi*		S (West Cascades and Coast Range) SC (East Cascades)			Coniferous forests with uneven canopy. Prefers open forests but occupies a variety of forest types.	Coos Douglas Jackson Klamath	LV-D		PV (1997) 1.8 miles NE of MP 28.86; CB (1998) 2.0, 2.4, 2.5 miles NE of MP 28.86; PV (1992) 3.0 miles W of MP 33.77; LV (1994) 1.9mi SW of MP 174.65; LV (1994) 2.8mi SW of MP 174.65.	MIIH	Potential disturbance and habitat modification.
Willow flycatcher *Empidonax traillii adastus*		S			Willows at the edges of streams flowing through meadows and marshes. Also breeds in thickets along edges of forest clearings and brushy vegetation near water.	Klamath	LV-D		PV (1997) 1.8 miles NE of MP 28.86; CB (1998) 2.2, 2.4 miles NE of MP 28.86; LV (1994) 2.5mi SW of MP 174.65; LV (1994) 2.0, 2.1mi SW of MP 174.65.	MIIH	Potential disturbance and habitat modification.
Streaked horned lark *Eremophila alpestris strigata*	T/CH				Expanses of thinly vegetated land, including fields, prairies, dunes, upper beaches, airports, and similar areas with low/sparse grassy vegetation.	Douglas Jackson	CB-D			NE	Project is outside known range, no suitable habitat is present.
Purple martin *Progne subis*		SC	SEN	SEN	Nests in tree cavities and nest boxes with open areas for foraging. May use open forests.	Coos Douglas Jackson Klamath	CB-D MD-S RO-D	UMP-S RRS-S F-W-S	Haynes Inlet and Coos Bay (arrive in April), Catching Slough (nest boxes; 1985), Days Creek BBS (3.7 mi), Glasgow BBS (centerline), Selma BBS (32.8 mi), Modoc Point BBS (16.3 mi), Clear Lake Reservoir BBS (20.4 mi).	MIIH	Modification of habitat, disturbance, and potential for injury or death if roosting/nesting in fell tree or snag.

TABLE I-3 (continued)

Special Status Marine Mammal and Terrestrial Wildlife Species That May Occur Near the Jordan Cove Energy Project

Common Name and/or Scientific Name	Status a/ Federal	State	BLM	Forest Service	Expected Habitat	Documented or Suspected Occurrence b/ County	BLM	Forest Service	Within Vicinity of Project Area c/	Effect of Impact d/	Impact Reasoning
Northern waterthrush *Parkesia noveboracensis*			SEN	SEN	Nests in cool, wooded swamps, ponds, slow-moving rivers; thickets of bogs, and rivers bordered with willow.	Jackson		RRS-S	No documented occurrences within 3mi of project area.	NI	Extremely rare in Oregon, limited habitat in survey area.
Yellow-breasted chat *Icteria virens auricollis*		SC			Brushy areas in riparian woodlands. Also uses tangles of brush in deciduous or mixed deciduous-coniferous woodlands.	Coos Douglas Jackson Klamath			On Modoc Point BBS (16.3 mi E) and Iron Gate BBS (19.7 mi S).	MIIH	Potential for disturbance if species is present.
Grasshopper sparrow *Ammodramus savannarum*		S	SEN	SEN	Short grasslands with few scattered shrubs, prefers bunchgrass grasslands on the north slopes of hills with scattered shrubs or uses cultivated grasslands and pastures.	Douglas Jackson	MD-D RO-D		Merrill BBS (centerline), MacDoel BBS (10.9 mi).	MIIH	Potential disturbance and habitat modification.
Oregon vesper sparrow *Pooecetes gramineus affinis*[3]	SOC	SC	SEN		Grassy foothills west of Cascades in the Umpqua and Rogue river valleys.	Coos Douglas Jackson	CB-D RO-D MD-D		Documented in BCR-5 and BCR-9 and during CBC (1997-2016).	MIIH	Disturbance and potential for loss of ground nests.
Tricolored blackbird *Agelaius tricolor*	SOC		SEN	SEN	Breeds in freshwater marshes with emergent vegetation or thickets of shrubs. May breed in Himalayan blackberry (*Rubus armeniacus*) near wetlands.	Douglas Jackson Klamath	MD-D LV-D	RRS-S F-W-D	ST (1980): 1.0mi SE of MP 196.17, PV (2000): 1.8mi W of MP 229.39, Modoc Point BBS (16.3 mi), Merrill BBS (centerline), Ingalls BBS (41.9 mi), Dorris BBS (3.5 mi), MacDoel BBS (10.9 mi), Hackamore BBS (34.7 mi), Iron Gate Reservoir BBS (19.7 mi) and during CBC (1997-2016).	MIIH	Disturbance.
Common nighthawk *Chordeiles minor*		S			Uses gravel bars and other sparsely-vegetated grasslands or forest clearings for nesting.	Coos Douglas Jackson Klamath			Documented in BCR 5 and BCR9	MIIH	Disturbance.
Reptiles											
Green sea turtle *Chelonia mydas*	T	E			Oceanic beaches for nesting, convergence zones in the open ocean, and benthic feeding grounds in coastal areas. Occasional sightings off the coasts of Washington and Oregon; most commonly occur from San Diego to the south.					NLAA	With avoidance and minimization, potential for injury or mortality due to ship-strikes and potential adverse effects from a carrier spill is low.
Leatherback sea turtle *Dermochelys coriacea*	E	E			Open ocean and coastal waters; widespread.					NLAA	With avoidance and minimization, potential for injury or mortality due to ship-strikes and potential adverse effects from a carrier spill is low.
Loggerhead sea turtle *Caretta caretta*	E	T			Oceanic beaches for nesting, open ocean, and nearshore coastal areas. Occasional sightings off the coasts of Washington and Oregon; most occur off the California coast.					NLAA	With avoidance and minimization, potential for injury or mortality due to ship-strikes and potential adverse effects from a carrier spill is low.
Olive ridley sea turtle *Lepidochelys olivacea*	T	T			Primarily open ocean, but known to inhabit coastal areas, including bays and estuaries. Primarily tropical species but occasionally occurring off the Oregon and Washington coasts.					NLAA	With avoidance and minimization, potential for injury or mortality due to ship-strikes and potential adverse effects from a carrier spill is low.

TABLE I-3 (continued)

Special Status Marine Mammal and Terrestrial Wildlife Species That May Occur Near the Jordan Cove Energy Project

Common Name and/or Scientific Name	Status a/ Federal	State	BLM	Forest Service	Expected Habitat	Documented or Suspected Occurrence b/ County	BLM	Forest Service	Within Vicinity of Project Area c/	Effect of Impact d/	Impact Reasoning
Western pond turtle *Actinemys marmorata* (formerly Northwestern/North Pacific/Pacific Pond Turtle, *Emys/Actinemys marmorata*)	SOC	SC	SEN	SEN	Rivers, creeks, small lakes, ponds, marshes, irrigation ditches, and reservoirs. Nests on sandy banks near water.	Coos Douglas Jackson Klamath	CB-D LV-D MD-D RO-D	F-W-D RRS-D UMP-D	(1993) 0.8mi W of MP 26.64; PRV (1993) 0.27mi E of MP 26.35; Middle Fork Coquille River (1994) 0.3mi NW and 0.4mi SE of MP 49.97; PV (1993) 1.4mi NE of MP 55.92; Olalla Creek (1995) 0.2mi NW of MP 59.5; Ben Irving Reservoir/RO (2000) 0.7mi SE of MP 54.7; South Umpqua River (1995); East Willis Creek (1995): 1.2mi SW of MP 67.47; South Umpqua River (1998) 0.2mi S of MP 68.99 and 0.7mi SE of MP 70.43; South Umpqua River (2000) 0.15mi E MP 94.45; Pond off S. Umpqua River (2000) 0.2mi S of Hult Chip Yard 1; Pond and upland habitat (2000) near Winchester Pipeyard; Drew Creek (2013) 3.5mi E of MP 99.6; UMP (2013) Drew Creek 2.2mi E of Rock Source 102.30; UMP (1993) 1.8mi NE of MP 105.24; UMP (1989) 1.5mi SW of MP 109.68; UMP (2000) 0.2mi SW of MP 110.1; MD (2006) 2mi NE of MP 114.1 (confluence of Wall Creek and Dead Horse Creek); MD (2000) 0.33mi W of MP 118.4; Rogue River/PV MP 122.67; Indian Creek (2006) 2 mi SW of MP 125.25; MD (2010) 2.8mi SW of MP 128.5; BLM (1993) 2.7 mi SW of MP 148.2; Klamath River (2009) at MP 199.1.	MIIH	Modification of habitat, disturbance, potential for injury or death.
Northern sagebrush lizard *Sceloporus graciosus graciosus*	SOC				Sagebrush habitats; also in chaparral, juniper woodlands, and coniferous forests.	Klamath			No documented occurrences within 3mi of project area.	NI	Not documented in Project vicinity.
California mountain kingsnake *Lampropeltis zonata*	SOC	S			Pine forests, oak woodland, and chaparral valleys. In, under, or near rotting logs in open wooded areas near streams.	Coos Douglas Jackson	MD-D		MD (1997) 0.7mi E of MP 140.75; MD (1991) 0.45mi E of MP 141.65.	MIIH	Potential disturbance and habitat modification.
Amphibians											
Oregon slender salamander *Batrachoseps wrighti*	SOC	S			Under bark or moss in mature and second-growth Douglas-fir forests. Also under rocks or logs in stands of moist hardwood forests within coniferous forests.	Douglas Klamath			No documented occurrences within 3 mi of project area.	NI	Outside of known range.
Shasta salamander *Hydromantes shastae*				S&M-A	Found mainly in limestone outcrops. Often occurs in cool, wet ravines and valleys in both forested and non-forested areas; usually in moist limestone fissures or caves. Eggs are laid in late summer in a cluster of 9-12 eggs. No aquatic larval stage.				No documented occurrences within 3 mi of project area.	NI	Not documented in Project vicinity.
Del Norte salamander *Plethodon elongatus*	SOC	S		S&M-D	Moist, rocky areas within forests. Occasionally in decaying logs and under forest floor litter.	Coos Douglas Jackson	MD-D		No documented occurrences within 3 mi of project area.	NI	Outside of known range.
Larch Mountain salamander *Plethodon larselli*	SOC	SC	SEN	SEN S&M-A	Most often inhabits steep forested or non-forested slopes associated with rocky substrates where spaces exist between the rock and soil. Breeds mainly in the fall, eggs are laid in late winter-early spring and hatch in about four months. Average clutch size of seven.				No documented occurrences within 3 mi of project area.	NI	Not documented in Project vicinity.
Siskiyou Mountains salamander *Plethodon stormi*	SOC	SC	SEN	SEN S&M- C (2003-A)	Loose rock rubble or talus on north-facing slopes or in dense wooded areas.	Jackson	MD-D RO-S	RRS-D	No documented occurrences within 3 mi of project area.	NI	Outside of known range.
Van Dyke's salamander *Plethodon vandykei*				S&M-A	Streams and seeps; also upland forest, talus, lakeshores, and cave entrances. Abundant in old forest stands with complex structure and moderate to high levels of woody debris and colluvial rock.				No documented occurrences within 3 mi of project area.	NI	Not documented in Project vicinity.
Southern torrent salamander *Rhyacotriton variegatus*		S			Shallow, cold waters of perennial, high-gradient streams within humid coniferous forests. Adults occupy splash zones or areas with overflowing water. Larvae found in cobble or gravel beds flushed with water.	Coos Douglas	CB-D	UMP-D	PV (1995) 1.8 mi W of MP 18.2BR; CB (1992) 2.5 mi SW of MP 27.5; CB (1998) 0.8 mi NE of MP 30.17; CB (1998) 0.48mi NE of MP 39.65; UMP (1997) 1.5 mi SW of MP 108.3.	MIIH	Modification of habitat and potential for injury or death.

TABLE I-3 (continued)

Special Status Marine Mammal and Terrestrial Wildlife Species That May Occur Near the Jordan Cove Energy Project

Common Name and/or Scientific Name	Status a/				Expected Habitat	Documented or Suspected Occurrence b/				Effect of Impact d/	Impact Reasoning
	Federal	State	BLM	Forest Service		County	BLM	Forest Service	Within Vicinity of Project Area c/		
Clouded salamander *Aneides ferreus*		S			Forest dweller found in moist areas, under logs and other debris.	Coos Douglas Jackson Klamath	CB-D MD-D	UMP-D	CB (2003) 2.8 miles NE of MP 32.35; CB (1994) 1.9 miles SW of MP 33.77; CB (2000) 3.4 mi SW of MP 35.8; CB (1998) 2.3mi SW of 35.8; CB (1996) 1.3mi SW of MP 40.33; CB (1992) 1.7mi NE of MP 41.55; UMP (1997) 1.2mi E of MP 100; UMP (1994) 2.7mi W of MP 103.12; MD (1995) 2.5mi SW of MP 137.8; UMP (1997) several documentations <1.0mi SW of MPs 108-109.7	MIIH	Modification of habitat and potential for injury or death.
Black salamander *Aneides flavipunctatus*			SEN	SEN	Near streams, in talus slopes or under rocks and logs. Inhabits open woodlands, and mixed coniferous and mixed-coniferous-deciduous forests.	Jackson	MD-D	RRS-D	No documented occurrences within 3 mi of project area.	NI	Outside of known range.
California slender salamander *Batrachoseps attenuatus*		SV	SEN	SEN	Lower-elevation forests along the southern coast, including hardwood, redwood, and other coniferous forests. Also in open areas with scattered trees. Under rocks, logs, or other objects on the ground.	Coos Jackson	CB-D	RRS-D	No documented occurrences within 3 mi of project area.	NI	Outside of known range.
Western toad *Bufo boreas*		S			Wide variety of habitats (desert, chaparral grassland, woodland, and forest) from sea level to above timberline.	Coos Douglas Jackson Klamath	MD-D LV-D	F-W-D	Trail Creek/PV (1982) 0.2mi NE of MP 120.6; MD (1996) 2.9 mi SW of MP 121.25; F-W (1995) Spencer Creek 0.1mi downstream; F-W (1995) 1.4mi NE of MP 171.44; PV (1994) 1.4mi NE of MP 173.6; LV/PV (1994) 1.0mi NE of MP 178.52.	MIIH	Modification of habitat and potential for injury or death.
Tailed frog *Ascaphus truei*		S			Cold, fast-flowing permanent streams, usually in forests. Sometimes in streams flowing through non-forested regions.	Coos Douglas Jackson Klamath	CB-D	UMP-D	CB (1994) 1.7mi SW of MP 33.77; CB (1994) 1.4mi SW of MP 33.77; PV (1993) 0.29 mile NE of MP 34.45; CB (1997) 2.8mi SW of 35.8; PV (2001) 2.7mi SW of 35.8; CB (1998, 2000): 2.9mi SW of 35.8: PV (2001): 2 mi S of MP 40.33; CB (1994) 0.31mi NW of MP 44.60; CB (1995): 0.5mi S of MP 45.39; UMP (2000) Drew Creek 0.2mi E of MP 108.2.	MIIH	Modification of habitat and potential for injury or death.
Foothill yellow-legged frog *Rana boylii*	SOC	SC	SEN	SEN	Permanent streams in a variety of habitat types such as grassland, chaparral, coniferous or deciduous forests, and woodlands. Missing from much of their historic habitat.	Coos Douglas Jackson Klamath	CB-D MD-D RO-D	RRS-D UMP-D	CB (1995) 1.8mi SW of MP 40.33; South Myrtle Creek (2001) SE of MP 71.4; PV (2001) 1.1mi S of MP 74.2; Coffee Creek/PV (1998) 1.9mi NE of MP 94.78; UMP/PV ~3mi NE of MP 98.1; Drew Creek (2005) 3.3mi E of MP 101.8; UMP (2006/2008) Calahan and Elk Creeks >1.7mi E of MPs 99.4; Trail Creek/PV (2003) 1.1mi E of MP 118.3; Indian Creek/MD 1.4mi SW of MP 127.31; PV/drainage ditch (1999) 2mi S of Winchester Pipe Yard; North Umpqua River (2011) 1.5mi E of Winchester Pipe Yard; RRS (1991) 0.5mi E of MP 162.6.	MIIH	Modification of habitat and potential for injury or death.
Cascades frog *Rana cascadae*	SOC	S			Lakes, ponds, and small streams that run through meadows. Ranges from 2,600 feet to treeline.	Douglas Jackson Klamath	RO-D MD-D LV-D	UMP-D RRS-D F-W-D	RO (2013) 1.3mi N of MP 51.3; MD (1996): 2.7mi SW of MP 121.25; UMP (1997) 1.3mi NE of MP 97.6; RRS (1990) 0.2mi SW of MP 158.7; RRS (1992) 1.5mi NE of MP 162.5; RRS (2007) 1.2mi E of MP 162.8 in medium creek; F-W (1995) 1.5mi NW of TEWA 168.85; LV (2002) 3mi S of MP 170.3; PV (1994): 1.3mi SW of MP 177.39.	MIIH	Modification of habitat and potential for injury or death.
Northern leopard frog *Lithobates pipiens*			SEN	SEN	Marshes, wet meadows, vegetated irrigation canals, ponds, and reservoirs. Prefers quiet or slow flowing waters.	Jackson Klamath	LV-S	F-W-S	No documented occurrences within 3 mi of project area.	NI	Outside of known range.
Northern red-legged frog *Rana aurora aurora*		S			Streams, ponds, and marshes in wooded areas.	Coos Douglas Jackson Klamath			Willanch Creek (2009) crossed by Pipeline at MP 8.27R; Wren Smith Creek (2010) 1.4mi E of MP 17.5BR; Several locations <3mi between MPs 16.6BR-MP 60; CB (1992) 0.2mi SE of MP 21.6BR; PRV (1995) 0.2mi W of MP 23.2BR; CB (1993) 0.5mi E of Weaver Road Quarry Site 1 MP 47.00; 1.8 mi NE of MP 19.88; CB (1992) 2.0mi NE of MP 24.34; Middle Creek (2010) 0.2mi NE and 2.6mi SW of MP 27.6; CB (1992) 2.7 miles SW of MP 28.05; Steel Creek (2010) 1mi N of MP 31.3; Estes Creek (2010) 2.4mi N of MP 50.2; Little Muley Ceek (2010) 1.6mi N of MP 53.9; UMP (2001) Calahan Creek 1.5mi E of MP 102; UMP (2000) Drew Creek 0.2mi E of MP 108; PV (1991) 2.1mi NE of MP 105.63; UMP (1997) 0.25mi downstream of MP 109.8; UMP (1991) 2.6mi NE of MP 111.83.	MIIH	Modification of habitat and potential for injury or death.

TABLE I-3 (continued)

Special Status Marine Mammal and Terrestrial Wildlife Species That May Occur Near the Jordan Cove Energy Project

Common Name and/or Scientific Name	Status a/ Federal	State	BLM	Forest Service	Expected Habitat	Documented or Suspected Occurrence b/ County	BLM	Forest Service	Within Vicinity of Project Area c/	Effect of Impact d/	Impact Reasoning
Oregon spotted frog *Rana pretiosa*	T/CH	SC			Inhabits emergent wetland habitats in forested landscapes. Almost always found in or near a perennial body of water that includes zones of shallow water and abundant emergent or floating aquatic plants.Higher elevations from the crest and east slope of Cascade Mountains.	Jackson Klamath	MD-D LV-S	F-W-D	Extant population at Buck Lake and downstream in Spencer Creek; South of MP 171.06 to MP 174.69 and separated by Clover Creek Road.	NLAA	Suspended sediment from Project crossing at Spencer Creek is not expected to remain in the water column 6,400 feet downstream at Buck Lake where species occurs, and because Spencer Creek downstream of Buck Lake is separated from the right-of-way by Clover Creek Road. Conservation measures would limit potential effects due to acoustic shock, introduction of non-native species and/or disease, fuel and chemical spills, and herbicides.
Columbia spotted frog *Rana luteiventris*			SEN	SEN	Rarely far from permanent quiet water; usually at grassy/sedgy margins of streams, lakes, ponds, springs, and marshes; may disperse into forest, grassland, during wet weather.		LV-D	F-W-S	No documented occurrences within 3mi of project area.	NI	Outside of known range.
Invertebrates e/											
Oregon shoulderband *Helminthoglypta hertleini*			SEN	SEN S&M- B (2003 – off)	Rocky areas, including talus deposits and outcrops generally within 98 feet of herbaceous vegetation and deciduous leaf litter; woody debris used as refugia.	Douglas Jackson	CB-S MD-D RO-D	RRS-S UMP-D	RO (2007) 60' NW of MP 64.59; RO (2007) 60' NW of ROW near MP 64.89, 2 observations within ROW near MP 75.92R; PRV (2006/2007) 2 observations within ROW/TEWA near MP 75.85; RO (2007) 175ft SW of MP 76; several documentation >500ft (MPs 58.53, 59.70, SW of 60.35).	MIIH	Disturbance and potential modification of habitat.
Klamath shoulderband *Helminthoglypta talmadgei*				S&M-A (2003 – D)	Stable talus and rockslides in limestone substrates, specially near springs or streams. Trees and bushes appear to be important for shading and food, though deep shade is not necessary.				No documented occurrences within 500ft of project area.	NI	Not documented in Project vicinity.
Oregon megomphix *Megomphix hemphilli*				S&M-A (2003 – off)	Species occurs at low to moderate elevations. Found within and under the mat of decaying leaves under big leaf maples (*Acer macrophyllum*), hazel bushes (*Corylus* spp.), and sword ferns (*Polystichum munitum*). Also found in leaf mold.	Coos, Douglas			No documented occurrences within 500ft of project area.	NI	Not documented in Project vicinity.
Chace (Siskiyou) sideband *Monadenia chaceana*				S&M-B	Late-successional forest and open talus or rocky areas; associated with large woody debris in mesic, forested habitats; otherwise, moist, shaded rock surfaces.	Douglas Jackson	MD-D RO-D	UMP-D F-W-D RRS-D	RO (2006): 2.8mi SW of MP 81.31; MD (2007) 135ft E of MP 148.9; MD (2007) UCSA 149.31- N near MP 149.09; MD (2007) 14ft N of MP 150.94; MD (2008) 460ft N of MP 151.25; MD (2008) 260-445ft N/S of MP 153.2; RRS (2007) in ROW at MP 156.49; RRS (1999) 0.6mi N of MP 161.45; RRS (2007) 66ft E of MP 163.45; RRS (2007) within ROW at MP 165.55; RRS (2007) 82 to 144ft N/S of ROW between MP 165.63-165.75; RRS (2007) 80ft N of MP 167.54; RRS (2007) in ROW at MP 166.99; F-W (2007) in ROW at MP 171.06; see Survey and Manage stand-alone report for additional information..	MIIH	Modification of habitat and potential for injury or death. However, remaining sites would provide a reasonable assurance of species persistence.
Church sideband *Monadenia churchi*				S&M-F (2003 – off)					No documented occurrences within 500 ft of project area.	NI	Not documented in Project vicinity.
Klamath sideband *Monadenia fidelis klamathica*				S&M-B (2003-off)					No documented occurrences within 500 ft of project area.	NI	Not documented in Project vicinity.
Dalles sideband *Monadenia fidelis minor*				SEN S&M-A					No documented occurrences within 500 ft of project area.	NI	Not documented in Project vicinity.
Yellow-based sideband *Monadenia fidelis ochromphalus*				S&M-B (2003 – off)					No documented occurrences within 500 ft of project area.	NI	Not documented in Project vicinity.
Shasta sideband *Monadenia troglodytes troglodytes*				S&M-A					No documented occurrences within 500 ft of project area.	NI	Not documented in Project vicinity.

TABLE I-3 (continued)

Special Status Marine Mammal and Terrestrial Wildlife Species That May Occur Near the Jordan Cove Energy Project

Common Name and/or Scientific Name	Status a/ Federal	State	BLM	Forest Service	Expected Habitat	Documented or Suspected Occurrence b/ County	BLM	Forest Service	Within Vicinity of Project Area c/	Effect of Impact d/	Impact Reasoning
Wintu sideband *Monadenia troglodytes wintu*				S&M-A					No documented occurrences within 500 ft of project area.	NI	Not documented in Project vicinity.
Green sideband *Monadenia fidelis flava*			SEN	SEN	Generally inhabits deciduous stands (including alder [*Alnus* spp.]) and brush in wet, relatively undisturbed forest; low elevation; low coastal scrub.	Coos	CB-D RO-D	RRS-D	No documented occurrences within 500 ft of project area.	NI	Not documented in Project vicinity.
Traveling sideband *Monadenia fidelis celeuthia*			SEN	SEN	Dry basal talus and rock outcrops; oak/maple overstory; along spring run in rock and moist vegetation and moss; mixed conifer-hardwood forest.	Jackson Klamath	MD-D RO-D	F-W-D RRS-D UMP-D	RO (2015) 65ft E of TEWA 91.70- W; UMP (2015) 104ft S of MP 104.92; UMP (2015) 66' N of MP 113.17; MD (2015) 60ft W of TEWA 116.06-W; MD (2007) adjacent to UCSA 116.31-W; MD (2012) 255ft SW of MP 116.63; MD (2007) in ROW near MP 116.69; MD (2012) 158ft NE of MP 116.94; MD (2007) in ROW near MP 119.44; MD (2007) 71ft S of MP 153.2; RRS (2007) 55ft N of MP 154.91; RRS (2015) 123ft W of MP 155.75; RRS (2007) in ROW near MP 156.48; RRS (2007) 116ft S of MP 157.14; RRS (2007) in UCSA 158.79-N; RRS (2015) 80ft E of MP 159.3; RRS (2010) 102ft S of MP 161.35; RRS (2015) 89ft W of MP 162.45; RRS (2007) in UCSA 164.34-N near MP 164.53; RRS (2007) 88ft S of MP 167.1; F-W (2010) in ROW at MP 173.38; F-W (2010) in ROW near MP 175.3; LV (2010) in ROW at MP 176.42 and MP 176.85.	MIIH	Modification of habitat and potential for injury or death.
Modoc Rim sideband *Monadenia fidelis ssp. nov.*			SEN	SEN	Talus and wetted rocky areas on lakeshore; mixed pine-Douglas fir forest or open grasslands; associated with seeps and springs in talus deposits.	Klamath	LV-D	F-W-D RRS-D	No documented occurrences within 500 ft of project area.	NI	Not documented in Project vicinity.
Chelan mountainsnail *Oreohelix n.p. 1*				S&M-A					No documented occurrences within 500 ft of project area.	NI	Not documented in Project vicinity.
Crater Lake tightcoil *Pristiloma crateris*			SEN	SEN S&M-A	Mature conifer forests; perennially wet areas among rushes, mosses, and other surface vegetation or under rocks and woody debris within 30 feet of open water in wetlands, springs, seeps, and riparian areas.	Douglas Jackson	MD-S RO-S	F-W-D UMP-D RRS-S	No documented occurrences within 500 ft of project area.	NI	Not documented in Project vicinity.
Shasta chaparral *Trilobopsis roperi*				S&M-A					No documented occurrences within 500 ft of project area.	NI	Not documented in Project vicinity.
Tehama chaparral *Trilobopsis tehmana*				S&M-A					No documented occurrences within 500 ft of project area.	NI	Not documented in Project vicinity.
Hoko vertigo *Vertigo sp. nov.*				S&M-A					No documented occurrences within 500 ft of project area.	NI	Not documented in Project vicinity.
Harney Basin duskysnail *Colligyrus depressus*			SEN	SEN	Shallow, cold springs at approximately 4,500 feet elevation in sage scrub habitat.			F-W-D	No documented occurrences within 500 ft of project area.	NI	Not documented in Project vicinity.

TABLE I-3 (continued)

Special Status Marine Mammal and Terrestrial Wildlife Species That May Occur Near the Jordan Cove Energy Project

Common Name and/or Scientific Name	Status a/ Federal	State	BLM	Forest Service	Expected Habitat	Documented or Suspected Occurrence b/ County	BLM	Forest Service	Within Vicinity of Project Area c/	Effect of Impact d/	Impact Reasoning
Siskiyou hesperian *Vespericola sierranas*			SEN	SEN	Terrestrial, usually found in perennially moist habitat such as springs, seeps and deep leaf litter along stream banks and under debris and rock. Prefers moist valley, ravine, gorge, or talus sites in areas not subject to flooding.	Douglas Jackson Klamath	MD-D RO-D	F-W-D RRS-D UMP-D	RO (2007) in UCSA 79.16-N near MP 79.75; UMP (2010) in ROW near MP 110.18; MD (2007) in UCSA 119.20-N near MP 119.47; UMP (2010) in ROW at MP 110.18; MD (2007) in ROW near MP 127.86; MD (2015) in ROW near MP 128.78; MD (2007) 62ft SW of TEWA 128.85-W; MD (2007) 350ft S of MP 129.26; MD (2007) in ROW near MP 136.85/EAR 136.84 road improvement [2 other sites within 100 feet of ROW – MP 136.9-137.1]; MD (2012) 2 live < 500ft from ROW near MP 148.74; MD (2007) in UCSA 149.31-N; MD (2007) 70ft E of MP 151.53; MD (2011) 100ft N of MP 153.46; RRS (2007) in ROW at MP 153.9; RRS (2007, 2012) 30ft N and S of MP 154.03; RRS (2007) adj to UCSA 154.13-W near MP 154.5; RRS (2012) 44ft S of MP 154.5; RRS (2014) in UCSA 154.82-W near MP 154.84; RRS (2014) 107ft S of MP 154.88; RRS (2015) adj to TEWA 155.62- NW near MP 155.7; RRS (2007) in ROW near MP 156.49; RRS (2007) in UCSA 156.82-N near MP 156.9; RRS (2014) 75ft S of MP 156.91; RRS (2014) 82ft S of MP 156.97; RRS (2008) 130ft S of MP 157.13; RRS (2015) 66'NW of MP 155.77RRS (2015) 75ft SE of MP 155.83; RRS (2015) 83ft SW of MP 155.87; RRS (2015) 68ft N of MP 156.23; RRS (2007) in ROW near MP 156.48; RRS (2015) 45ft E of TEWA 158.73-N; RRS (2007) 58ft E of MP 159.35; RRS (2015) 96ft N of MP 160; RRS (2015) 88ft N of MP 160.57; RRS (2010) 112ft S of MP 161.35; RRS (2007) in ROW near MP 162.29; RRS (2014) in UCSA 164.23-W near MP 164.29; RRS (2007) in UCSA 164.34-N near MP 164.54; RRS (2007) in ROW at MP 164.71; F-W (2014) 71ft and 250ft S of MP 168.77; F-W (2014) adj to TEWA 168.85-N;	MIIH	Modification of habitat and potential for injury or death.
Pressley Hesperian *Vespericola pressleyi*				S&M-A					No documented occurrences within 500 ft of project area.	NI	Not documented in Project vicinity.
Shasta heesperian *Vespericola shasta*				S&M-A					No documented occurrences within 500 ft of project area.	NI	Not documented in Project vicinity.
Evening fieldslug *Deroceras hesperium*				S&M-B	Associated with wet meadows in forested habitats in a variety of low vegetation, litter, debris, and rocks.	Jackson	LV-D	UMP-D F-W-D	F-W (2010) near MP 171.1.see Survey and Manage stand-alone report for additional information.	MIIH	Potential impacts to individuals or habitat; however, remaining sites would provide a reasonable assurance of species persistence.
Keeled jumping-slug *Hemphillia burringtoni*				S&M-A (2003 – E)					No documented occurrences within 500 ft of project area.	NI	Not documented in Project vicinity.
Warty jumping-slug *Hemphillia glandulosa*				S&M-C (2003 – off/OR					No documented occurrences within 500 ft of project area.	NI	Not documented in Project vicinity.
Malone jumping slug *Hemphillia malonei*				S&M-C (2003 – off/OR					No documented occurrences within 500 ft of project area.	NI	Not documented in Project vicinity.
Panther jumping slug *Hemphillia pantherina*				S&M-B					No documented occurrences within 500 ft of project area.	NI	Not documented in Project vicinity.
Franklin's bumble bee *Bombus franklini*	PE		SEN	SEN	Grasslands associated with lakes, rivers, streams and seeps; 1400-4000 feet. Requires adequate supply of floral resources for continuous blooming throughout the flight season. Generalist forager. Eusocial bumblebee with a flight season from mid-May to the end of September.	Douglas Jackson	MD-S RO-S	RRS-D	No documented occurrences within 3 mi of project area.	LAA	Modification of foraging and nesting habitat, and potential for injury or death.
Western bumblebee *Bombus occidentalis*			SEN	SEN	Prairie habitat in Oregon. Generalist pollinator; visits a wide range of plants. Queen emerges in late winter or early spring and starts new colony laying 8-16 eggs in first batch.	Coos Douglas Jackson Klamath	CB-S LV-S MD-D RO-D	F-W-D RRS-S UMP-D	F-W (2009) 4.3 mi NE of MP 168.	MIIH	Loss or modification of habitat.

TABLE I-3 (continued)

Special Status Marine Mammal and Terrestrial Wildlife Species That May Occur Near the Jordan Cove Energy Project

Common Name and/or Scientific Name	Status a/ Federal	State	BLM	Forest Service	Expected Habitat	Documented or Suspected Occurrence b/ County	BLM	Forest Service	Within Vicinity of Project Area c/	Effect of Impact d/	Impact Reasoning
Siskiyou short-horned grasshopper *Chloealtis aspasma*	SOC		SEN	SEN	Grassland/herbaceous habitats; associated with elderberry (*Sambucus* spp.).	Jackson	MD-D RO-S	F-W-S RRS-D UMP-S	MD (2008) 0.6 mi S of MP 153.35; MD (H-1973): 0.06 mi S of MP 153.5.	MIIH	Modification of habitat and potential for injury or death.
Siuslaw sand tiger beetle *Cicindela hirticollis siuslawensis*			SEN	SEN	Moist sand near the ocean, swales behind dunes, and upper beaches beyond high tides.	Coos Douglas	CB-D		None reported within 3 mi of Pipeline project; Oregon Dunes (2009) 8.7mi N of MP 3.6.	NI	No suitable habitat in survey area or within 5 mi.
Leona's little blue butterfly *Philotiella leona*				SEN	Mazama ash and pumice fields east of Crater Lake with sub-surface moisture and spurry buckwheat (*Eriogonum spergulinum reddingianum*) caterpillar host plant.	Klamath		F-W-D	No documented occurrences within 3mi of project area.	NI	Does not occur in Project vicinity.
Gray-blue butterfly *Plebejus podarce klamathensis*			SEN	SEN	Subalpine meadows and marshy slopes with deep grasses and dense stands of false hellebore (*Veratrum viride*), eggs laid on host plant (shooting stars; *Dodecatheon* spp.).	Douglas Jackson Klamath	MD-D	F-W-D RRS-D UMP-D	None reported within 3 mi of project; F-W (2010) 8.5 mi N of mp 168.03	MIIH	Modification of habitat and potential for injury or death.
Coastal greenish blue butterfly *Plebejus saepiolus littoralis*			SEN	SEN	Associated with blooming clover in coastal dune areas along stream edges, bogs, and wet meadows, also drier meadow habitat.	Coos	CB-S	RRS-S	No documented occurrences within 3 mi of project area.	NI	Not documented in Project vicinity.
Johnson's hairstreak *Callophrys johnsoni* *(Mitoura johnsoni)*			SEN	SEN	Old-growth coniferous forests with red fir (*Abies magnifica*), western hemlock or grey pine (*Pinus sabiniana*) on which its parasitic host grows.	Coos Douglas Jackson Klamath	CB-D MD-D RO-D	F-W-D RRS-D UMP-D	No documented occurrences within 3 mi of project area.	MIIH	Modification of habitat and potential for injury or death.
Yuma skipper *Ochlodes yuma*			SEN	SEN	Herbaceous wetland. Desert seeps and along streams, canals etc.	Klamath	LV-S		No documented occurrences within 3 mi of project area.	NI	Not documented in Project vicinity.
Mardon skipper butterfly *Polites mardon*			SEN	SEN	Small (0.5-10 acres) high-elevation (4,500-5,100 feet) grassy meadows within mixed conifer forests.	Jackson Klamath	CB-D MD-D	F-W-S RRS-D UMP-S	Short Creek Prairie – 4 sites, RRS (2006) 0.48 mi and 0.8 mi S of MP 160.0; RRS (2007) 4.6 mi SW of MP 164.22	MIIH	Modification of habitat and potential for injury or death.
Coronis fritillary *Speyeria coronis coronis*			SEN	SEN	Mountain slopes, foothills, prairie valleys, chaparral, sagebrush, and forest openings; hosts are violets (*Viola* spp.).	Jackson	MD-D	RRS-S UMP-S	No documented occurrences within 3 mi of project area.	MIIH	Modification of habitat and potential for injury or death.

a/ Status Key:
Federal Status: T = Threatened, E = Endangered, PT = Proposed Threatened, C = Candidate, SOC = Species of Concern; CH = Critical Habitat, PCH = Proposed Critical Habitat
State Status: T = Threatened, E = Endangered, C = Candidate, SC = Sensitive-Critical, S = Sensitive
BLM and Forest Service Status: SEN =Sensitive, S&M = Survey and Manage, letter after S&M = Survey and Manage Species Category (A – F)

b/ Occurrence Key:
BLM: CB = Coos Bay District, RO = Roseburg District, MD = Medford District, LV = Lakeview District
Forest Service: W = Winema National Forest, RR = Rogue River National Forest, UMP = Umpqua National Forest

D = Documented occurrence: A species located on land administered by the BLM or the Forest Service based on historic or current known sites of a species reported by a credible source for which BLM and the Forest Service have knowledge of written, mapped or specimen documentation of the occurrence.
S = Suspected occurrence: Species is not documented on land administered by the BLM or the Forest Service, but may occur on the unit because: 1) BLM District or National Forest is considered to be within the species' range and 2) appropriate habitat is present or 3) known occurrence of the species (historic or current) in vicinity such that the species could occur on BLM or FS land.

c/ Pacific Connector Pipeline Project: mollusks and red tree vole documented within 500 feet of the proposed pipeline; all other species are documented within 3 mi of the proposed pipeline.

d/ Effect of Impact:
Species federally listed or proposed for listing:
NE = No Effect
NLAA = Not Likely to Adversely Affect
LAA = Likely to Adversely Affect
NJ = Not Likely to Jeopardize the Continued Existence for a Proposed Species

All other species:
NI = No Impact
MIIH = May Impact Individuals or Habitat, but is not likely to contribute to a trend toward federal listing or loss of viability of the species

TABLE I-3 (continued)

Special Status Marine Mammal and Terrestrial Wildlife Species That May Occur Near the Jordan Cove Energy Project

Common Name and/or Scientific Name	Status a/				Expected Habitat	Documented or Suspected Occurrence b/				Effect of Impact d/	Impact Reasoning
	Federal	State	BLM	Forest Service		County	BLM	Forest Service	Within Vicinity of Project Area c/		

e/ Aquatic Invertebrates are included in table I-4 in appendix I.

References:
Species Status and Range: ODFW 2016; OFWO 2016; FWS 2017a; ORBIC 2017; FWS 2013; Forest Service and BLM 2011; BLM 2015; Forest Service 2015; ORBIC 2006a, 2006, 2012, 2016; Janes et al. 2005.
Expected Habitat: Csuti et al. 2001; NatureServe 2013, 2017; ORBIC 2006a; Gilligan et al. 1994; Kozloff 1976; Forest Service 2006; BLM 2006.
Documented Occurrences: BLM 2006, 2010, 2012, 2017; eBird 2019; ORBIC 2017; Forest Service 2017; BLM 2019; Forest Service 2019; Siskiyou BioSurvey, various dates (summarized in biological survey reports).

TABLE I-4

Special Status Fish Species and Aquatic Invertebrates That May Occur Near the Jordan Cove Energy Project

Common and/or Scientific Name	Status a/ Federal	Status a/ State	Status a/ BLM	Status a/ Forest Service	Life History and Expected Habitat	Occurrence b/ County	Occurrence b/ BLM	Occurrence b/ Forests Service	Occurrence b/ Waterbodies Crossed by Project/ Documentation in Vicinity of Project Area c/	Effect of Impact d/	Impact Reasoning
Nonanadromous Freshwater Fish											
Western Brook Lamprey *Lampetra richardsoni*	SOC	S			Non-parasitic and non-anadromous. Ammocoetes in stream eddies with silt and/or sand substrates. Adults spawn over gravel late April - early June	Coos Douglas Jackson			Most perennial streams west of the Cascades.	MIIH	Potential disturbance or change to habitat.
Great Basin (interior) redband trout *Onchorynchus mykiss gibbsi*	SOC	S			Occupies remnant streams in seven Pleistocene lake beds in Oregon. Highly fragmented and isolated populations.	Klamath	LV-D	F-W-D	Spawning occurs in Spencer Creek from mouth to RM 12; most spawning occurs between Roads 100 and 110.	MIIH	Potential disturbance or change to habitat.
Umpqua chub *Oregonichthys kalawatseti*	SOC	SC	SEN	SEN	Endemic to the mainstem and South Umpqua River, resident species. Occupies habitats with higher current velocities; spawning occurs primarily in rocky areas.	Coos Douglas	MD-D RO-D	UMP-D	Tenmile Creek (1971); endemic to Umpqua and South Umpqua rivers.	MIIH	Potential disturbance or change to habitat.
Millicoma dace *Rhinichthys cataractae ssp.*	SOC	S	SEN		Endemic to Coos Basin, resident species. Prefers swift current associated with cobble and boulders and probably high velocity waters.	Coos Douglas	CB-D		South Fork Coos River.	MIIH	Potential disturbance or change to habitat.
Anadromous and Marine Fish											
River lamprey *Lampetra ayresii*	SOC	S			Anadromous species; migrates to sea and returns to freshwater to spawn in the spring. Freshwater habitat includes rivers and creeks, with low to moderate gradients and pools and riffles. Marine habitats are near shore and estuarine habitats include bay/sound and river mouths and tidal rivers.	Coos Douglas			Coastal drainages.	MIIH	Potential disturbance or change to habitat.

TABLE I-4 (continued)

Special Status Fish Species and Aquatic Invertebrates That May Occur Near the Jordan Cove Energy Project

Common and/or Scientific Name	Status a/ Federal	Status a/ State	Status a/ BLM	Status a/ Forest Service	Life History and Expected Habitat	Occurrence b/ County	Occurrence b/ BLM	Occurrence b/ Forests Service	Waterbodies Crossed by Project/ Documentation in Vicinity of Project Area c/	Effect of Impact d/	Impact Reasoning
Pacific lamprey *Entosphenus tridentatus*	SOC		SEN	SEN	Anadromous species, spawning habitat is similar to salmonids including cool, flowing water and clean gravel. Rearing areas are slow-moving backwaters with fine sediment. Larvae spend several years in freshwater before transforming and migrating to the ocean.	Coos Douglas Jackson Klamath	CB-D LV-D MD-D RO-D	F-W-D RRS-D UMP-D	Coos Bay and coastal drainages.	MIIH	Potential disturbance, mortality, and modification of habitat.
Chinook salmon *Oncorhynchus tshawytscha* Oregon Coast ESU Coastal SMU-Spring run		S			Anadromous species that rears in the Pacific Ocean for most of its life and spawns in freshwater streams. Most enter Oregon's coastal rivers April to December, but some start in February. Spawning generally occurs from August to early November for spring Chinook. Preferred spawning and rearing areas have a low gradient (<3%); adults often ascend to higher gradient reaches to find spawning areas. Spawns and rears in a range of sizes of streams and rivers, and often uses estuaries for rearing. Adults require deep pools within proximity to spawning areas where they hold and mature between migration and spawning.	Coos Douglas			Coos Bay, Coos, Coquille, South Umpqua, and Umpqua sub-basins	MIIH	Potential disturbance, mortality, and modification of habitat.

TABLE I-4 (continued)

Special Status Fish Species and Aquatic Invertebrates That May Occur Near the Jordan Cove Energy Project

Common and/or Scientific Name	Status a/ Federal	State	BLM	Forest Service	Life History and Expected Habitat	Occurrence b/ County	BLM	Forests Service	Waterbodies Crossed by Project/ Documentation in Vicinity of Project Area c/	Effect of Impact d/	Impact Reasoning
Chinook salmon *Oncorhynchus tshawytscha* Southern Oregon/ Northern California Coast ESU-Fall run, spring run Rogue SMU-Spring run		S	SEN	SEN	Anadromous species that rears in the Pacific Ocean for most of its life and spawns in freshwater streams. Most enter Oregon's coastal rivers April to December, but some start in February. Spawning generally occurs from October to early March. Preferred spawning and rearing areas have a low gradient (<3%); adults often ascend to higher gradient reaches to find spawning areas. Spawns and rears in a range of sizes of streams and rivers, and often uses estuaries for rearing. Adults require deep pools within proximity to spawning areas where they hold and mature between migration and spawning.	Coos Jackson Douglas	CB-D MD-D	RRS-D	Rogue River and tributaries (spawning and rearing).	MIIH	Potential disturbance, mortality, and modification of habitat.
Chum salmon *Oncorhynchus keta* Pacific Coast ESU Coastal SMU		SC	SEN		Anadromous species that rears in the Pacific Ocean for most of its life and spawns in freshwater streams in the fall. Utilizes low gradient, gravel-rich, barrier-free freshwater habitats and productive estuaries. Juveniles migrate to estuarine environments after emergence.	Coos Douglas	CB-D RO-D		None.	NI	Does not occur in Project vicinity; presumed extinct.
Steelhead *Oncorhynchus mykiss* Klamath Mountains Province ESU-Summer run, winter run Rogue SMU-Summer run		S	SEN		Anadromous species; juveniles rear in freshwater streams 1-4 years. Adults live in marine environment prior to spawning in winter or spring. May spawn more than once.	Jackson	CB-D MD-D	RRS-D	Upper Rogue River.	MIIH	Potential disturbance, mortality, and modification of habitat.

TABLE I-4 (continued)

Special Status Fish Species and Aquatic Invertebrates That May Occur Near the Jordan Cove Energy Project

Common and/or Scientific Name	Status a/ Federal	Status a/ State	Status a/ BLM	Status a/ Forest Service	Life History and Expected Habitat	Occurrence b/ County	Occurrence b/ BLM	Occurrence b/ Forests Service	Occurrence b/ Waterbodies Crossed by Project/ Documentation in Vicinity of Project Area c/	Effect of Impact d/	Impact Reasoning
Steelhead *Oncorhynchus mykiss* Oregon Coast ESU Coastal SMU-Summer run	SOC	S	SEN	SEN	Anadromous species; juveniles rear in freshwater streams 1-4 years. Adults live in marine environment prior to spawning mostly in winter or spring. May spawn more than once.	Coos Douglas	CB-D MD-D RO-D	UMP-D RRS-D	Coos, Coquille, South Umpqua, and Umpqua HUs.	MIIH	Potential disturbance, mortality, and modification of habitat.
Coho salmon *Oncorhynchus kisutch* Southern Oregon/Northern California Coast ESU Rogue SMU Klamath SMU	T/CH	S			Juvenile summer and winter rearing and spawning often located in small headwater streams. Juvenile and adult migration corridors, as well as spawning areas are found in tributaries, mainstream reaches, and estuarine zones. Growth and development of adults occurs primarily in near- and off-shore marine waters. Spawning occurs late summer to mid-winter, and juvenile migration occurs in spring.	Jackson	CB-D MD-D	RRS-D	Perennial waterbodies within Upper Rogue River sub-basin.	LAA	Potential disturbance, mortality, and modification of habitat.
Coho salmon *Oncorhynchus kisutch* Oregon Coast ESU Coastal SMU	T/CH	S			Juvenile summer and winter rearing and spawning often located in small headwater streams. Juvenile and adult migration corridors, as well as spawning areas are found in tributaries, mainstream reaches, and estuarine zones. Growth and development of adults occurs primarily in near- and off-shore marine waters. Spawning occurs November to March, and juvenile migration occurs in spring.	Coos Douglas	CB-D RO-D MD-D	UMP-D RRS-D	Perennial waterbodies within Coos, Coquille, and South Umpqua sub-basins.	LAA	Potential disturbance, mortality, and modification of habitat.

TABLE I-4 (continued)

Special Status Fish Species and Aquatic Invertebrates That May Occur Near the Jordan Cove Energy Project

Common and/or Scientific Name	Status a/ Federal	Status a/ State	Status a/ BLM	Status a/ Forest Service	Life History and Expected Habitat	Occurrence b/ County	Occurrence b/ BLM	Occurrence b/ Forests Service	Waterbodies Crossed by Project/ Documentation in Vicinity of Project Area c/	Effect of Impact d/	Impact Reasoning
Pacific eulachon *Thaleichthys pacificus* Southern DPS	T/CH				Occur in nearshore ocean waters except for brief spawning runs into their natal streams. Spawning occurs over sand or coarse gravel substrates in the lower reaches of larger rivers, temperatures range from 39 to 50°F.	Coos	CB-D		Pacific Ocean and Coos Bay, no spawning in the estuary or Coos River.	LAA	Potential presence in Coos Bay. Impacts from turbidity and entrainment are possible.
North American green sturgeon *Acipenser medirostris* Southern DPS	T/CH	SC			Mainly a marine species, but also in fresh water. Migratory species. Southern DPS includes coastal watersheds.	Coos Douglas	CB-D		Pacific Ocean and summer in Coos Bay estuary and freshwater tributaries to head of tide.	LAA	Potential disturbance or change to habitat, potential mortality (subadults).
Basking shark *Cetorhinus maximus*	SOC				Most commonly observed in coastal temperate waters where flow patterns set up convergence zones that concentrate forage.	Coos			No documentation	NI	Not documented in Project vicinity.
Cowcod *Sebastes levis*	SOC				Marine environments; 68-1200 feet depths; soft and hard bottoms, canyons.	Coos			No documentation	NI	Not documented in Project vicinity.
Aquatic Invertebrates											
Great Basin ramshorn *Helisoma newberryi newberryi*			SEN	SEN	Larger lakes, slow rivers, larger spring sources, and spring-fed creeks; burrows in soft mud.	Klamath	LV-D	F-W-D	Upper Klamath Lake and Lost Sub-basin	NI	Not documented in Project vicinity.
Montane peaclam *Pisidium ulttramontanum*			SEN	SEN	Associated with open water lake, river, and stream habitat. Freshwater, herbaceous wetlands, and shallow water; benthic species. Occurs in streams, lakes or pools that are spring-influenced, and prefers sand or gravel substrates. Often occurs on roots of *Salicornia* species.	Klamath	MD-S	F-W-D	PV (T40S,R11E,S25; no date): approximately 0.2mi S of MP 221.83; Lost Sub-basin.	MIIH	Potential disturbance, mortality, and loss or modification of habitat.

TABLE I-4 (continued)

Special Status Fish Species and Aquatic Invertebrates That May Occur Near the Jordan Cove Energy Project

Common and/or Scientific Name	Status a/ Federal	Status a/ State	Status a/ BLM	Status a/ Forest Service	Life History and Expected Habitat	Occurrence b/ County	Occurrence b/ BLM	Occurrence b/ Forests Service	Occurrence b/ Waterbodies Crossed by Project/ Documentation in Vicinity of Project Area c/	Effect of Impact d/	Impact Reasoning
California floater mussel *Anodonta californiensis*			SEN	SEN	Low elevation lakes and lake-like streams with shallow water. Shallow muddy or sandy habitats in larger rivers, reservoirs, and lakes. Reaches maturity within 4 to 5 years with a lifespan of 10 to 15 years.	Coos Klamath		UMP-S RRS-S F-W-D	MP 17.24-20.96 (Coquille River historic population); Coos, Coquille, and Upper Klamath sub-basins.	MIIH	Potential disturbance, mortality, and loss or modification of habitat.
Western ridged mussel *Gonidea angulata*			SEN	SEN	Creeks and rivers with varying substrates in Pacific drainages, rarely found in lakes or reservoirs.	Coos Douglas Klamath	CB-S RO-D LV-S	F-W-D RRS-S UMP-S	South Umpqua River, Middle Fork Coquille River, and Lost River near Merrill.	MIIH	Potential disturbance, mortality, and loss or modification of habitat.
Pinto abalone *Haliotis kamtschatkana*	SOC				Typically in low intertidal zone. Feeds mostly on kelp and drift algae. Spawns April to June.	Coos			Rare in Coos Bay.	MIIH	Potential for disturbance and habitat modification if species is present.
Newcomb's littorine snail *Littorina subrotundata*	SOC		SEN		Inhabits salt marshes at the edge of bays and estuaries on glasswort/pickleweed; tolerant of fresh and saltwater. Cold, clear, well-oxygenated water on a various types of sand bottoms. Found in upper intertidal zones. Eggs are laid in moist locations in June or July and hatchlings emerge beginning in mid-July through early August.	Coos	CB-D		None reported by ORBIC, 2017.	NI	Not documented in Project vicinity.
Fredenburg pebblesnail *Fluminicola sp. nov. 11*				S&M-A	Freshwater in Middle Rogue and Upper Klamath sub-basins; possibly extirpated. Found in narrow and shallow small, cold spring runs, on cobbles and gravel.	Jackson Klamath	MD-D		Upper Klamath Sub-basin.	NI	Not documented in Project vicinity.
Toothed pebblesnail *Fluminicola sp. nov.*				S&M-A	Very large, cold springs and their outflow with exceptionally good water quality and gravel or boulder substrates.	Jackson	MD-D		Upper Rogue and Upper Klamath sub-basins.	NI	Not documented in Project vicinity.

TABLE I-4 (continued)

Special Status Fish Species and Aquatic Invertebrates That May Occur Near the Jordan Cove Energy Project

Common and/or Scientific Name	Status a/ Federal	Status a/ State	Status a/ BLM	Status a/ Forest Service	Life History and Expected Habitat	Occurrence b/ County	Occurrence b/ BLM	Occurrence b/ Forests Service	Occurrence b/ Waterbodies Crossed by Project/ Documentation in Vicinity of Project Area c/	Effect of Impact d/	Impact Reasoning
Klamath Rim pebblesnail *Fluminicola sp. nov. 3*				S&M-A	Gravel or boulder substrates with flowing water (cold, oligotrohpic water with high dissolved oxygen); rarely found in springs, avoids dense macrophyte beds.	Klamath		RRS-S	Upper Klamath Sub-basin.	NI	Not documented in Project vicinity.
Turban pebblesnail *Fluminicola turbinformis*				SEN	Found to date only in one, large oligotrophic spring complex with very cold water, in semi-arid sage scrub. Abundant *Rorippa* and *Mimulus* flora present. Substrate is mud, basalt gravel, bedrock and cobble, with bedrock predominate in area of occurrence.	Klamath		F-W-D	None reported by ORBIC, 2017.	NI	Not documented in or near Project area.
Archimedes springsnail *Pyrgulopsis archimedis*				SEN	Freshwater in Upper Klamath and Lost River sub-basins, possibly extirpated. Prefers gravel-boulder basalt and pumice substrates. Completely aquatic with a lifespan of 1 year.	Klamath		F-W-D	Lost Sub-basin.	MIIH	Potential mortality and loss or modification of habitat.
Crooked Creek springsnail *Pyrgulopsis intermedia*			SEN		Freshwater, possibly extirpated. . Clear, cold springs, spring-influenced creeks with gravel-boulder substrates.	Klamath	LV-S	F-W-D	None reported by ORBIC, 2017.	NI	Not anticipated to occur in watersheds crossed by the Project.
Jackson Lake springsnail *Pyrgulopsis robusta*			SEN		Freshwater, possibly extirpated. Cold water habitats, predominantly large springs and spring-influenced portions of streams, lakes, and rivers. Found on a variety of substrates. Semelparous; lays eggs on hard substrates. Emergence of young snails in summer and fall. Lifespan of approximately 1 year.	Klamath	LV-S		None reported by ORBIC, 2017.	NI	Not anticipated to occur in watersheds crossed by the Project.

TABLE I-4 (continued)

Special Status Fish Species and Aquatic Invertebrates That May Occur Near the Jordan Cove Energy Project

Common and/or Scientific Name	Status a/ Federal	State	BLM	Forest Service	Life History and Expected Habitat	Occurrence b/ County	BLM	Forests Service	Waterbodies Crossed by Project/ Documentation in Vicinity of Project Area c/	Effect of Impact d/	Impact Reasoning
Lined rams-horn *Vorticifex effusa diagonalis*			SEN	SEN	Freshwater; possibly extirpated. Large streams, spring-influenced lakes, and highly oxygenated cold water on boulder-gravel substrate. Semelparous with a lifespan of 1-2 years. Eggs are laid from spring to fall; they attach to plants, stones, or other objects. No larval stage. Not active in the winter.	Klamath		F-W-D	None reported by ORBIC, 2017.	NI	Not documented in or near Project area.
Sinitsin rams-horn *Vorticifex klamathensis sinitsini*				S&M-E	Freshwater; possibly extirpated in Upper Klamath Lake sub-basins, springs and spring runs, substrates include mud, silt, sand, gravel, cobble, and boulders. Hermaphroditic and capable of self-fertilization. Semelparous with a lifespan of 1 year.	Klamath		F-W-S	Upper Klamath Lake	NI	Not documented in or near Project area.
Robust walker *Pomatiopsis binneyi*			SEN	SEN	Freshwater; possibly extirpated Coos Sub-basin. Seeps, rivulets, shallow mud banks and marsh seepages leading into shallow streams. Semi-aquatic.	Coos	CB-S	RRS-D	None reported by ORBIC, 2017.	NI	Not documented in or near Project area.
Pacific walker *Pomatiopsis californica*			SEN	SEN	Freshwater; possibly extirpated from Coos Sub-basin. Semi-aquatic; inhabits wet leaf litter and vegetation adjacent to flowing or standing water in humid, shaded areas.	Coos	CB-D	RRS-S	None reported by ORBIC, 2017.	NI	Not documented in or near Project area.
Scale lanx *Lanx kalmathensis*			SEN	SEN	Spring-influenced portions of large lakes and streams or limnocrene springs with boulder-cobble substrates and well-oxygenated, cold water.	Klamath	MD-S	F-W-D RRS-S	Lost and Upper Klamath sub-basins.	NI	Not documented in or near Project area.

TABLE I-4 (continued)

Special Status Fish Species and Aquatic Invertebrates That May Occur Near the Jordan Cove Energy Project

Common and/or Scientific Name	Status a/ Federal	State	BLM	Forest Service	Life History and Expected Habitat	Occurrence b/ County	BLM	Forests Service	Waterbodies Crossed by Project/ Documentation in Vicinity of Project Area c/	Effect of Impact d/	Impact Reasoning
Rotund lanx *Lanx subrotunda*			SEN	SEN	Found in unpolluted rivers and large streams at low to moderate elevations, in highly oxygenated, swift-flowing, cold water on stable cobble, boulder, or bedrock substrates.	Coos Douglas	CB-S MD-S RO-D	F-W-D RRS-S UMP-D	Distribution includes portions of the North Umpqua River below the confluence with Little River, all of Little River, portions of the South Umpqua River and major tributaries above Roseburg, and Cow Creek.	NI	Not documented in or near Project area.
Highcap lanx *Lanx alta*			SEN	SEN	Freshwater in Middle Rogue and Upper Klamath sub-basins; possibly extirpated. Larger tributaries and outcrops, on upper surfaces of bedrock and bedrock outcrops. Cold, fast-flowing, highly oxygenated, clear water. Semelparous with a lifespan of 1 to 2 years. Eggs are laid from spring to fall. No larval stage. Feeds through scraping.	Jackson Klamath	CB-S MD-D RO-D	F-W-D RRS-S UMP-D	None reported by ORBIC, 2017.	NI	No suitable habitat in Project area.
Denning's agapetus caddisfly *Agapetus denningi*	SOC				Creeks; possibly extirpated. Streams with cobble, boulder, or bedrock substrates free of fine sediment. Streams often have an open mixed deciduous-coniferous canopy. Larvae are aquatic and feed by scraping periphyton and fine detritus from rock and wood. Univoltine, from egg development through 5 larval instars, pupate and emerge as adults in one year. Feeds through scraping.	Jackson	MD-S	RRS-S UMP-D	None reported by ORBIC, 2017.	NI	Not documented in or near Project area.

TABLE I-4 (continued)

Special Status Fish Species and Aquatic Invertebrates That May Occur Near the Jordan Cove Energy Project

Common and/or Scientific Name	Status a/ Federal	State	BLM	Forest Service	Life History and Expected Habitat	Occurrence b/ County	BLM	Forests Service	Waterbodies Crossed by Project/ Documentation in Vicinity of Project Area c/	Effect of Impact d/	Impact Reasoning
Green Springs Mountain farulan caddisfly *Farula davisi*	SOC				Not well studied. Probably uses small streams or seeps, maybe marshes. Associated with exposed bedrock having thin streams passing over the bedrock. Univoltine; larvae pupate in aggregations on the underside of rocks and logs.	Jackson	MD-D	RRS-S	Upper Klamath Sub-basin.	MIIH	Potential mortality and loss or modification of habitat.
A caddisfly (no common name) *Rhyacophila chandleri*			SEN	SEN	Very cold larger spring-fed creeks or springs, often with cobble and boulder substrate with high sand/gravel embedding.	Douglas	CB-S	UMP-D	South Umpqua Sub-basin.	MIIH	Potential mortality and loss or modification of habitat.
A caddisfly (no common name) *Rhyacophila leechi*			SEN	SEN	Confined to smaller, headwater streams, or even springs	Jackson	MD-D		Upper Klamath Sub-basin	MIIH	Potential mortality and loss or modification of habitat.
Haddock's Rhyacophilan caddisfly *Rhyacophila haddocki*			SEN	SEN	Creeks or springs, clear mountain streams, sometimes prefers riffles. In order to develop, larvae and pupae require cool, well-aerated microsites free of excessive fine sediments. Pupae are found on the underside of cobbles at base of riffles, cascades, or bedrock chutes.	Douglas	CB-D	RRS-S	None reported by ORBIC, 2017.	NI	Not documented in or near Project area; extremely restricted range.

a/ Status Key:
Federal Status: T = Threatened, CH = Critical Habitat, SOC = Species of Concern
State Status: SC = Sensitive-Critical, S = Sensitive
BLM and Forest Service Status: SEN = Sensitive Species, S&M = Survey and Manage, letter after S&M = Survey and Manage Species Category (A – F)

b/ Occurrence Key:
BLM: CB = Coos Bay District, RO = Roseburg District, MD = Medford District, LV = Lakeview District
Forest Service: F-W = Fremont-Winema National Forest, RRS = Rogue River-Siskiyou National Forest, UMP = Umpqua National Forest
D = Documented occurrence: A species located on land administered by the BLM or the Forest Service based on historic or current known sites of a species reported by a credible source for which BLM and the Forest Service have knowledge of written, mapped or specimen documentation of the occurrence.
S = Suspected occurrence: Species is not documented on land administered by the BLM or the Forest Service, but may occur on the unit because: 1) BLM District or National Forest is considered to be within the species' range and 2) appropriate habitat is present or 3) known occurrence of the species (historic or current) in vicinity such that the species could occur on BLM or FS land.

TABLE I-4 (continued)

Special Status Fish Species and Aquatic Invertebrates That May Occur Near the Jordan Cove Energy Project

Common and/or Scientific Name	Status a/ Federal	State	BLM	Forest Service	Life History and Expected Habitat	Occurrence b/ County	BLM	Forests Service	Waterbodies Crossed by Project/ Documentation in Vicinity of Project Area c/	Effect of Impact d/	Impact Reasoning

I = Forest Service Actions Influence Downstream

c/ Documentation within Project Area: Aquatic invertebrates documented within 500 feet of the proposed Pacific Connector Pipeline Project alignment.

d/ Effect of Impact:
Species federally listed or proposed for listing:
NE = No Effect
NLAA = Not Likely to Adversely Affect
LAA = Likely to Adversely Affect
All other species:
NI = No Impact
MIIH = May Impact Individuals or Habitat, but is not likely to contribute to a trend toward federal listing or loss of viability of the species

Species Fish Type Abbreviations:

SMU Species Management Unit (Oregon State Designation only)
ESU Evolutionarily Significant Unit (NMFS designation)
DPS Distinct Population Segment (NMFS and FWS designations)

References:
Status and Occurrence References: FWS 2017, 2019; ORBIC 2017, 2019; BLM 2015, 2019; Forest Service 2015, 2019.
Life History and Expected Habitat References: Kostow 1995; NatureServe 2017; ODFW 2005; Laufle et al. 1986; Pauley et al. 1986; NMFS 2012.
Waterbodies Crossed: ORBIC 2017; Kostow 1995.

TABLE I-5

Special Status Plant (Vascular and Non-Vascular) and Fungi Species That May Occur Near the Jordan Cove Energy Project

Common Name and/or Scientific Name	Status a/				Expected Habitat	Documented or Suspected Occurrence b/				Effect of Impact d/	Impact Reasoning
	Federal	State	BLM	Forest Service		County	BLM	Forest Service	Within Vicinity of Project Area c/		
Bryophytes											
Aloina bifrons			SEN		Arid shrub-steppe (sagebrush) and grassland habitat below 4,000 feet. A component of biological soil crusts.		LV-S			NI	Not documented in Project vicinity.
Tiny notchwort *Anastrophyllum minutum*			SEN	SEN	On peaty soil >5,500 feet. In the *Tsuga mertensiana* zone, typically associated with ledges or at the base of cliffs.	Jackson	MD-S	UMP-S RRS-S FW-S		NI	Not documented in Project vicinity.
Broad-leaved lantern moss *Andreaea schofieldiana*			SEN	SEN	Forms mats on dry and exposed to moist, shaded igneous rocks, montane to subalpine.	Jackson	CB-S MD-D	UMP-S RRS-D		NI	No suitable habitat in Project area.
Giant fourpoint *Barbilophozia lycopodioides*			SEN	SEN	Forming mats on peaty soil on damp ledges of rock outcrops and cliffs at higher elevations (known sites in OR and WA: 3,400-7,500 feet).			FW-S		NI	Not documented in Project vicinity.
Spidery threadwort *Blepharostoma arachnoideum*			SEN	SEN	Old-growth forests, in mesic habitats, where it most often grows on rotten logs.	Douglas Jackson	CB-D	UMP-D		NI	Not documented in Project vicinity.
Brotherella roelli				S&M E	Rotten wood and bark in cool to moist mixed deciduous and conifer forest, usually at low elevations along valley margins.					NI	Not documented in Project vicinity.
Bryoerythrophyllum columbianum			SEN		Arid shrub-steppe (sagebrush) and grassland habitat below 4,000 feet. A component of biological soil crusts		LV-S			NI	Not documented in Project vicinity.
Beautiful bryum *Bryum calobryoides*			SEN	SEN	Rock outcrops and shallow soil	Jackson	RO-S MD-D	UMP-D RRS-D		NI	Not documented in Project vicinity.
Bog pouchwort *Calypogeia sphagnicola*			SEN	SEN	Sphagnum containing wetlands.	Coos Douglas Jackson	CB-D MD-D	UMP-D RRS-D		NI	Not documented in Project vicinity.
Campylopus schmidii			SEN	SEN	Nutrient-poor sandy substrates near the coast. Grows on shaded to exposed sand around the edges of vernal pools. Also seen on exposed seasonally flooded sand on deflation plains.		CB-S RO-D			NI	Not documented in Project vicinity.
Spiny threadwort *Cephaloziella spinigera*			SEN	SEN	Wetlands containing Sphagnum.	Jackson Klamath	CB-S RO-S MD-D	UMP-S RRS-D FW-D		NI	Not documented in Project vicinity.
Cryptomitrium tenerum			SEN	SEN	Forms small to locally extensive mats on bare, usually shaded and humid soil on hillsides, rock outcrops, and streambanks. In OR, between sea level and 1,000 feet. Root balls and cutbanks are favored habitat in forests.		CB-S	RRS-D		NI	Not documented in Project vicinity.
Diplophyllum plicatum				S&M-B	Moist cool forests on bark, rotting wood, humus and soil.	Coos Douglas	CB-D RO-S MD-D	RRS-S		NI	Not documented in Project vicinity.
White-mouthed Extinguisher-moss *Encalypta brevicollis*			SEN	SEN	Deep, rocky ravine.	Coos	CB-S MD-S	UMP-S RRS-D		NI	Not documented in Project vicinity.
Candle snuffer moss *Encalypta brevipes*			SEN	SEN	Soil on ledges and in crevices on cliffs, reported from both igneous and siliceous substrates.		CB-S	UMP-S RRS-D		NI	No suitable habitat in Project area.
Banded cord-moss *Entosthodon fascicularis*			SEN	SEN	Seasonally wet, exposed soil in seeps or along intermittent streams. Usually hidden among grasses, other mosses, and litter. Known habitats: grassland, oak savanna, grassy balds, and rock outcrops. In OR, known at elevations below 3,000 feet.	Jackson Klamath	CB-S RO-S MD-S	UMP-S RRS-S		NI	Not documented in Project vicinity.
Emerald dewdrops *Ephemerum crassinervium*			SEN		Bare soil, high light levels, and seasonal moisture.	Jackson	LV-D MD-D			NI	Not documented in Project vicinity.
Braided frostwort *Gymnomitrion concinnatum*			SEN	SEN	On peaty soil of cliffs and rock outcrops, full exposure or shaded. In OR and WA, it has only been found in subalpine parkland areas.		CB-S RO-S MD-S	UMP-S		NI	Not documented in Project vicinity.

TABLE I-5 (continued)

Special Status Plant (Vascular and Non-Vascular) and Fungi Species That May Occur Near the Jordan Cove Energy Project

Common Name and/or Scientific Name	Status a/ Federal	State	BLM	Forest Service	Expected Habitat	Documented or Suspected Occurrence b/ County	BLM	Forest Service	Within Vicinity of Project Area c/	Effect of Impact d/	Impact Reasoning
Haplomitrium hookeri			SEN	SEN	Growing on soil in full sun, intermixed with other liverworts and hornworts.		CB-S			NI	Not documented in Project vicinity.
Great mountain flapwort *Harpanthus flotovianus*			SEN	SEN	Wet places, often with sphagnum.	Douglas Klamath		UMP-S RRS-D FW-D		NI	Not documented in Project vicinity.
Herbertus aduncus ssp. *aduncus*			SEN	SEN S&M-E	Although often an epiphyte in the northern part of its range, this species is found only on cliffs in Oregon. Its primary associates are mosses and other liverworts. It is found in cool, moist sites in a variety of forest types.					NI	Not documented in Project vicinity.
Iwatsukiella leucotricha				S&M-B	In OR and WA, appears to be restricted to forests along maritime fog-drenched coastal ridges that usually have older *Abies* species present. OR elevations: 2,700-2,900 feet.					NI	Not documented in Project vicinity.
Jamesoniella autumnalis var. *heterostipa*				SEN	Reportedly an obligate aquatic taxon growing over rocks in moving water or forming sometimes extensive, loose mats in lakes.			UMP-S		NI	Not documented in Project vicinity.
Kurzia makinoana			SEN	SEN S&M-B	In old growth forests. Occurs on rocky cliffs and ledges, soil banks and cuts and on decayed wood, rarely on the base of trees, in shaded moist sites or in bogs. Located in humic soils at lower elevations, especially stream terraces, often with liverworts.	Coos	CB-D	RRS-S		NI	Not documented in Project vicinity.
Frye's limbella moss *Limbella fryei*	SOC	C	SEN	SEN	On wet rotting wood, leaf litter and lower trunks of tall shrubs in coastal shrub swamps.	Coos	CB-D			NI	Not documented in Project vicinity.
Gillman's pawwort *Lophozia gillmanii*			SEN	SEN	Found on peaty soil, usually associated with cliffs or ledges. It is an obligate calciphile.			UMP-S RRS-D FW-S		NI	Not documented in Project vicinity.
Lophozia laxa			SEN	SEN	Restricted to well-developed hummocks of Sphagnum in fens and bogs along the coast and in the Cascade Range. Grows in full sun to partial shade. Elevation ranges from sea level to 5,000 feet.		CB-S			NI	Not documented in Project vicinity.
Marsupella emarginata var. *aquatica*			SEN	SEN S&M-B	Old growth forests. Grows in robust colonies attached to submerged rocks in partially shaded cold, flowing, cold perennial stream habitats. Known occurrence at Waldo Lake, Willamette National Forest in the Oregon Cascades.			UMP-S		NI	Not documented in Project vicinity.
Metzgeria violacea			SEN	SEN	Forming mats or mixed with other bryophytes on trunks of trees and shrubs in coastal rainforest. Usually in cool, moist riparian areas or shaded north-facing talus slopes and outcrops.		CB-D			NI	Not documented in Project vicinity.
Orthodontium gracile				SEN S&M-B	Occurs in old-growth or secondary growth redwood. May be found on the lower bark of trunks, below tree wounds, or downed redwood logs. Typically on redwood bark that has been burned or charred.			RRS-D		NI	Not documented in Project vicinity.
Translucent orthodontium *Orthodontium pellucens*			SEN	SEN	Forming dense cushions or mats on stumps, rotten logs and bark of living redwood trees, confined to redwood groves near the Pacific Ocean. Sometimes on charred wood, or below gaping wounds in trees. In OR, restricted to *Sequoia sempervirens* in extreme SW corner of the state.		MD-S	RRS-D		NI	No suitable habitat in Project area.
Tuberous hornwort *Phymatoceros phymatodes*			SEN	SEN	On bare, mineral soil which remains moist until late spring or summer. From near sea level to 2,100 feet elevation	Douglas	CB-D RO-S MD-D	RRS-D		NI	Not documented in Project vicinity.
Dwarf rock haircap *Polytrichastrum sexangulare* var. *vulcanicum* (*Polytrichum sphaerothecium*)				SEN	Base of cliffs and boulders in open lava field; on thin dry soil over rock; on dry shaded rock; on dry soil in graminoid meadow; and on dry exposed soil in alpine tundra near summit. Elevations range between 5,400 ft. to 7,000 feet			UMP-S FW-S		NI	Not documented in Project vicinity.
Hummock haircap moss *Polytrichum strictum*			SEN	SEN	Organic soils, particularly on top of Sphagnum hummocks, in coastal and montane bogs and fens.		CB-S	UMP-S		NI	Not documented in Project vicinity.
Bolander's scalemoss *Porella bolanderi*			SEN	SEN	On a variety of rock types (siliceous, calcareous, and metamorphic) and trunks of *Quercus*, *Umbellularia*, and *Acer macrophyllum*. In the Pacific Northwest, known elevations range from 500-3,000 feet.	Douglas Jackson	CB-S RO-D MD-D	UMP-S RRS-D		NI	Not documented in Project vicinity.

TABLE I-5 (continued)

Special Status Plant (Vascular and Non-Vascular) and Fungi Species That May Occur Near the Jordan Cove Energy Project

Common Name and/or Scientific Name	Status a/				Expected Habitat	Documented or Suspected Occurrence b/				Effect of Impact d/	Impact Reasoning
	Federal	State	BLM	Forest Service		County	BLM	Forest Service	Within Vicinity of Project Area c/		
Three-ranked spear moss *Pseudocalliergon trifarium (Calliergon trifarium)*			SEN	SEN	Calcareous fens.	Klamath		RRS-S FW-D		NI	No suitable habitat in Project area.
Racomitrium aquaticum (*Codriophorus ryszardii*)				S&M-E	Forms mats on shaded, moist rocks and cliffs along shady streams or in forests, often in the splash zone, but never aquatic.		CB-S			NI	Not documented in Project vicinity.
Racomitrium depressum (*Codriophorus depressus*)			SEN	SEN	Forming mats on rocks in perennial or intermittent streams, and in the spray zone of waterfalls, between 400 and 11,000 feet elevation. Habitats are subject to scour at high water.		CB-S RO-S MD-D	UMP-S RRS-S FW-S		NI	Not documented in Project vicinity.
Rhizomnium nudum				S&M–B (OR)	On moist organic soil, or among rocks or on rotten logs in mid to high elevations.	Douglas	CB-S	UMP-D RRS-S FW-S		NI	Not documented in Project vicinity.
Rivulariella gemmipara (*Chiloscyphus gemmiparus*)			SEN	SEN	Grows attached to rocks in moderately fast-moving water. Restricted to places where water flows over gravel or rocks.	Jackson Klamath	MD-S	UMP-S RRS-D FW-S		NI	Not documented in Project vicinity.
Scapania obscura			SEN	SEN	On peaty soil close to streams below cold water springs and in snow melt seepage channels. At least in this region, it grows in full sun.			UMP-S		NI	Not documented in Project vicinity.
Schistidium moss *Schistidium cinclidodonteum*			SEN	SEN	On wet or dry rocks or on soil in crevices of rocks and boulders, often along intermittent streams, at elevations of 5,000-11,000 feet.	Jackson Klamath	LV-D MD-D	RRS-D FW-S		NI	Not documented in Project vicinity.
Schistostega pennata				S&M-A	Mineral soil in shaded pockets of overturned tree roots, often with shallow pools of standing water at the base of the root wad; attached to rock or mineral soil around the entrance to caves, old cellars, and animal burrows. Microhabitat requirements include dense shade, high humidity, and some source of reflection of light (i.e., a pool of water)	Douglas Klamath	CB-S RO-S	UMP-D RRS-S FW-S		NI	Not documented in Project vicinity.
Alpine masterwort *Schofieldia monticola*				SEN	Terrestrial, on peaty soil under heather or beside small streams; strictly subalpine-alpine.			UMP-S		NI	Not documented in Project vicinity.
Tetraphis geniculata			SEN	SEN S&M-A	A moss that occurs in moist, coniferous forests with down logs; on the cut or broken ends or lower half of large (usually over 15" dbh), decay class 3, 4, and 5 rotted logs, or stumps, and occasionally on peaty banks in moist coniferous forests from sea level to subalpine elevations.		CB-S RO-S	UMP-S		NI	Not documented in Project vicinity.
Mucronleaf tortula moss *Tortula mucronifolia*			SEN	SEN	On soil or rock.	Jackson	RO-S MD-D LV-S	RRS-D		NI	Not documented in Project vicinity.
Asano's trematodon moss *Trematodon asanoi*			SEN	SEN	On moist bare soil along the edges of trails, streams and ponds in the subalpine zone. Soils usually have some organic content and are irrigated by meltwater from late-season snowbeds.		RO-S	UMP-S FW-S		NI	Not documented in Project vicinity.
Tritomaria exsectiformis				S&M-B	Occurs in shady, cool, moist sites such as wet banks of riparian areas, spring heads, decaying logs and associated humus. Also on cliffs, ledges, and rock crevices covered with thin peaty acidic soils. In Oregon, it mostly occurs in peaty soils of mid-elevation coldwater streams.	Douglas Klamath		UMP-D RRS-S FW-D		NI	Not documented in Project vicinity.
Tritomaria quinquedentata				S&M-B	Restricted to organic substrates where perpetually shady, cool, and moist.					NI	Not documented in Project vicinity.
Fungi											
Acanthophysium farlowii (*Aleurodiscus farlowii*)				S&M-B	Fruits on recently dead twigs attached to living Pinaceae.					NI	Not documented in Project vicinity.
Albatrellus avellaneus			SEN	SEN S&M-B	Presumed mycorrhizal with pine trees, known from Shore Acres in Coos County, in T26S, R14W, Sec. 17 SWNE along Cape Arago area.	Coos	CB-S	RRS-D		NI	Not documented in Project vicinity.
Albatrellus caeruleoporus				S&M-B	Old growth forest, ranging from near sea level to montane.	Coos	CB-D	UMP-D RRS-S		NI	Not documented in Project vicinity.

TABLE I-5 (continued)

Special Status Plant (Vascular and Non-Vascular) and Fungi Species That May Occur Near the Jordan Cove Energy Project

Common Name and/or Scientific Name	Status a/ Federal	State	BLM	Forest Service	Expected Habitat	Documented or Suspected Occurrence b/ County	BLM	Forest Service	Within Vicinity of Project Area c/	Effect of Impact d/	Impact Reasoning
Albatrellus ellisii (*Scutiger ellisii*)				S&M-B	Occurs as solitary sporocarps or small clusters on soil surface in coniferous or mixed hardwood-coniferous forests; see the Survey and Manage Report (appendix F.5 of this EIS).	Douglas Jackson Klamath	CB-S LV-D MD-D RO-D	UMP-D RRS-D FW-D	Observed in UMP, RRS, and FW and RO BLM; see the Survey and Manage Report (appendix F.5 of this EIS).	MIIH	Potential impacts to individuals or habitat; however, remaining sites would provide a reasonable assurance of species persistence.
Arcangeliella crassa				S&M-B	Associated withconifers, including *Tsuga mertensiana, Abies concolor, A. magnifica, Pinus ponderosa, P. jeffreyi, and P. contorta*.	Coos Douglas	CB-D	UMP-S RRS-S FW-D	Observed > 100 feet from ROW in FW near MP 173.2; see the Survey and Manage Report (appendix F.5 of this EIS).	MIIH	Potential impacts to individuals or habitat; however, remaining sites would provide a reasonable assurance of species persistence.
Arcangeliella lactarioides (*Lactarius lactariodes*)				S&M-B	Forms sporocarps beneath the soil surface associated with various Pinaceae species., particularly *Abies magnifica* and *Pinus ponderosa* above 5,400 feet elevation.			RRS-S		NI	Not documented in Project vicinity.
Powdery piggyback mushroom *Asterophora lycoperdoides*				S&M-B	It grows as a parasite on other mushrooms, mainly *Russulas*.	Coos	CB-D			NI	Not documented in Project vicinity.
Silky piggyback mushroom *Asterophora parasitica*				S&M-B	It grows as a parasite on other mushrooms, mainly *Russulas*.		CB-S MD-D			NI	Not documented in Project vicinity.
Lavender baeospora *Baeospora myriadophylla*				S&M-B	Lignicolous scattered to densely gregarious on decayed *Abies* spp. logs, sometimes buried deep within the logs, at higher elevations in mixed coniferous forests.					NI	Not documented in Project vicinity.
Balsamia nigrens				S&M-B	Likely associated with mature stands. Forms sporocarps beneath the soil surface associated with various Pinaceae species., particularly *Pinus jeffreyi* and *Pseudotsuga menziesii* and at low to mid elevation. (Note: has also been called *B. nigra*.)	Jackson	CB-S MD-D	RRS-D		NI	Not documented in Project vicinity.
Boletus haematinus				S&M-B	Populations range from 42-5,620 feet in elevation and are found in equal numbers on south, east and west-facing slopes. No populations have been documented on north facing sites.					NI	Not documented in Project vicinity.
Boletus pulcherrimus				S&M-B	West side Cascades, sporocarps usually solitary in association with mixed conifer (grand fir, Douglas-fir) and hardwoods (tanoak) in coastal forests; also found in low- to mid-elevation coniferous forests and open stands of mixed hardwoods and young conifers.	Jackson Klamath	MD-D RO-D	RRS-D FW-D	Observed in RRS and FW; 7 sites documented within the project area; see the Survey and Manage Report (appendix F.5 of this EIS).	MIIH	Potential impacts to individuals or habitat; however, remaining sites would provide a reasonable assurance of species persistence.
Giant polypore fungus *Bridgeoporus nobilissimus*			SEN	SEN S&M-A	On large, dying and dead noble fir and Pacific silver fir in late-successional old-growth forests and on remnant stumps and snags in young and mature second-growth forests in the Pacific silver fir and western hemlock zones in western Washington and Oregon.		RO-S			NI	Not documented in Project vicinity.
Catathelasma ventricosa				S&M-B	Grows alone or scattered on the ground under conifers	Coos	CB-S			NI	Not documented in Project vicinity.
Chalciporus piperatus (Boletus piperatus)				S&M-D	Coniferous, mixed and broadleaf forests, under various trees.		CB-S			NI	Not documented in Project vicinity.
Chamonixia caespitosa			SEN	SEN S&M-B	Forms sporocarps beneath the soil surface associated with various Pinaceae species., particularly *Abies amabilis* and *Tsuga* spp. at high elevation and *Picea sitchensis, Pseudotsuga menziesii,* and *Tsuga heterophylla* in coastal forests.	Jackson Klamath	CB-S MD-S	RRS-D		NI	Not documented in Project vicinity.
Choiromyces alveolatus				S&M-B	Forms sporocarps beneath the soil surface associated with various Pinaceae species., particularly *Abies* sp., lodgepole pine, Douglas-fir, western hemlock, and mountain hemlock between 1,600 and 7,000 feet.	Douglas Jackson Klamath	RO-S MD-D	UMP-D RRS-D FW-D	One site observed in FW outside of ROW between MP 172.1 and 172.2; see the Survey and Manage Report (appendix F.5 of this EIS).	MIIH	Potential impacts to individuals or habitat; however, remaining sites would provide a reasonable assurance of species persistence.
Choiromyces venosus			SEN	SEN S&M-B	Grows in acid soils with high rainfall, associated with deciduous and coniferous trees; prefers clayey soils.					NI	Not documented in Project vicinity.
Chroogomphus loculatus				S&M-B	Found in association with the roots of assorted Pinaceae, particularly *Tsuga mertensiana*.	Jackson Klamath		UMP-S		NI	Not documented in Project vicinity.

TABLE I-5 (continued)

Special Status Plant (Vascular and Non-Vascular) and Fungi Species That May Occur Near the Jordan Cove Energy Project

Common Name and/or Scientific Name	Status a/ Federal	State	BLM	Forest Service	Expected Habitat	Documented or Suspected Occurrence b/ County	BLM	Forest Service	Within Vicinity of Project Area c/	Effect of Impact d/	Impact Reasoning
Chrysomphalina grossula				S&M-B	Coniferous debris, mixed forests and parks.	Coos	CB-S	UMP-S RRS-D		NI	Not documented in Project vicinity.
Clavariadelphus ligula				S&M-B	Grows in coniferous forest on the ground, as well as in moss at higher elevations	Coos Douglas Jackson	CB-D LV MD-D	UMP-D	UMP): < 100 feet from ROW.	NI	Occurrence located in the moderate to high intensity burned area during the Stouts Creek fire.
Clavariadelphus occidentalis				S&M-B	Coniferous and hardwood forests; see the Survey and Manage Report (appendix F.5 of this EIS).	Douglas	CB-D RO-D	UMP-D RRS-D	Observed in UMP, CB and RO; see the Survey and Manage Report (appendix F.5 of this EIS).	MIIH	Potential impacts to individuals or habitat; however, remaining sites would provide a reasonable assurance of species persistence.
Clavariadelphus sachalinensis				S&M-B	Coniferous forests; see the Survey and Manage Report (appendix F.5 of this EIS).		RO-D LV MD-D	UMP-D RRS-D FW-D	Observed in RO, MD, UMP, and RRS; see the Survey and Manage Report (appendix F.5 of this EIS).	MIIH	Potential impacts to individuals or habitat; however, remaining sites would provide a reasonable assurance of species persistence.
Clavariadelphus subfastigiatus				S&M-B	On soil or duff, under mixed conifers.	Douglas Jackson	RO-D MD-D	UMP-D RRS-S		NI	Not documented in Project vicinity.
Clavariadelphus truncatus				S&M-B [e/] (outside Jackson County, OR) / D (Jackson County, OR)	Coniferous forests; see the Survey and Manage Report (appendix F.5 of this EIS).	Douglas Jackson Klamath	CB-D RO-D LV MD-D	UMP-D RRS-D FW-D	Observed in RO, MD, UMP, FW, and RRS; see the Survey and Manage Report (appendix F.5 of this EIS).	MIIH	Potential impacts to individuals or habitat; however, remaining sites would provide a reasonable assurance of species persistence.
Clavulina castaneipes var. *lignicola*				S&M-B	Associated with late successional forests. On wood or bark.		CB-S			NI	Not documented in Project vicinity.
Clitocybe senilis				S&M-B	Restricted to conifer forests, in duff under *Pinus* and *Picea* spp.		CB-S			NI	Not documented in Project vicinity.
Clitocybe subditopoda				S&M-B	Usually found gregarious to subcaespitose on needle beds in coastal to mid-elevation conifer forests.					NI	Not documented in Project vicinity.
Collybia bakerensis				S&M-F	Restricted to conifer forests; see the Survey and Manage Report (appendix F.5 of this EIS).	Klamath		FW-D RRS-D	Observed in FW (2000); see the Survey and Manage Report (appendix F.5 of this EIS).	MIIH	Potential impacts to individuals or habitat; however, remaining sites would provide a reasonable assurance of species persistence.
Collybia [Dendrocollybia] racemosa				S&M-B	Gregarious, on rotting or mummified remnants of agarics, or seldom in nutrient-rich leaf mulch, in forests.	Douglas Jackson	CB-D MD-D	UMP-D RRS-D	Observed in UMP; and MD; see the Survey and Manage Report (appendix F.5 of this EIS).	MIIH	Potential impacts to individuals or habitat; however, remaining sites would provide a reasonable assurance of species persistence.
Cordyceps ophioglossoides (*Tolypocladium ophioglossoides*)				S&M-B	Grows underground on other fungi.		CB-S			NI	Not documented in Project vicinity.
Cortinarius barlowensis (C. azureus)			SEN	SEN S&M-B	Coastal to montane conifer forests up to at least 3,940 feet elevation; late successional old-growth association; fruits in autumn.	Douglas	CB-S	UMP-D		NI	Not documented in Project vicinity.
Cortinarius boulderensis				S&M-B	Well-decayed, large conifer stumps and snags containing brown cubical rot.	Douglas	MD			NI	Not documented in Project vicinity.
Cortinarius cyanites				S&M-B	Solitary to gregarious in coastal to montane conifer forests up to at least 3,940 feet elevation		CB-S			NI	Not documented in Project vicinity.
Cortinarius depauperatus (C. spilomeus)				S&M-B	Moist conifer forests.		CB-S			NI	Not documented in Project vicinity.

TABLE I-5 (continued)

Special Status Plant (Vascular and Non-Vascular) and Fungi Species That May Occur Near the Jordan Cove Energy Project

Common Name and/or Scientific Name	Status a/ Federal	State	BLM	Forest Service	Expected Habitat	Documented or Suspected Occurrence b/ County	BLM	Forest Service	Within Vicinity of Project Area c/	Effect of Impact d/	Impact Reasoning
Cortinarius magnivelatus				S&M-B	Old-growth, montane coniferous forests. Sporocarps known to occur in association with the roots of various species, including *Abies concolor*, *A. lasiocarpa*, *A. magnifica*, *Picea engelmannii*, *Pinus lambertiana*, and *P. ponderosa* at elevations above 4,500 feet.	Klamath Jackson	MD-D	FW-D RRS-D	Observed in FW; see the Survey and Manage Report (appendix F.5 of this EIS)..	MIIH	Potential impacts to individuals or habitat; however, remaining sites would provide a reasonable assurance of species persistence.
Cortinarius olympianus				S&M-B	Found in complex coniferous forests, generally restricted to the western hemlock zone; see the Survey and Manage Report (appendix F.5 of this EIS).	Coos Jackson Klamath	CB-D MD-D	UMP-D RRS-D	Observed in UMP and RRS; see the Survey and Manage Report (appendix F.5 of this EIS).	MIIH	Potential impacts to individuals or habitat; however, remaining sites would provide a reasonable assurance of species persistence.
Cortinarius pavelekii (*Thaxterogaster pavelekii*)			SEN	SEN	Forms mycorrhiza exclusively with the roots of mature to old-growth Sitka spruce		CB-S			NI	Not documented in Project vicinity.
Cortinarius speciosissimus				S&M-B	Acidic soils in forested areas.					NI	Not documented in Project vicinity.
Cortinarius tabularis				S&M-B	Unknown.					NI	Not documented in Project vicinity.
Cortinarius umidicola				S&M-B	Unknown.					NI	Not documented in Project vicinity.
Cortinarius valgus				S&M-B	Solitary, scattered, gregarious or cespitose; sometimes locally abundant under *Abies amabilis,Picea sitchensis, Pseudotsuga menziesii,* and *Tsuga heterophylla*.	Douglas	MD			NI	Not documented in Project vicinity.
Cortinarius variipes				S&M-B	Dry habitats on basic soils.					NI	Not documented in Project vicinity.
Cortinarius verrucisporus				S&M-B	Dry, late-successional conifer forests at elevations above 4,000 feet; Associated with *Abies magnifica* and possibly other true fir species, as well as *Pinus albicaulis*.	Klamath		RRS-S FW-D	Observed in FW near MP 168.8 and between 172.1 and 173.3; see the Survey and Manage Report (appendix F.5 of this EIS).	MIIH	Potential impacts to individuals or habitat; however, remaining sites would provide a reasonable assurance of species persistence.
Cortinarius wiebeae				S&M-B	Montane coniferous forests.			FW-S		NI	Not documented in Project vicinity.
Cudonia monticola				S&M-B	On woody debris and spruce needles in mature, moist coniferous forests with white fir, Douglas-fir, and pine.	Coos Douglas Jackson Klamath	CB-D MD-D	UMP-D RRS-D	Observed in UMP; see the Survey and Manage Report (appendix F.5 of this EIS).	MIIH	Potential impacts to individuals or habitat; however, remaining sites would provide a reasonable assurance of species persistence.
Cyphellosterium laeve				S&M-B	Scattered to gregarious on various species of moss, usually on moss-covered banks. Widely distributed in coniferous forests.					NI	Not documented in Project vicinity.
Dermocybe humboldtensis			SEN	SEN S&M-B	Stabilized dunes on roots of pine and huckleberry species and conglomerate rock and gravelly loam soil with Douglas-fir and ponderosa pine	Douglas	CB-S RO-D MD-S	UMP-S RRS-S		NI	Not documented in Project vicinity.
Destuntzia fusca				S&M-B	Forms sporocarps beneath the soil associated with *Lithocarpus densiflorus*, *Pseudotsuga menziesii* & *Tsuga heterophylla*, below 3,280 feet elevation.			UMP-S RRS-S		NI	Not documented in Project vicinity.
Destuntzia rubra				S&M-B	In association with the roots of *Abies grandis, Arbutus menziesii, Lithocarpus densiflora, Pseudotsuga menziesii,* and *Sequoia sempervirens* at below 2,130 feet elevation.			UMP-S RRS-S		NI	Not documented in Project vicinity.
Dichostereum boreale				S&M-B	Presumed mycorrhizal with *Tsuga* spp.					NI	Not documented in Project vicinity.
Elaphomyces anthracinus				S&M-B	Forms sporocarps beneath the soil surface associated with the roots of *Pinus ponderosa* in Oregon.			FW-S		NI	Not documented in Project vicinity.
Elaphomyces subviscidus				S&M-B	Forms sporocarps beneath the soil surface associated with the roots of *Pinus contorta* and *Tsuga mertensiana* at high elevation (7,210 feet).	Douglas	MD-S	RRS-S FW-S UMP-D		NI	Not documented in Project vicinity.
Endogone acrogena				S&M-B	Found in association with the roots of *Abies lasiocarpa*.					NI	Not documented in Project vicinity.
Endogone oregonensis				S&M-B	Roots of Sitka spruce, Douglas-fir, and western hemlock, below 1,150 feet elevation, known from Cascade Head and Lincoln County.	Douglas	CB-S			NI	Not documented in Project vicinity.
Entoloma nitidum				S&M-B	Saprobic in coniferous woodland, especially with pine trees, usually on acidic soil.					NI	Not documented in Project vicinity.
Fayodia bisphaerigera (*F. gracilipes*)				S&M-B	On conifer needles	Douglas	CB-S			NI	Not documented in Project vicinity.

TABLE I-5 (continued)

Special Status Plant (Vascular and Non-Vascular) and Fungi Species That May Occur Near the Jordan Cove Energy Project

Common Name and/or Scientific Name	Status a/ Federal	State	BLM	Forest Service	Expected Habitat	Documented or Suspected Occurrence b/ County	BLM	Forest Service	Within Vicinity of Project Area c/	Effect of Impact d/	Impact Reasoning
Fevansia aurantiaca				S&M-B	High altitude true fir and hemlock forests.					NI	Not documented in Project vicinity.
Galerina atkinsoniana				S&M-B [e/]	Found in boreal forests with full canopies and sufficient moss and needle litter; typically found in moist areas within spruce and Douglas-fir forests.		MD-D RO-D	UMP-D RRS-D	Observed in UMP in 2010; see the Survey and Manage Report (appendix F.5 of this EIS).	MIIH	Potential impacts to individuals or habitat; however, remaining sites would provide a reasonable assurance of species persistence.
Galerina cerina				S&M-B	Gregarious on mosses in sphagnum bogs. Also sometimes found on the mucky humus in sphagnum bogs or on colonizing mosses in burned areas.		CB			NI	Not documented in Project vicinity.
Galerina heterocystis				S&M-E	Found in rotting wood or in moss	Coos Douglas Jackson	CB-S MD			NI	Not documented in Project vicinity.
Galerina sphagnicola				S&M-E	Gregarious on mosses in sphagnum bogs. Also sometimes found on the mucky humus in sphagnum bogs or on colonizing mosses in burned areas.					NI	Not documented in Project vicinity.
Gastroboletus imbellus				S&M-B	Occurs in Pacific Silver Fir (50%) and Mountain Hemlock (50%) series at elevations of 2,528-5,169 feet. Associated with roots of grand fir, subalpine fir and mountain hemlock.			UMP-S		NI	Not documented in Project vicinity.
Gastroboletus ruber				S&M-B	Occurs above 4,000 ft. and is found in association with the roots of assorted Pinaceae, particularly *Tsuga mertensiana*, *Abies amabilis*, *Abies procera*, or *Pinus monticola*.					NI	Not documented in Project vicinity.
Gastroboletus subalpinus				S&M-B	Grows in association with roots of various conifers including mountain hemlock, California red fir, lodgepole pine, and whitebark pine; see the Survey and Manage Report (appendix F.5 of this EIS).	Klamath		UMP-D RRS-D FW-D	Observed in FW: adjacent to and south of MP 172.5 and 172.6; see the Survey and Manage Report (appendix F.5 of this EIS)	MIIH	Potential impacts to individuals or habitat; however, remaining sites would provide a reasonable assurance of species persistence.
Gastroboletus turbinatus				S&M-B	Scattered to gregarious under conifers in the montane regions.		CB-S MD			NI	Not documented in Project vicinity.
Gastroboletus vividus			SEN	SEN S&M-B	Associated with *Abies magnifica* and *Tsuga mertensiana*.	Douglas Jackson Klamath	MD-S	UMP-S RRS-D FW-S		NI	Not documented in Project vicinity.
Gastrolactarius camphoratus (*Arcangeliella camphorate; Lactarius silviae*]			SEN	SEN S&M-B	Associated with the roots of *Tsuga heterophylla, Pseudotsuga menziesii,* and possibly *Picea sitchensis* from sea level to 3,040 feet elevation.	Coos Douglas	CB-D MD-S	RRS-D		NI	Not documented in Project vicinity.
Gastrosuillus amaranthii				S&M-E	Found in association with the roots of *Pinus lambertiana* above 5,000 feet and in association with the roots of *Pinus monticola* above 7,000 feet elevation.					NI	Not documented in Project vicinity.
Gastrosuillus umbrinus				S&M-B	Insufficient locations to determine.					NI	Not documented in Project vicinity.
Gautieria magnicellaris				S&M-B	Only two knonw locations.					NI	Not documented in Project vicinity.
Gautieria otthii				S&M-B	Forms sporocarps beneath the soil surface associated with the roots of *Pinus ponderosa* and other Pinaceae between 2,620 and 5,415 feet elevation.	Jackson	MD-S	RSS-S		NI	Not documented in Project vicinity.
Gelatinodiscus flavidus (*Chloroscypha flavida*)				S&M-B	Scattered to gregarious in habit and restricted to fruiting from cones, twigs and foliage of *Chamaecyparis nootkatensis*.	Douglas Jackson	MD-D			NI	Not documented in Project vicinity.
Glomus radiatum				S&M-B	Forms sporocarps beneath the soil surface associated with the roots of *Chamaecyparis nootkatensis* and *Sequoia sempervirens* below 5,415 feet elevation.		CB-S	RRS-S		NI	Not documented in Project vicinity.
Gomphus bonarii				S&M-B	Late successional forest. Singly, in cespitose clusters and arcs under conifers.		MD-S	UMP-D RRS FW-D		NI	Not documented in Project vicinity.

TABLE I-5 (continued)

Special Status Plant (Vascular and Non-Vascular) and Fungi Species That May Occur Near the Jordan Cove Energy Project

Common Name and/or Scientific Name	Status a/				Expected Habitat	Documented or Suspected Occurrence b/				Effect of Impact d/	Impact Reasoning
	Federal	State	BLM	Forest Service		County	BLM	Forest Service	Within Vicinity of Project Area c/		
Gomphus clavatus				S&M-F	Found in LSOG forests, typically in deep humus in coniferous forests.	Coos Douglas Jackson Klamath	CB-D MD-D RO-D	UMP-D RRS-D FW-D	Three sites observed in UMP; see the Survey and Manage Report (appendix F.5 of this EIS).	MIIH	Potential impacts to individuals or habitat; however, remaining sites would provide a reasonable assurance of species persistence.
Gomphus kauffmanii				S&M-E	Associated with true firs, Douglas-fir, pine, and hemlock trees in LSOG forests, as well as younger forests.	Coos Douglas Jackson Klamath	CB-D RO-D MD-D	UMP-D RRS-D FW-D	Observed in RRS and FW; see the Survey and Manage Report (appendix F.5 of this EIS).	MIIH	Potential impacts to individuals or habitat; however, remaining sites would provide a reasonable assurance of species persistence.
Gymnomyces abietis				S&M-B	Grows in association with the roots of conifer trees, including true fir and mountain hemlock, primarily above 3,000 feet.	Jackson		RRS-D	Observed in RRS; see the Survey and Manage Report (appendix F.5 of this EIS).	MIIH	Potential impacts to individuals or habitat; however, remaining sites would provide a reasonable assurance of species persistence.
Gymnomyces fragrans			SEN	SEN	Populations have been located in the Pacific silver fir, mountain hemlock and Shasta red fir plant associations. Populations range from 4,803-6,853 feet elevation and are found on east-facing and west-facing slopes.	Jackson	MD-D	UMP-S RRS-D		NI	Not documented in Project vicinity.
Gymnomyces nondistincta				S&M-B	Associated with roots of Pacific silver fir and mountain hemlock in Mountain Hemlock and Parkland series.	Klamath	MD-D			NI	Not documented in Project vicinity.
Gyromitra (*Pseudorhizina*) *californica*			SEN	SEN S&M-B	Solitary or in small groups in conifer woods; fruiting in humus or on rotting wood in moist areas; also found on soil along streams, skid trails, and recently disturbed soil.	Douglas Jackson Klamath	RO-S MD-S	UMP-D RRS-D FW-D		NI	Not documented in Project vicinity.
Hebeloma olympianum				S&M-B	Associated with roots of various Pinaceae.					NI	Not documented in Project vicinity.
Helvella crassitunicata			SEN	SEN S&M-B	Scattered or gregarious on soil along trails in montane regions with *Abies* spp.		RO-S MD-D			NI	Not documented in Project vicinity.
Helvella elastica				S&M-B	Conifer woodlands on acid soil.	Douglas Jackson	CB-S MD-D			NI	Not documented in Project vicinity.
Hydnotrya inordinata				S&M-B	Found in association with the roots of *Abies amabilis, Pseudotsuga menziesii, Pinus contorta*, and *Tsuga heterophylla* at mid to high elevation.	Klamath				NI	Not documented in Project vicinity.
Hydnotrya subnix				S&M-B	Found in association with the roots of *Abies amabilis.*					NI	Not documented in Project vicinity.
Hydropus marginellus (Mycena marginella)				S&M-B	Conifer wood; *Abies*, *Pinus.*	Douglas	CB-D	RRS-S		NI	Not documented in Project vicinity.
Hygrophorus caeruleus				S&M-B	Found at mid-elevations in montane coniferous forests, typically in conifer duff; occurs in soil in association with roots of conifer trees. near melting snowbanks.	Klamath		UMP-D RRS-D FW-D	Observed in RRS and FW; see the Survey and Manage Report (appendix F.5 of this EIS).	MIIH	Potential impacts to individuals or habitat; however, remaining sites would provide a reasonable assurance of species persistence.
Hygrophorus karstenii				S&M-B	Forms associations with trees (both broadleaf and conifer) and hence typically found in woodlands.					NI	Not documented in Project vicinity.
Hygrophorus vernalis				S&M-B	Associated with roots of Pinaceae species near melting snowbanks in spring.					NI	Not documented in Project vicinity.
Hypomyces luteovirens				S&M-B	Solitary, scattered or gregarious in the woods, often partially buried in the duff, usually on the fruiting bodies of *Lactarius* and/or *Russula*.	Klamath	CB-S			NI	Not documented in Project vicinity.
Leucogaster citrinus				S&M-B	LSOG coniferous forests at low to high elevations, ranging from about 250–6,500 feet It grows in association with roots of white fir, subalpine fir, lodgepole pine, western white pine, Douglas-fir, and hemlocks.	Klamath	CB-S MD-D	RRS-S UMP-D FW-D	Observed in UMP and FW.	MIIH	Occurrences located in the moderate to high intensity burned areas during the Stouts Creek fire..
Leucogaster microsporus				S&M-B	Found in soil or duff under conifers, in association with the roots of Douglas-fir and western hemlock		CB-S			NI	Not documented in Project vicinity.
Macowanites chlorinosmus				S&M-B	Found in association with the roots *of Picea sitchensis* and *Tsuga heterophylla* below 660 feet elevation.		CB-S			NI	Not documented in Project vicinity.
Macowanites lymanensis				S&M-B	Found in association with the roots of *Abies amabilis* and *A. lasiocarpa* at high elevation.					NI	Not documented in Project vicinity.

TABLE I-5 (continued)

Special Status Plant (Vascular and Non-Vascular) and Fungi Species That May Occur Near the Jordan Cove Energy Project

Common Name and/or Scientific Name	Status a/ Federal	State	BLM	Forest Service	Expected Habitat	Documented or Suspected Occurrence b/ County	BLM	Forest Service	Within Vicinity of Project Area c/	Effect of Impact d/	Impact Reasoning
Macowanites mollis				SEN S&M-B	Found in association with the roots of *Pseudotsuga menziesii, Abies grandis,* and *Tsuga heterophylla* above 3,500 feet elevation.		MD-D			NI	Not documented in Project vicinity.
Marasmius applanatipes				S&M-B	Found gregarious to subcaespitose in duff.					NI	Not documented in Project vicinity.
Martellia fragrans				S&M-B	Found in association with the roots of *Tsuga mertensiana* or *Pseudotsuga menziesii* at high elevation.		MD			NI	Not documented in Project vicinity.
Martellia idahoensis				S&M-B	Found in association with the roots of *Abies amabilis, A. lasiocarpa, A. procera, Picea engelmannii,* and *Tsuga mertensiana* above 3,500 feet elevation.		CB-S			NI	Not documented in Project vicinity.
Mycena hudsoniana				S&M-B	Restricted to conifer forests and is usually found scattered in the duff.					NI	Not documented in Project vicinity.
Mycena overholtsii				S&M-D	Coniferous forests above 3,000 feet, primarily near true fir trees; see the Survey and Manage Report (appendix F.5 of this EIS).	Jackson Klamath		UMP-D RRS-D FW-D	Observed in FW; see the Survey and Manage Report (appendix F.5 of this EIS).	MIIH	Potential impacts to individuals or habitat; however, remaining sites would provide a reasonable assurance of species persistence.
Mycena quinaultensis				S&M-B	Found in gregarious, caespitose clusters on senescent conifer needles or uncommonly on decayed wood in conifer forests.		CB-S RO-S MD-S	UMP-S RRS-S		NI	Not documented in Project vicinity.
Mycena tenax				S&M-B	Densely gregarious in duff under fir, Douglas-fir, spruce, and redwood trees, known from several coastal sites in Douglas, Lane, and Lincoln Counties; fruits in spring and autumn.	Douglas	CB-S	UMP-S RRS-D		NI	Not documented in Project vicinity.
Mythicomyces corneipes			SEN	SEN S&M-B	Occurs along bog margins, among mosses, or on wet soil under conifers.					NI	Not documented in Project vicinity.
Neolentinus adhaerens				S&M-B	On logs and stumps of conifers, occasionally hardwood.					NI	Not documented in Project vicinity.
Neolentinus kauffmanii				S&M-B	Saprophytic on conifer logs.		CB-S	FW-D		NI	Not documented in Project vicinity.
Nivatogastrium nubigenum				S&M-B (except Oregon Eastern Cascades and California Cascades Physiographic Provinces)	Solitary to scattered on conifer wood in montane areas; fruiting during the spring shortly after snow-melt; common.		MD	FW-D	Observed in FW (2000); see the Survey and Manage Report (appendix F.5 of this EIS).	NI	Not listed as S&M in Oregon Eastern Cascades Physiographic Provinces, where observation was located.
Octaviania cyanescens				S&M-B	Found with *Tsuga mertensiana* at 6,230 feet elevation.			UMP-S		NI	Not documented in Project vicinity.
Octavianina macrospora				S&M-B	Found in association with the roots of *Tsuga heterophylla.*					NI	Not documented in Project vicinity.
Octavianina papyracea				S&M-B	Found in association with the roots of Pinaceae in forests dominated by *Sequoia sempervirens* at low elevation (below 2,000 feet).					NI	Not documented in Project vicinity.
Otidea leporina				S&M-D	Grows terrestrially in woods under hardwoods or conifers; often clustered, but occasionally growing alone or scattered.		CB-D MD-D			NI	Not documented in Project vicinity.
Otidea smithii				S&M-B	On exposed soil, moss, litter or humus under Douglas fir, western hemlock, ponderosa pine, bigleaf maple, Oregon white oak and black cottonwood.	Douglas Jackson	CB-S RO-D MD-D	RRS-D	Observed in RO BLM (2014), >100 feet near MP 61.3.	WOFV [f/]	Potential impacts to individuals or habitat; indirect habitat effects. May cause loss of viability and/or contribute to a trend toward Federal listing [f/]
Phaeocollybia attenuata				S&M-D	Undisturbed, moist coniferous forests and mixed hardwood-coniferous forests. It is also occasionally found in urban parks and younger forests. Grows in highly humus soil associated with mosses under conifers, such as *Picea sitchensis*, *Tsuga heterophylla*, or *Abies amabilis.*		CB-D RO-D MD		Observed in CB (in ROW and <100 feet from ROW) and RO BLM (<100 feet from ROW).	MIIH [f/]	Potential removal of individuals within ROW; direct and indirect habitat effects. [f/]
Phaeocollybia californica			SEN	SEN S&M-B	Roots of Sitka spruce, Pacific silver fir and western hemlock	Douglas	CB-D RO-D MD-D	RRS-D		NI	Not documented in Project vicinity.

TABLE I-5 (continued)

Special Status Plant (Vascular and Non-Vascular) and Fungi Species That May Occur Near the Jordan Cove Energy Project

Common Name and/or Scientific Name	Status a/				Expected Habitat	Documented or Suspected Occurrence b/				Effect of Impact d/	Impact Reasoning
	Federal	State	BLM	Forest Service		County	BLM	Forest Service	Within Vicinity of Project Area c/		
Phaeocollybia dissiliens				S&M-B	On soil, litter and humus is association with roots of Pacific fir, Sitka spruce, Douglas fir and western hemlock principally in Western Hemlock series (67%) at elevations of 313-2,431 feet.		CB-D RO-S		Observed in CB BLM (2012) greater than 100 feet from ROW near MP 24.85BR.	MIIH [f/]	Potential indirect effects to individuals and habitat [f/]
Phaeocollybia fallax				S&M-D	Scattered to gregarious in highly humus soil in mixed coniferous forests associated with *Abies, Picea, Pseudotsuga*, and *Tsuga*.	Coos	CB-D MD		Observed in CB BLM (2010) within ROW.	MIIH [f/]	Potential removal of individuals within ROW; direct and indirect habitat effects. [f/]
Phaeocollybia gregaria			SEN	SEN S&M-B	Associated with the roots of Sitka spruce and Douglas-fir in Sitka Spruce (50%) and Western Hemlock (50%) series at elevations of 477-1,486 feet.	Douglas	CB-S MD-D RO-S			NI	Not documented in Project vicinity.
Phaeocollybia kauffmanii				S&M-D	Appears to be restricted to mesic coniferous forests in closed-canopy stands, primarily LSOG forests; primarily found in undisturbed forests, although also documented in younger plantations about 35 years old and in urban parks. Often associated with the roots of *Picea sitchensis, Pseudotsuga menziesii, Tsuga heterophylla*, and occasionally *Abies amabilis* and may be found in mixed stands with *Sequoia*, *Lithocarpus*, *Tsuga, Abies,* and *Pseudotsuga* species.	Coos	CB-D MD-D		Observed in CB BLM within ROW.	MIIH [f/]	Potential removal of individuals within ROW; direct and indirect habitat effects. [f/]
Phaeocollybia olivacea				S&M-B [e/]	Primarily found in fairly complex forests with a mix of hardwood trees, particularly *Quercus* or *Lithocarpus,* and conifer trees and occasionally in pure coniferous stands. More prevalent in low-elevation coastal forests, but has been found in montane coniferous forests.	Coos Douglas	CB-D MD-D	RRS-D	Observed in CB BLM within ROW and <100 meters from ROW near MP 27.4.	MIIH [f/]	Potential removal of individuals within ROW; direct and indirect habitat effects. [f/] /
Phaeocollybia oregonensis			SEN	SEN S&M-B	On soil in association with roots of Douglas-fir, western hemlock and Pacific silver fir, primarily in Western Hemlock series (75%) at elevations of 826-3,817 feet.	Coos Douglas	CB-D RO-S MD-D			NI	Not documented in Project vicinity.
Phaeocollybia piceae				S&M-B	Solitary to scattered to concrescent, in duff under conifers, primarily Sitka spruce; common from mid fall through winter in northern coastal forests.		CB-D MD-D		Not observed during Project surveys; however, agency databases indicate there is a site in the vicinity of the Project documented in 2012 in CB BLM.	MIIH [f/]	Potential indirect effects to individuals and habitat. [f/]
Phaeocollybia pseudofestiva				S&M-B	Associated with Pinaceae, mixed conifers, and hardwoods; fruits in October - January and April – July.	Coos Douglas Jackson	CB-D RO-D MD-D	RRS-S		NI	Not documented in Project vicinity.
Phaeocollybia scatesiae				S&M-B	Found in well-decomposed wood or woody humus in densely canopied coniferous forest; primarily in LSOG coniferous forests. Grows in association with *Abies* spp., *Picea sitchensis,* and *Vaccinium* spp. More prevalent in low-elevation coastal forests but has been found in montane coniferous forests.		CB-D		Observed in CB BLM within ROW and <100 meters from ROW.	MIIH [f/]	Potential removal of individuals within ROW; direct and indirect habitat effects. [f/]
Phaeocollybia sipei				S&M-B	Occurs in humus, litter, or soil in coniferous and mixed hardwood-coniferous forests at elevations ranging between approximately 350 and 3,550 feet. Found associated with the roots of western hemlock, Douglas-fir, Sitka spruce, Pacific silver fir, and red fir.		CB RO			NI	Not documented in Project vicinity.
Phaeocollybia spadicea				S&M-B	Associated with the roots of various Pinaceae: A*bies amabilis, Tsuga heterophylla, Pseudotsuga menziesii,* and *Picea sitchensis*. .		CB-D MD		Not observed during Project surveys; however, agency databases indicate there is a site in the vicinity of the Project documented in 2012 near MP 21.5 in CB BLM.	MIIH [f/]	Potential indirect effects to individuals and habitat. [f/]
Phellodon atratus (P. atratum)				S&M-B	Solitary to scattered to concrescent, in duff under conifers, primarily Sitka spruce; common from mid-fall through winter in northern coastal forests.		CB-S			NI	Not documented in Project vicinity.
Pholiota (*Stropharia*) *albivelata*				S&M-B	Scattered under conifers on conifer litter from late April through early January.	Coos	CB-S			NI	Not documented in Project vicinity.
Podostroma alutaceum (*Trichoderma alutaceum*)				S&M-B	Conifer forests.		CB-S	UMP-S RRS-S		NI	Not documented in Project vicinity.
Polyozellus multiplex				S&M-B	Primarily found in LSOG coniferous forests at mid-elevations; see the Survey and Manage Report (appendix F.5 of this EIS).	Jackson Klamath	CB-S MD-D	UMP-D RRS-D FW-D	Observed in RRS; see the Survey and Manage Report (appendix F.5 of this EIS).	MIIH	Potential impacts to individuals or habitat; however, remaining sites would provide a reasonable assurance of species persistence.

TABLE I-5 (continued)

Special Status Plant (Vascular and Non-Vascular) and Fungi Species That May Occur Near the Jordan Cove Energy Project

Common Name and/or Scientific Name	Status a/ Federal	State	BLM	Forest Service	Expected Habitat	Documented or Suspected Occurrence b/ County	BLM	Forest Service	Within Vicinity of Project Area c/	Effect of Impact d/	Impact Reasoning
Pseudaleuria quinaultiana				S&M-B	Occurs on disturbed microsites (trail sides, recent windthrow mounds) in low elevation old-growth forest that includes *Picea sitchensis, Pseudotsuga menziesii,* and *Tsuga heterophylla.*		CB-S			NI	Not documented in Project vicinity.
Pseudorhizina (*Gyromitra*) *californica*			SEN	SEN S&M-B	Solitary or in small groups in conifer woods; fruiting in humus or on rotting wood in moist areas; also found on soil along streams, skid trails, and recently disturbed soil.	Douglas Jackson Klamath	RO-S MD-S	UMP-D RRS-D FW-D		NI	Not documented in Project vicinity.
Ramaria abietina (*Phaeoclavulina abietina*)				S&M-B	In duff under conifers, especially Monterey cypress and Coast Redwood; from late fall to late winter.	Douglas Jackson	RO-D MD-D CB-S	UMP-S RRS-D		NI	Not documented in Project vicinity.
Ramaria amyloidea			SEN	SEN S&M-B	In humus or soil under *Abies* spp., Douglas-fir, and western hemlock from September to October.	Douglas Jackson Klamath	RO-S	UMP-D RRS-S FW-D		NI	Not documented in Project vicinity.
Ramaria araiospora (var. *araiospora* or var. *rubella)*				S&M-B	Primarily found in humus or soil in coniferous forests in association with true firs, Douglas-fir, western hemlock, and Sitka spruce; see the Survey and Manage Report (appendix F.5 of this EIS).	Coos	CB-D	UMP-D	Observed in CB and UMP; see the Survey and Manage Report (appendix F.5 of this EIS).	MIIH	Potential impacts to individuals or habitat; however, remaining sites would provide a reasonable assurance of species persistence.
Ramaria aurantiisiccescens				S&M-B	Form coralloid sporocarps in humus or soil that mature above the surface of the ground.	Coos Douglas Jackson Klamath	CB-D MD-D			NI	Not documented in Project vicinity.
Ramaria botrytis var. *aurantiramosa*				S&M-B	Form coralloid sporocarps in humus or soil that mature above the surface of the ground.	Coos Douglas Klamath	RO-S	UMP-D RRS-S FW-D		NI	Not documented in Project vicinity.
Ramaria celerivirescens				S&M-B	Primarily found in LSOG coniferous forests in association with true firs (*Abies* spp.), Douglas-fir, and western hemlock; although has also been found in urban parks and younger forests neighboring LSOG stands.		CB-D MD		Observed in CB BLM within ROW.	MIIH f/	Potential removal of individuals within ROW; direct and indirect habitat effects. f/ f/
Ramaria claviramulata				S&M-B	Form coralloid sporocarps in humus or soil that mature above the surface of the ground.					NI	Not documented in Project vicinity.
Ramaria concolor f. marrii				S&M-B	Form coralloid sporocarps in humus or soil that mature above the surface of the ground.					NI	Not documented in Project vicinity.
Ramaria concolor f. tsugina (*R. tsugina*)				S&M-B	In humus or soil under *Abies* ssp., Douglas-fir, and western hemlock in October.	Coos	CB-S RO-S			NI	Not documented in Project vicinity.
Ramaria conjunctipes var. *sparsiramosa*				S&M-B	On ground in moist conifer forests in fall.	Coos Douglas	CB-D RO-D MD-S	UMP-S RRS-D		NI	Not documented in Project vicinity.
Ramaria coulterae				S&M-B	Found in coniferous debris; associated with trees in the Pinaceae family.	Douglas Jackson Klamath	RO-S MD-D	UMP-D RRS-D FW-D	Observed in RRS and FW; see the Survey and Manage Report (appendix F.5 of this EIS).	MIIH	Potential impacts to individuals or habitat; however, remaining sites would provide a reasonable assurance of species persistence.
Ramaria cyaneigranosa				S&M-B	Form coralloid sporocarps in humus or soil that mature above the surface of the ground.		CB-D MD-D			NI	Not documented in Project vicinity.
Ramaria gelatiniaurantia				S&M-B	Occurs on litter and soil, associated with *Pinaceae* spp.	Coos Douglas Jackson	CB-D RO-S	RRS-S		NI	Not documented in Project vicinity.
Ramaria gracilis				S&M-B	Fruits in humus or soil and matures above the surface of the ground. Associated with *Abies* spp., *Pseudotsuga menziesii*, and *Tsuga heterophylla*	Jackson	CB-S MD-S	RRS-D		NI	Not documented in Project vicinity.
Ramaria hilaris var. *olympiana*				S&M-B	Form coralloid sporocarps in humus or soil that mature above the surface of the ground.	Douglas	CB-D			NI	Not documented in Project vicinity.
Ramaria largentii				S&M-B	In humus or soil under *Abies* spp., Douglas-fir, western white pine, and western hemlock in October.	Douglas Jackson Klamath	CB-S RO-D MD-D	UMP-D RRS-D FW-D		NI	Not documented in Project vicinity.

TABLE I-5 (continued)

Special Status Plant (Vascular and Non-Vascular) and Fungi Species That May Occur Near the Jordan Cove Energy Project

Common Name and/or Scientific Name	Status a/ Federal	State	BLM	Forest Service	Expected Habitat	Documented or Suspected Occurrence b/ County	BLM	Forest Service	Within Vicinity of Project Area c/	Effect of Impact d/	Impact Reasoning
Ramaria lorithamnus				S&M-B	Form coralloid sporocarps in humus or soil that mature above the surface of the ground.	Coos				NI	Not documented in Project vicinity.
Ramaria maculatipes				S&M-B	Fruits in humus or soil and matures above the surface of the ground. Associated with *Abies* spp., *Pseudotsuga menziesii*, and *Tsuga heterophylla*.	Jackson Klamath	MD-D	UMP-S RRS-S FW-D		NI	Not documented in Project vicinity.
Ramaria rainierensis				S&M-B	In humus or soil under *Abies* ssp Douglas-fir and western hemlock in December and March.	Coos	CB-D	RRS-S		NI	Not documented in Project vicinity.
Ramaria rubella var. *blanda*			SEN	SEN S&M-B	Fruits on wood in conifer forests.	Coos Douglas	RO-D CB-D	RRS-D		NI	Not documented in Project vicinity.
Ramaria rubribrunnescens				S&M-B	Terrestrial under species of Pinaceae in October and November.	Coos Douglas Jackson	CB-D RO-D MD-D	UMP-D RRS-S		NI	Not documented in Project vicinity.
Ramaria rubrievanescens (RARU5)				S&M-B	Found primarily in LSOG coniferous forests in association with trees in the Pinaceae family; see the Survey and Manage Report (appendix F.5 of this EIS).	Coos Douglas Jackson	CB-D MD-D	UMP-D RRS-D FW-D	Observed in UMP; see the Survey and Manage Report (appendix F.5 of this EIS).	MIIH	Potential impacts to individuals or habitat; however, remaining sites would provide a reasonable assurance of species persistence.
Ramaria rubripermanens (RARU6)				S&M-D (OR) / B (WA and CA)	Found primarily in LSOG coniferous forests in association with trees in the Pinaceae family; see the Survey and Manage Report (appendix F.5 of this EIS).	Douglas Jackson Klamath	CB-D MD-D	UMP-D RRS-D FW-D		NI	
Ramaria spinulosa var. *diminutiva*				S&M-B	Terrestrial under species of Pinaceae in October and November.	Douglas	CB-S RO-D MD-S	UMP-S RRS-S		NI	Not documented in Project vicinity.
Ramaria stuntzii				S&M-B	Found primarily in LSOG coniferous forests in association with trees in the family Pinaceae, particularly Douglas-fir, western hemlock, and Pacific silver fir.		CB-D MD-D RO-D	UMP-D RRS-D	Observed in CB BLM (<100 feet)..	MIIH [f/]	Potential indirect effects to individuals and habitat. [f/]
Ramaria suecica				S&M-B	On litter; fruits in autumn	Douglas	RO-D MD-D	UMP-S RRS-S		NI	Not documented in Project vicinity.
Ramaria thiersii				S&M-B	Terrestrial under species of Pinaceae in June.	Coos Douglas Jackson Klamath	RO-S MD-D	UMP-S RRS-S FW-D		NI	Not documented in Project vicinity.
Ramaria tsugina (*R. concolor f. tsugina*)				S&M -B	In humus or soil under *Abies* ssp., Douglas-fir, and western hemlock in October.	Coos Klamath	CB-D RO-S			NI	Not documented in Project vicinity.
Ramaria verlotensis				S&M-B	Unknown.					NI	Not documented in Project vicinity.
Rhizopogon abietis				S&M-B	Associated with Pinaceae. subalpine fir, Englemann spruce, and sestern white pine.		MD-D	UMP-S RRS-S FW-D		NI	Not documented in Project vicinity.
Rhizopogon alexsmithii (*Alpova alexsmithii*)			SEN	SEN S&M-B	Known from *Tsuga mertensiana*, *Abies amabilis*, and *Thuja plicata* vegetation zones at elevations of 2,852-5,805 feet. Associated species include *Abies amabilis*, *Pinus contorta*, *Picea engelmannii, Tsuga mertensiana, Vaccinium membranaceum* and *Vaccinium scoparium*.	Klamath				NI	Not documented in Project vicinity.
Rhizopogon atroviolaceus				S&M-B	Ectomycorrhizal association with trees in the Pinaceae family. Common symbionts of pine, fir, and Douglas-fir trees.			UMP-D RRS-S FW-S		NI	Not documented in Project vicinity.
Rhizopogon brunneiniger				S&M-B	Associated with roots of various Pinaceae species in low to high elevation conifer forests in September and October.	Douglas	CB-S RO-S MD-S	UMP-D RRS-D		NI	Not documented in Project vicinity.
Rhizopogon chamaleontinus			SEN	SEN S&M-B	Found in association with the roots of *Pseudotsuga menziesii* and scattered *Pinus lambertiana* at 3,600 feet elevation.		RO-S MD-S	RRS-D		NI	Not documented in Project vicinity.
Rhizopogon ellipsosporus			SEN	SEN S&M-B	Associated with roots of Douglas-fir and sugar pine in October.	Douglas Jackson	MD-D	RRS-D		NI	Not documented in Project vicinity.

TABLE I-5 (continued)

Special Status Plant (Vascular and Non-Vascular) and Fungi Species That May Occur Near the Jordan Cove Energy Project

Common Name and/or Scientific Name	Status a/ Federal	State	BLM	Forest Service	Expected Habitat	Documented or Suspected Occurrence b/ County	BLM	Forest Service	Within Vicinity of Project Area c/	Effect of Impact d/	Impact Reasoning
Rhizopogon evadens var. *subalpinus*				S&M-B	Found in association with the roots of *Tsuga mertensiana* or *Abies* spp. at mid to high elevation.	Douglas Klamath	LV	FW-D		NI	
Rhizopogon exiguus			SEN	SEN S&M-B	Associated with the roots of *Pseudotsuga menziesii* and *Tsuga heterophylla* at 3,100 feet elevation.		CB-S RO-S MD-D	UMP-S RRS-D		NI	Not documented in Project vicinity.
Rhizopogon flavofibrillosus				S&M-B	Associated with roots of various Pinaceae species in mid to high elevation conifer forests from July through November.	Douglas	CB-S RO-D MD-S	UMP-D RRS-D FW-S		NI	Not documented in Project vicinity.
Rhizopogon inquinatus			SEN	SEN S&M-B	Found in association with the roots of *Pinus jeffreyi*, *Pseudotsuga menziesii* and *Tsuga heterophylla* from 1,640 to 4,600 feet elevation.			UMP-S		NI	Not documented in Project vicinity.
Rhizopogon olivaceotinctus (*Alpova olivaceotinctus*)				S&M-B	Primarily found in ectomycorrhizal association with trees in the Pinaceae family and are especially common symbionts of pine, fir, and Douglas-fir trees.	Jackson	MD-D	RRS-S		NI	Not documented in Project vicinity.
Rhizopogon truncatus				S&M-D	Found in coniferous forests; documented on *Abies* spp., *Arbutus menziesii, Arctostaphylos uva-ursi, Pinus contorta, P. lambertiana, P. monticule, P. ponderosa, P. resinosa, Pseudotsuga menziesii, Tsuga canadensis, and T. mertensiana.*	Douglas Jackson Klamath	CB-S MD-D	UMP-D RRS-D FW-D	Observed in UMP and RRS; see the Survey and Manage Report (appendix F.5 of this EIS).	MIIH	Potential impacts to individuals or habitat; however, remaining sites would provide a reasonable assurance of species persistence.
Rhodocybe speciosa				S&M-B	Found in gregarious, caespitose clusters on rotten conifer wood at high elevation.					NI	Not documented in Project vicinity.
Rickenella swartzii (*R. setipes)*				S&M-B	Moist, shaded locations, typically in moss beds; known from coastal forests in the fall; locally abundant in small troops on or among mosses under hardwoods.	Coos Douglas	CB-D RO-D	RRS-S		NI	Not documented in Project vicinity.
Russula mustelina				S&M-B	Scattered to gregarious in montaine coniferous forests, particularly with *Abies* spp.	Coos				NI	Not documented in Project vicinity.
Sarcodon fuscoindicus				S&M-B	Found on soil associated with mature forests and old trees in conifer and mixed temperate forests.	Douglas Jackson	CB-S RO-D MD-D	UMP-D RRS-S	Observed in UMP; see the Survey and Manage Report (appendix F.5 of this EIS).	WOFV	Potential impacts to individuals or habitat; would affect site persistence and remaining sites may not provide a reasonable assurance of species persistence.
Sedecula pulvinata				S&M-B	Restricted to relatively dry areas of coniferous forests at relatively high elevation ranges and with little annual rainfall; found in association with the roots of *Abies concolor, A. lasiocarpa, A. magnifica, Picea engelmannii,* and *Pinus contorta*.	Jackson Klamath		RRS-D FW-D	Observed in RRS; see the Survey and Manage Report (appendix F.5 of this EIS).	MIIH	Potential impacts to individuals or habitat; however, remaining sites would provide a reasonable assurance of species persistence.
Sowerbyella rhenana				S&M-B	Prefers wet mossy areas under conifers.	Douglas Jackson Klamath	CB-D MD-D			NI	Not documented in Project vicinity.
Sparassis crispa				S&M-D	Primarily found in low-elevation coniferous forests in association with very large conifer trees; typically found within 6 feet of the base of a living conifer tree, such as *Pseudotsuga menziesii, Pinus muricate,* and *P. radiata.*	Coos Douglas Jackson	CB-D MD-D RO-D	UMP-D RRS-D	Observed in RO BLM and UMP; see the Survey and Manage Report (appendix F.5 of this EIS).	MIIH	Potential impacts to individuals or habitat; however, remaining sites would provide a reasonable assurance of species persistence.
Spathularia flavida				S&M-B	Found in a variety of forest types, ranging from coniferous to hardwood forests.	Jackson Klamath	CB-S RO-D	RRS-D UMP-D	Observed in RRS, UMP, and RO BLM; see the Survey and Manage Report (appendix F.5 of this EIS).	MIIH	Potential impacts to individuals or habitat; however, remaining sites would provide a reasonable assurance of species persistence.
Stagnicola perplexa			SEN	SEN S&M-B	Colonizes plant debris in wet coniferous forest floor depressions and shallow pools.	Douglas		UMP-S RRS-D		NI	Not documented in Project vicinity.
Stropharia (*Pholiota*) *albovelata*				S&M - B	Scattered under conifers on conifer litter from late April through early January.	Coos	CB-S			NI	Not documented in Project vicinity.
Thaxterogaster pavelekii (*Cortinarius pavelekii*)				S&M-B	Associated with roots of Sitka spruce and lodgepole pine in Sitka Spruce (63%) and Western Hemlock (37%) series at elevations of 17-588 feet.		CB-S			NI	Not documented in Project vicinity.

TABLE I-5 (continued)

Special Status Plant (Vascular and Non-Vascular) and Fungi Species That May Occur Near the Jordan Cove Energy Project

Common Name and/or Scientific Name	Status a/				Expected Habitat	Documented or Suspected Occurrence b/				Effect of Impact d/	Impact Reasoning
	Federal	State	BLM	Forest Service		County	BLM	Forest Service	Within Vicinity of Project Area c/		
Tremiscus helvelloides				S&M-D	Typically found in mesic coniferous forests where the humidity is high and the moss layer is well-developed.	Coos Douglas Jackson Klamath	CB-D RO-D MD-D	UMP-D RRS-D	Observed in RO, MD, UMP, and RRS; see the Survey and Manage Report (appendix F.5 of this EIS).	MIIH	Potential impacts to individuals or habitat; however, remaining sites would provide a reasonable assurance of species persistence.
Tricholoma venenatum				S&M-B	Solitary to scattered in duff of montane conifers; fruiting in the spring shortly after winter snows have melted; common. See the Survey and Manage Report (appendix F.5 of this EIS).	Douglas	RO-D	UMP-D	Observed in RO and UMP.	NI	Occurrences located in the moderate to high intensity burned areas during the Stouts Creek fire.
Tricholomopsis fulvescens				S&M-B	Found solitary on decayed conifer wood above 3,280 feet elevation.			UMP-S RRS-S		NI	Not documented in Project vicinity.
Tuber asa				S&M-B	Found in association with the roots of *Pseudotsuga menziesii* and *Tsuga heterophylla* at 560 to 1,640 feet elevation in Oregon.		CB-S			NI	Not documented in Project vicinity.
Tuber pacificum				S&M-B	Low elevation moist coniferous forests.	Coos	CB-S			NI	Not documented in Project vicinity.
Tylopilus porphyrosporus (T. pseudoscaber)				S&M-D	Solitary to scattered under conifers, especially Sitka Spruce. Also associated with pines.		CB-D			NI	Not documented in Project vicinity.
Lichens											
Horsehair lichen *Bryoria pseudocapillaris*			S&M-B	S&M-A	Grows on exposed or moderately exposed coastal trees, shrubs, and (once) on rock, primarily in late seral and old-growth shorepine scrub forests of dunes, marine terraces, and in Sitka spruce forests along the edges of coastal lagoons, estuaries, and headlands at or near sea level (0-250 feet elevation). Occurring in sites with moderated temperature and high humidity provided by frequent fog.		CB-D RO-S			NI	Not documented in Project vicinity.
Bryoria spiralifera				S&M-A	Grows on exposed or moderately exposed coastal trees, shrubs, and (once) on rock, primarily in late seral and old-growth shorepine scrub forests of dunes, marine terraces, and in Sitka spruce forests along the edges of coastal lagoons, estuaries, and headlands at or near sea level (0-250 feet elevation). Occurring in sites with moderated temperature and high humidity provided by frequent fog.	Coos Douglas	CB-D RO-S			NI	Not documented in Project vicinity.
Bryoria subcana			SEN	SEN S&M-B	Grows on conifer bark in forests of coastal bays, streams, dune forests, and high precipitation ridges within 30 mi (50 km) of the ocean. Inhabits areas of high humidity, mostly in late-seral to old-growth stands.	Coos	CB-D RO-D	RRS-D	Observed in CB BLM approximately 100 ft from ROW near MP 21.88BR.	MIIH [f/]	Potential indirect effects to individuals and habitat. [f/]
Buellia oidalea				S&M-E	Bark of various shrubs, hardwoods, and conifers, maritime (< 1 km from coastline), known from Oregon Dunes NRA.	Douglas Jackson	CB-S			NI	Not documented in Project vicinity.
Calicium abietinum				S&M-B	Mostly found in sparsely forested reegions, becoming very rare in drier, non-forested areas and wetter, densely forested areas.	Coos	CB-D			NI	Not documented in Project vicinity.
Calicium adspersum				S&M-E	Highly textured bark on the boles of old growth conifer trees.	Coos	CB-S RO-S			NI	Not documented in Project vicinity.
Cetrelia cetrarioides				S&M-E	Riparian and epiphytic lichen that is typically found on the bark of hardwood and conifer trees, including *Alnus rubra, Acer macrophyllum,* and *Pseudotsuga menziesii,* in riparian areas; occasionally found on mossy rocks.	Coos	CB-D		Observed in CB BLM (<100 m from ROW) near MP 17.6BR.	MIIH [f/]	Potential indirect effects to individuals and habitat. [f/]
Chaenotheca chrysocephala				S&M-B	Frequent on bark and wood of old conifers including *Abies* spp., *Picea* spp., *Pseudotsuga menziesii*, *Thuja plicata* and decorticated snags. Prefers semi-open forests at relatively low elevations (260-13,770 feet elevation) and is most abundant on conifer trunks in mixed forests and in edge habitats, also in relatively young stands.	Douglas	CB-D RO-D MD-D		Observed in CB (<100 feet from ROW), RO (within ROW and <100 feet from ROW), and MD.	MIIH [f/]	Potential removal of individuals within ROW; direct and indirect habitat effects. [f/]
Chaenotheca ferruginea				S&M-B	Found on the bark and wood of conifers in semi-open montane forests and foothills, as well as on conifer boles in rainforests. In the Pacific Northwest, mostly found on the bark of oak and coniferous trees more than 200 years old in open habitats, with occasional occurrences on slightly younger trees.	Douglas Jackson	CB-S RO-D MD-S		Observed in RO (within ROW and <100 feet from ROW) and MD (<100 meters from ROW).	MIIH [f/]	Potential removal of individuals within ROW; direct and indirect habitat effects. [f/]

TABLE I-5 (continued)

Special Status Plant (Vascular and Non-Vascular) and Fungi Species That May Occur Near the Jordan Cove Energy Project

Common Name and/or Scientific Name	Status a/ Federal	State	BLM	Forest Service	Expected Habitat	Documented or Suspected Occurrence b/ County	BLM	Forest Service	Within Vicinity of Project Area c/	Effect of Impact d/	Impact Reasoning
Chaenotheca furfuracea				S&M-F [e/]	Generally found in sheltered coves under the bole of an old-growth tree, but occasionally within other overhangs with exposed roots. Typically associated with trees more than 200 years old; presumed to be restricted to specific microclimate conditions of LSOG coniferous and mixed hardwood-coniferous forests across a wide elevation range.		CB-D RO-D		Observed in CB BLM and RO BLM.	MIIH [f/]	Potential impacts to individuals or habitat. [f/]
Chaenotheca subroscida				S&M-E	Primarily found on conifer bark and occasionally wood in old-growth forests at low to middle elevations, generally less than 6,000 feet.	Douglas Jackson Klamath	RO-D MD-D CB-S	UMP-D RRS-D FW-D	Observed in RO BLM, MD BLM, RRS, and FW.	MIIH	Potential impacts to individuals or habitat; however, remaining sites would provide a reasonable assurance of species persistence.
Chaenothecopsis pusilla				S&M-E	Usually occurs in relatively open stands in drier microhabitats where sheltered from precipitation, such as in crevices of bark, the dry side of leaning trunks, or the underside of limbs.		CB-S			NI	Not documented in Project vicinity.
Cladidium bolanderi			SEN	SEN	On a variety of rock types (sandstone, chert, granite, serpentine) on coastal bluffs and coastal grasslands. Presumably nitrophilous because of its occurrence where birds roost. Elevations from sea level to 1,000 feet.		CB-S			NI	Not documented in Project vicinity.
Cladonia norvegica				S&M-B [e/]	Decaying wood and bark at the base of conifers in humid shady forests.		CB-D			NI	Not documented in Project vicinity.
Collema nigrescens				S&M-F (WA and OR; except Klamath Physio-graphic Province)	Grows on bark of hardwood trees and shrubs, including Garry oak, canyon live oak, big-leaf maple, cottonwood, and vine maple.		RO-D MD-D			NI	Not documented in Project vicinity.
Dendriscocaulon intricatulum				S&M-A (OR, except Coos, Curry, Douglas, Josephine and Jackson counties, and WA) / E (CA)	In oak habitat is is most commonly found growing on the boles and larger branches of young oaks.		MD-D		Observed in MD; not S&M in Jackson County.	MIIH	Potential impacts to individuals or habitat; however, this species is not considered an S&M species in Jackson County.
Dermatocarpon luridum				S&M-E	Aquatic lichen which grows on rocks, small boulders, and bedrock, submerged or seasonally emergent, adjacent to or in clear mountain streams where it can be locally abundant. It is present on seepy terraces, and in streams and rivers with red alder, Douglas-fir, western hemlock and riparian vegetation ranging from young stands to old-growth, and in streams in alpine meadows.		CB-S	RRS-S UMP-D FW-S		NI	Not documented in Project vicinity.
Fuscopannaria (Pannaria) saubinetii				S&M-E	Base of large *Quercus* spp. and *Fagus* spp. in Mediterranean climates at low elevations.		CB-D		Observed in CB BLM.	MIIH [f/]	Potential impacts to individuals or habitat. [f/]
Heterodermia sitchensis				S&M-E	Restricted to the immediate coast. The north-facing, foreshore exposure in Oregon seems to indicate a requirement for high humidity.	Douglas	CB-S			NI	Not documented in Project vicinity.
Hypogymnia duplicata				S&M-C	Mid-elevation moist western hemlock stands, old-growth Douglas-fir, mature western hemlock/Douglas-fir forest, moist Pacific silver fir or noble fir forests, Sitka spruce, riparian forest and later-successional forest, along ridgetops in Oregon Coast Range, also on red alder in sedge-sphagnum bogs in Oregon Coast Range. Elevation 1,100-5,450 feet.		CB-S RO-S			NI	Not documented in Project vicinity.
Hypogymnia vittata				S&M-E	Grow on bark, cork, plant surface, trunks, branches, twigs.					NI	Not documented in Project vicinity.
Hypotrachyna revoluta				S&M-E	On rocks, trunks of alders growing on streambanks and lakesides.	Coos	CB-D		Observed in CB BLM (2014) less than 100 feet from ROW near MP 21.88BR.	MIIH [f/]	Potential indirect effects to individuals or habitat. [f/]
Treepelt lichen *Leioderma sorediatum*			SEN	SEN	On shrubs (huckleberry and manzanita) and mossy conifer branches in humid coastal forests.	Coos Douglas	CB-S			NI	Not documented in Project vicinity.
Leptogium burnetiae var. *hirsutum*				S&M-E	Usually on hardwood trunks and branches but also on decaying logs and rocks. In mesic open forests.	Jackson	MD-S	UMP-S FW-S		NI	Not documented in Project vicinity.
Leptogium cyanescens			SEN	SEN S&M-A	Occurs in mixed conifer and Douglas-fir stands, and in maple and willow thickets in both riparian and upland habitats.	Douglas Jackson	CB-S	RRS-S		NI	Not documented in Project vicinity.

TABLE I-5 (continued)

Special Status Plant (Vascular and Non-Vascular) and Fungi Species That May Occur Near the Jordan Cove Energy Project

Common Name and/or Scientific Name	Status a/ Federal	State	BLM	Forest Service	Expected Habitat	Documented or Suspected Occurrence b/ County	BLM	Forest Service	Within Vicinity of Project Area c/	Effect of Impact d/	Impact Reasoning
Leptogium rivale				S&M-E	Streams with no scouring and no or only minor siltation and unpolluted water; primarily found on rocks submerged in water.		CB-S MD-D			NI	Not documented in Project vicinity.
Leptogium teretiusculum				S&M-E	Found in hardwood stands in riparian areas, particularly in shaded areas where humidity is high; more abundant on hardwoods compared to conifers and prefers larger, older trees; see the Survey and Manage Report (appendix F.5 of this EIS).	Douglas Jackson	CB-S RO-D MD-D	UMP-S RRS-D	Observed in MD BLM and RRS; see the Survey and Manage Report (appendix F.5 of this EIS)	MIIH	Potential impacts to individuals or habitat; however, remaining sites would provide a reasonable assurance of species persistence.
Lobaria linita			SEN	SEN S&M-A (WA and OR)	On trees, shrubs, mossy rocks or alpine sod. Montane to alpine.	Douglas Jackson	CB-S RO-D MD-D	UMP-D RRS-S		NI	Not documented in Project vicinity.
Microcalicium arenarium			SEN	SEN S&M-B	Forms small colonies on free-living green algae or leprose lichens growing in drier microhabitats such as bark, wood, root, and rock faces that are sheltered from precipitation. In the Pacific Northwest, probably restricted to old-growth forests because its host species often appear only in forests older than 100 years. Known elevations are below 2,000 feet.	Coos	CB-D			NI	Not documented in Project vicinity.
Nephroma bellum				S&M-E (OR: Klamath, Willamette Valley, E. Cascades; WA: W. Cascades outside GPNF, E. Cascades, Olympic Peninsula)/ F [e/] (OR: W. Cascades, Coast; WA: W. Cascades in GPNF)	Strongly associated with riparian stands. They often have a gappy canopy, a large proportion of hardwood versus conifer trees, variable tree size, and perennial surface water.					NI	Not documented in Project vicinity.
Nephroma isidiosum				S&M-E	Grows on bryophytes, mosses, liverworts, bark, cork, plant surface trunks, branches, twigs, rock, stones, pebbles.					NI	Not documented in Project vicinity.
Nephroma occultum				S&M-B [e/]	Found on branches of old-growth Douglas-fir, western hemlock, and Pacific silver fir; elevation 1,000-3,200 feet.	Douglas Jackson	CB-S MD-S RO-D	RRS-D UMP-D		NI	Not documented in Project vicinity.
Niebla lichen *Niebla cephalota*			SEN	SEN S&M-A	Strictly a coastal species but may extend up to 15 miles inland where influenced by the coastal fog belt; occurs on exposed trees shrubs, and less often on rocks or bark; elevation <250 feet. Found on exposed Sitka's spruce, Hooker's willow, Monterey cypress, and shore pine in open forest, forest edges, and scrublands.	Coos	CB-D			NI	Not documented in Project vicinity.
Pannaria rubiginella			SEN	SEN	On bark and wood in cool, moist habitats along the Pacific coast. Inland habitat not well documented.	Coos	CB-D			NI	Not documented in Project vicinity.
Pannaria rubiginosa			SEN	SEN S&M-E	Low elevation coastal shrub thickets on wet deflation plains, mature Douglas-fir/western hemlock forest, and old growth conifer forest dominated by Douglas-fir, Sitka spruce, and western red cedar.	Coos Douglas	CB-S			NI	Not documented in Project vicinity.
Peltigera pacifica				S&M-E	Grows on soil, moss, rocks, logs, and tree bases, mainly in moist coniferous and hardwood forests with closed canopy stands.		CB-D RO-D MD-D	RRS-S UMP-D	Observed in RO (within ROW and <100 meters from ROW).	MIIH [f/]	Potential removal of individuals within ROW; direct and indirect habitat effects. [f/]
Pilophorus nigricaulis			SEN	SEN	Grows primarily on volcanic rock substrates (basalt and andesite). Habitats have been described as lava flows, cliffs, rock outcrops, talus slopes, and large boulders.		RO-S			NI	Not documented in Project vicinity.
Platismatia lacunosa				S&M-E (except OR Coast Range)	Uncommon on the boles and branches of hardwood and conifer bark in moist, cool upland sites as well as moist riparian forest in the Coast Range and Cascades.		CB-D		Observed in CB BLM (2014) in ROW at MP 18.99BR.	MIIH [f/]	Potential removal of individuals within ROW; direct and indirect habitat effects. [f/]

TABLE I-5 (continued)

Special Status Plant (Vascular and Non-Vascular) and Fungi Species That May Occur Near the Jordan Cove Energy Project

Common Name and/or Scientific Name	Status a/ Federal	State	BLM	Forest Service	Expected Habitat	Documented or Suspected Occurrence b/ County	BLM	Forest Service	Within Vicinity of Project Area c/	Effect of Impact d/	Impact Reasoning
Pseudocyphellaria perpetua (Pseudocyphellaria sp. 1)				S&M-A	Oregon Coast on old growth conifer trees in western hemlock forests, sand late-seral Douglas-fir forests.	Coos	CB-D RO-S			NI	Not documented in Project vicinity.
Pseudocyphellaria rainierensis				S&M-A	Epiphyte primarily on conifer trees in cool, humid, old-growth to climax forests in the Western Hemlock or lower Pacific Silver Fir zones; elevation between 330-4,000 feet.	Douglas	CB-D RO-S	UMP-D		NI	Not documented in Project vicinity.
Ramalina pollinaria			SEN	SEN	Bark and wood, usually in low elevation swamps.	Coos Jackson?	CB-D	UMP-S RRS-S		NI	Not documented in Project vicinity.
Stenocybe clavata				S&M-E	On bark of old conifers in humid, sheltered forests at low elevations.	Coos	CB-D		Observed in CB BLM (2014) within ROW.	MIIH [f/]	Potential removal of individuals within ROW; direct and indirect habitat effects. [f/]
Stereocaulon spathuliferum			SEN	SEN	On rock.	Jackson.	MD-S RO-S			NI	Not documented in Project vicinity.
Teloschistes flavicans			SEN	SEN S&M-A	Forested headlands and dunes of the coastal fog belt, especially on capes or peninsulas, at sites less than 200 m (600 ft) elevation. Found on oak, shore pine, Sitka spruce, shrubs, moss, and soil.	Coos	CB-D			NI	Not documented in Project vicinity.
Texosporium sancti-jacobi			SEN	SEN	Arid to semi-arid shrub-steppe, grassland or savannah communities up to 3,280 feet in elevation. It requires natural openings or gaps in arid vegetation that are not maintained by fire.		LV-S	FW-S		NI	Not documented in Project vicinity.
*Tholurna dissimilis (*south of Columbia River*)*			SEN	SEN S&M-B	On krummholz subalpine fir and Engleman spruce on windswept ridges in the upper montane and subalpine zones up to timberline. Elevation from just above sea level to 6,700 feet., in old growth forests.					NI	Not documented in Project vicinity.
Usnea hesperina				S&M-E	Epiphyte on coniferous trees and hardwood shrubs in forested and shrubby habitats of the coastal fog belt. All known sites are within 5 km (3 mi) of the Pacific Ocean.		CB-S MD-S			NI	Not documented in Project vicinity.
Usnea longissima				S&M-A (Curry, Josephine, Jackson counties OR; CA / F (other OR counties; WA)	Occurs in old-growth and late successional conifer stands, and in hardwood stands and lowland riparian woodland areas. It can also grow in clear-cut and other young stands where there is suitable substrate (i.e. conifers and hardwoods) for colonization.		CB-D MD-D RO-D	UMP-D	CB BLM within ROW and < 100 meters from ROW near MP 27.3 and 27.4.	MIIH [f/]	Potential indirect effects to individuals or habitat.[f/]
Usnea nidulans			SEN	SEN	Occurs exclusively in hyper-maritime forests on the immediate coast and in the Coast Ranges. It grows on conifers and deciduous trees.		CB-S			NI	Not documented in Project vicinity.
Vascular Plants											
Pink sand verbena *Abronia umbellata* var. *breviflora*	SOC	E	SEN	SEN	Beaches and foredunes of the Pacific Coast. In Oregon and north, restricted to beaches, and rarely occurs in foredune environments. Occurs on fine sand between the high-tide line and the long-term driftwood zone. Occurs in areas of sand movement. Most populations occur on broad beaches and/or near the mouths of creeks or rivers.	Coos Douglas	CB-D			NI	Not documented in Project vicinity.
California maiden-hair *Adiantum jordanii*			SEN	SEN	Rocky areas in moist woods.	Coos Douglas Jackson	CB-D RO-D MD-D	UMP-S RRS-D FW-S		NI	Not documented in Project vicinity.
Cusick's giant-hyssop *Agastache cusickii*			SEN		Dry, rocky sites and often on talus slopes.		LV-D			NI	Not documented in Project vicinity.
Geyer's onion *Allium geyeri* var. *geyeri*			SEN	SEN	Moist, open slopes, meadows, or stream banks in mountains.		LV-D			NI	Not documented in Project vicinity.
Peninsular onion *Allium peninsulare*			SEN	SEN	Dry open or wooded slopes and flats to 3000 feet; valley grassland, foothill woodlands; March through June.	Jackson	MD-D	RRS-S		NI	Not documented in Project vicinity.

TABLE I-5 (continued)

Special Status Plant (Vascular and Non-Vascular) and Fungi Species That May Occur Near the Jordan Cove Energy Project

Common Name and/or Scientific Name	Status a/ Federal	Status a/ State	Status a/ BLM	Status a/ Forest Service	Expected Habitat	Documented or Suspected Occurrence b/ County	Documented or Suspected Occurrence b/ BLM	Documented or Suspected Occurrence b/ Forest Service	Documented or Suspected Occurrence b/ Within Vicinity of Project Area c/	Effect of Impact d/	Impact Reasoning
Koehler's rockcress *Arabis koehleri* var. *koehleri*	SOC	C	SEN		Rocky cliff sites.	Douglas	RO-D			NI	Not documented in Project vicinity.
Rogue Canyon rockcress *Arabis modesta*			SEN	SEN	Known only from the Rogue River canyon near Galice, Josephine County.	Jackson	MD-D	RRS-D	STF (2017) 2 sites 24 feet and 90 feet N/NW of TEWA 124.30-N.	MIIH	Potential indirect impacts to individuals and habitat.
Gasquet (hairy) manzanita *Arctostaphylos hispidula*			SEN	SEN	Rocky serpentine soils or sandstone, open forests.	Douglas	CB-D RO-S MD-S	RRS-D		NI	Outside of known (or probable) range
Shasta arnica *Arnica viscosa*			SEN	SEN	High elevation, open rocky sites; known in Deschutes, Klamath, Douglas Co, OR; In Fremont-Winema NF, found at a few sites in wilderness along the Cascade Crest and on Pelican Butte.	Douglas Klamath	MD-S	UMP-D RRS-S FW-D		NI	Not documented in Project vicinity.
Coastal sagewort *Artemisia pycnocephala*			SEN	SEN	Rocky or sandy soils, coastal strand.	Coos	CB-D			NI	No suitable habitat in Project area.
Grass-fern *Asplenium septentrionale*			SEN	SEN	Grows on shady, moist, north faces of large rocks; only known in North Umpqua.	Dougals Jackson Klamath	RO-S MD-S	UMP-D RRS-D FW-D		NI	Not documented in Project vicinity.
Applegate's milk-vetch *Astragalus applegatei*	E	E			Occurs in flat-lying, seasonally moist, strongly alkaline soils dominated by greasewood with sparse, native bunch grasses and patches of bare soil.	Klamath			Sites documented near ROW between MP 195.35 and 196.50 and within the Klamath Falls Memorial Drive 2/Bair pipe storage yard. Historical documentation between MP 191.20 – 214.30.	LAA	Impacts to potential habitat that has not been surveyed; impacts to individuals if present.
California milk-vetch *Astragalus californicus*			SEN		Dry open areas in shrubland.	Jackson Klamath	MD-D			NI	Not documented in Project vicinity.
Gambel milk-vetch *Astragalus gambelianus*			SEN		Open grassy areas, shrublands.	Jackson	MD-D			NI	Not documented in Project vicinity.
Geyer's milk-vetch *Astragalus geyeri* var. *geyeri*			SEN		Chenopod scrub, Great Basin scrub		LV-S			NI	Not documented in Project vicinity.
Lemmon's milk-vetch *Astragalus lemmonii*	SOC		SEN	SEN	Great Basin scrub, meadows and seeps, marshes and swamps (lake shores). NOTE: According to 10/23/2012 plant meeting in Corvallis, *A. lemmonii* should be *A. cooperi* (*A. lemmonii* not in OR).	Klamath		FW-D		NI	Not documented in Project vicinity.
Peck's milk-vetch *Astragalus peckii*		T	SEN	SEN	Very dry sites, on loose, sandy soil or pumice. Often found in/along dry water courses, in sagebrush or rabbitbrush openings in lodgepole pine forests (in the south) or in western Juniper woodlands (in the north), occ. on barren flats.	Klamath		FW-D		NI	Species has not been documented in Project vicinity and no suitable habitat is present in Project area.
Bastard kentrophyta *Astragalus tegetarioides*		C	SEN	SEN	Dry sandy soil in Ponderosa pine forests (4,790-5,315 feet).		LV-D			NI	Not documented in Project vicinity.
Bensonia *Bensoniella oregana*		C	SEN	SEN	Wet meadows and moist streamside sites in pre-Cretaceous metasedimentary rock at elevations above 4,000 feet.	Coos Douglas	CB-D RO-D MD-D	RRS-D	One site located (2011) in RO BLM approximately 150' E of existing Signal Tree Road Quarry (MP 47.00)	NI	The single site observed during surveys will be avoided.
Crater Lake rock-cress *Boechera horizontalis* (*Arabis suffrutescens* var. *horizontalis*)	SOC	C			Gravel or stony slopes, dry pumice; high elevation open sites.	Jackson Klamath		UMP-S RRS-S FW-S		NI	Not documented in Project vicinity.
Crenulate moonwort (Crenulate grape-fern) *Botrychium crenulatum*		C	SEN	SEN	Marshes, meadows above 4000 feet.	Douglas Jackson	LV-D	FW-S		NI	Not documented in Project vicinity.
Victorin's grape-fern *Botrychium minganense*				S&M-A (OR and CA)	Various: old-growth forests and riparian zone (not wet soils), subalpine and lush meadows, mossy talus slopes under bigleaf maple, road cuts, shrub lands, and alder thickets.	Douglas	RO-S	UMP-S		NI	Not documented in Project vicinity.
Mountain grape-fern *Botrychium montanum*			SEN	SEN S&M-A	Occurs in dark coniferous forests, usually near swamps and streams from (3300-9800 feet) in elevation.					NI	Not documented in Project vicinity.

TABLE I-5 (continued)

Special Status Plant (Vascular and Non-Vascular) and Fungi Species That May Occur Near the Jordan Cove Energy Project

Common Name and/or Scientific Name	Status a/ Federal	State	BLM	Forest Service	Expected Habitat	Documented or Suspected Occurrence b/ County	BLM	Forest Service	Within Vicinity of Project Area c/	Effect of Impact d/	Impact Reasoning
Pumice grape-fern *Botrychium pumicola*		T	SEN	SEN	Loose volcanic soil, frost pockets and lodgepole pine basins (4,985 8,105 feet).	Klamath	LV-S	UMP-S RRS-S FW-D		NI	Species has not been documented in Project vicinity and no suitable habitat is present in Project area.
Dwarf brodiaea *Brodiaea terrestris*			SEN	SEN	Grassland, open woodlands.	Coos	CB-D			NI	Not documented in Project vicinity.
Brewer's reedgrass *Calamagrostis breweri*			SEN	SEN	Restricted to subalpine habitats in a narrow elevation range in Oregon. Most populations in Oregon occur between 5,000-6,000 feet. Usually found in moist meadows with limited vegetative competition.			UMP-S		NI	Not documented in Project vicinity.
Winged water-starwort *Callitriche marginata*			SEN		Ponds, vernal pools.	Jackson	MD-D			NI	Not documented in Project vicinity.
Cox's (Crinite) mariposa-lily *Calochortus coxii*	SOC	E	SEN		Typically grows in serpentine grasslands and forest margins most often on shady, north-facing, mesic sites near ridgelines.	Douglas	RO-D MD-S		RO BLM within construction right-of-way between MP 74.08-75.02	WOFV	Impacts to individuals and habitat.
Greene's mariposa-lily *Calochortus greenei*		C	SEN	SEN	Grows on dry, bushy hillsides in southern Jackson County.	Jackson Klamath	MD-D	FW-S		NI	Not documented in Project vicinity.
One-leaved mariposa-lily *Calochortus monophyllus*			SEN		Wooded slopes, clay loam soils.	Jackson	MD-D			NI	Not documented in Project vicinity.
Siskiyou mariposa lily *Calochortus persistens*	SOC	C	SEN		Open rocky areas.	Jackson	MD-D			NI	Not documented in Project vicinity.
Umpqua mariposa lily *Calochortus umpquaensis*		E	SEN	SEN	Transitional zone between forest and grassland, on serpentine soils (885-2,690 feet).	Douglas Jackson	MD-S RO-D	UMP-D	UMP (2016) 7 plants along EAR 102.30 and 25 feet E of Rock Source/Disposal Hatchet Quarry MP 102.30; large populations have been documented 1.3 to 2.5 miles E of MP 99.55 on Umpqua National Forest.	MIIH	Potential impacts to individuals and habitat.
Howell's camassia *Camassia howellii*	SOC	C	SEN	SEN	Grassy wet meadows, swampy ground, and transitional areas between wet meadows and coniferous woodlands.	Jackson	RO-S MD-D	RRS-D		NI	No suitable habitat in Project area.
Slender-flowered evening-primrose *Camissonia graciliflora* (*Tetrapteron graciliflorum*)			SEN	SEN	Open rocky grassy and shrublands, usually clay soils.	Jackson	MD-D	RRS-D		NI	Not documented in Project vicinity.
Washoe suncup *Camissonia pusilla*			SEN	SEN	Dry, open to branchy slopes, flats, and roadsides on sandy soil with *Artemisia* to pinyon-juniper			FW-S		NI	Not documented in Project vicinity.
Short-stemmed sedge *Carex brevicaulis*			SEN	SEN	Rocky or sandy soils.	Coos Douglas	CB-D RO-S			NI	Not documented in Project vicinity.
Capitate sedge *Carex capitata*			SEN	SEN	Wet places.	Jackson Klamath	MD-D LV-S	RRS-D FW-D		NI	Not documented in Project vicinity.
Bristly sedge *Carex comosa*			SEN	SEN	Wet places.	Jackson Klamath	RO-S MD-D	RRS-S FW-S	Observed on private land 66 feet S of TEWA 184.30.	MIIH	Potential indirect impacts to individuals and habitat.
Cordilleran sedge *Carex cordillerana*			SEN	SEN	Naturally disturbed, rocky slopes with organic layer and leaf litter in mesic mixed forests, or disturbed, open, grassy slopes; 1,640-7,900 feet.			FW-D		NI	Not documented in Project vicinity.
Lesser panicled sedge *Carex diandra*			SEN	SEN	Meadows.	Jackson Klamath	LV-D	UMP-S RRS-S FW-D		NI	Not documented in Project vicinity.
A sedge *Carex klamathensis*			SEN	SEN	Chaparral, cismontane woodland, meadows, and seeps.		MD-D	RRS-D		NI	Not documented in Project vicinity.

TABLE I-5 (continued)

Special Status Plant (Vascular and Non-Vascular) and Fungi Species That May Occur Near the Jordan Cove Energy Project

Common Name and/or Scientific Name	Status a/ Federal	State	BLM	Forest Service	Expected Habitat	Documented or Suspected Occurrence b/ County	BLM	Forest Service	Within Vicinity of Project Area c/	Effect of Impact d/	Impact Reasoning
Slender sedge *Carex lasiocarpa* var. *americana*			SEN	SEN	Bogs, shallow water.	Klamath	LV-D	UMP-S RRS-S FW-D		NI	Not documented in Project vicinity.
Pale sedge *Carex livida*			SEN	SEN	Moist to wet, shade-free habitats such as bogs, fens, swamps, stream banks and damp forests.		CB-S MD-D	RRS-D		NI	Not documented in Project vicinity.
Bighead sedge *Carex macrocephala*			SEN	SEN	Sandy beaches, sand dunes.	Coos Douglas	CB-S			NI	Not documented in Project vicinity.
Spikenard sedge *Carex nardina*			SEN	SEN	Exposed arctic and alpine tundra, usually calcareous cliffs, rocky slopes, ridges, and summits; 150-10,800 feet.	Douglas		UMP-D		NI	Not documented in Project vicinity.
Sierra nerved sedge *Carex nervina*			SEN	SEN	Moist to wet places.	Jackson	MD-S	RRS-D		NI	Not documented in Project vicinity.
Russet sedge *Carex saxatilis*				SEN	Fens, bogs, wet tundra, roadside ditches, shores of lakes, ponds, and slow moving streams, often in shallow water, 0-12,150 feet.			FW-S		NI	Not documented in Project vicinity.
Dark alpine sedge *Carex subnigricans*			SEN	SEN	Moist rocky slopes, alpine meadows; above 8,200 feet.		LV-S			NI	Not documented in Project vicinity.
Native sedge *Carex vernacula*			SEN	SEN	Moist alpine tundra, moist forest openings just below treeline.		LV-S	UMP-S FW-D		NI	Not documented in Project vicinity.
Green-tinged paintbrush *Castilleja chlorotica*			SEN	SEN	Grows on dry gravelly or sandy slopes; Elevation 6000 - 8000 feet; late June through mid-August. Found in shrub openings on slopes and ridges.	Klamath	LV-S	FW-D		NI	No suitable habitat in Project area.
Split-hair paintbrush *Castilleja schizotricha*				SEN	Decomposed granite or marble at high elevations.	Jackson		RRS-D		NI	No suitable habitat in Project area.
Desert chaenactis *Chaenactis xantiana*			SEN	SEN	Open, deep, loose sandy (rarely gravelly) soils, arid and semiarid shrublands, chaparral.		LV-D			NI	Not documented in Project vicinity.
Coville's lip-fern *Cheilanthes covillei*			SEN	SEN	Rock outcrops, cliffs.	Jackson	MD-D	RRS-D		NI	Not documented in Project vicinity.
Fee's lip-fern *Cheilanthes feei*			SEN	SEN	Calcareous cliffs and ledges, usually on limestone or sandstone; 325-12,470 feet.		LV-S	FW-S		NI	Not documented in Project vicinity.
Coastal lip-fern *Cheilanthes intertexta*			SEN	SEN	Rock outcrops, cliffs.	Douglas Jackson	MD-D	RRS-S FW-S	Observed in MD BLM (2015) 65 feet W of MP 148.9; >100 feet of MP 149.9 (2000).	MIIH	Potential impacts to individuals and habitat.
Narrow-leaved amole *Chlorogalum angustifolium*			SEN	SEN	Clay soils in dry grassland.	Jackson	MD-D	RRS-S		NI	Not documented in Project vicinity.
Soap lily *Chlorogalum pomeridianum* ssp. *novum*			MW		Coastal shrub, chaparral, oak woodlands, low elevation conifer and mixed-evergreen forests.		MD-D		Observed in MD BLM (2007) in ROW near MP 150.7 and AGF 150.7.	MIIH	Potential impacts to individuals and habitat.
Oregon timwort *Cicendia quadrangularis*			SEN	SEN	Openings.	Coos Douglas	CB-D RO-D	RRS-D		NI	Not documented in Project vicinity.
Tall bugbane *Cimicifuga elata* var. *elata*		C			Mature to old-growth forests; generally with distinct canopy layers and relatively sparse understory.	Douglas				NI	Not documented in Project vicinity.
Mt. Mazama collomia *Collomia mazama*			SEN	SEN	Dry woods at high elevations; July and August; True fir/lodgepole pine forest, meadows, and meadow edges; On Fremont-Winema NF, found in Lost Creek, Horse Creek, Rock Creek and Cherry Creek drainages, Klamath RD.	Douglas Jackson Klamath		UMP-D RRS-D FW-D		NI	Not documented in Project vicinity.
Spleenwort-leaved goldthread *Coptis asplenifolia*				S&M-A	Occurs in moist forests and bogs, at low to middle elevations, in areas with a strong maritime influence.		RO			NI	Not documented in Project vicinity.
Threeleaf goldthread *Coptis trifolia*			SEN	SEN S&M-A	Associated with small wetland areas located within mature coniferous forests in the Western Hemlock Zone and Silver Fir Zone at an elevation of 3,280-3,800 feet above sea level. Soils are poorly drained histosols.					NI	Not documented in Project vicinity.

TABLE I-5 (continued)

Special Status Plant (Vascular and Non-Vascular) and Fungi Species That May Occur Near the Jordan Cove Energy Project

Common Name and/or Scientific Name	Status a/ Federal	State	BLM	Forest Service	Expected Habitat	Documented or Suspected Occurrence b/ County	BLM	Forest Service	Within Vicinity of Project Area c/	Effect of Impact d/	Impact Reasoning
Pt. Reyes bird's-beak *Cordylanthus maritimus* ssp. *palustris* (*Chloropyron maritimum ssp. palustre*)	SOC	E			Inhabits salt marshes along the coast, sometimes growing just above tidewater in wet areas.	Coos	CB-D		Documented on the shorelines of: Jordan Cove (1992), 260 feet S of TEWA 0.10 (1999); Haynes Inlet (1999) 815 feet N of Jordan Cove MS; also occurs along the shoreline between APCO Sites 1 and 2 and along shoreline south of the South Dunes site. Pony Slough (1999) 670 feet W/SW of MP 1.09; (2017) on edge of Coos Bay inlet in 475 feet NW of ROW near MP 0.9 and 700 feet W/NW of TEWA 1.09-W.	MIIH	Construction of the Project has the potential to impact individual plants found within and near the proposed Project (including both the LNG Project area and the pipeline). Plants adjacent to the pipeline construction areas would be protected through the appropriate installation of safety and silt fence.
Coldwater corydalis *Corydalis aquae-gelidae*		C	SEN	SEN S&M-A	Found in close proximity to seeps, springs, or streams with relatively cold water, a substrate of gravelly-sand, upper level canopy closure of 70% to 90%, and little herbaceous competition. Located in the Western Hemlock and Pacific Silver Fir Zones. Elevation range between 1,200-4,260 feet.			RRS-D		NI	Not documented in Project vicinity.
Seaside cryptantha *Cryptantha leiocarpa*			SEN		Coastal strand, northern coastal scrub.		CB-D			NI	Not documented in Project vicinity.
Milo baker's cryptantha *Cryptantha milobakeri*			SEN	SEN	Rocky or gravelly soils in conifer openings, chaparral or oak woodlands.	Jackson	MD-D RO-D	RRS-D		NI	Not documented in Project vicinity.
Pine woods cryptantha *Cryptantha simulans*				SEN	Gravelly or rocky habitats.	Douglas Jackson Klamath	LV-D	RRS-D FW-D	RRS (2017): 50 plants 96 feet NW of MP 155.8; FW (2017): 5 plants on edge of Clover Creek Rd and 10 feet from ROW near MP 175.3; LV BLM: 100 plants in ROW near MP 176.96; 1 plant on edge of Clover Creek Road and ROW near MP 176.98.	MIIH	Potential impacts to individuals and habitat.
Snowline spring-parsley *Cymopterus nivalis*			SEN	SEN	Dry drainages, coarse soils in shrub-steppe.		LV-D			NI	Not documented in Project vicinity.
Short-pointed cyperus *Cyperus acuminatus*			SEN	SEN	Wet, low places in valley and lowlands, edges of temporary pools, ponds, streams, ditches.	Jackson	MD-S	RRS-S		NI	Not documented in Project vicinity.
Clustered lady's slipper *Cypripedium fasciculatum*		C	SEN	SEN S&M-C	Perennial herbaceous plant, found in a variety of habitats, although primarily in older Douglas-fir forests on old stream terraces. The largest populations in southwestern Oregon tend to occur on moist stream terraces, but others inhabit dry rocky up-slope sites. Elevation ranges from 1,000-6,400 feet.	Douglas Jackson	RO-S MD-D	UMP-D RRS-D	Observations in 1994 and 2003 documented species on UMP at MP 104.1 and on MD BLM west of MP 128; see the Survey and Manage Report (appendix F.5 of this EIS).	MIIH	Potential impacts to individuals or habitat; however, remaining sites would provide a reasonable assurance of species persistence.
Mountain lady's slipper *Cypripedium montanum*				S&M-C	Inhabits a wide variety of substrates in wooded communities with 60-80 percent canopy closure. Generally found growing in mixed conifers and mixed evergreen/oak woodland plant communities. Elevation range: 1,500-6,500 feet.	Douglas Jackson Klamath	MD-D RO-D LV-D	UMP RRS-D FW	Observed in MD BLM.	MIIH f/	Potential removal of individuals within ROW; direct and indirect habitat effects. f/
Red larkspur *Delphinium nudicaule*			SEN	SEN	Rocky openings, often in talus on moist slopes.	Douglas Jackson	RO-S MD-D	RRS-D		NI	Not documented in Project vicinity.
Few-flowered bleedingheart *Dicentra pauciflora*	SOC		SEN	SEN	Openings in coniferous forests, in volcanic and granitic soils; 3,90 -8,900 feet.		MD-D	RRS-D		NI	Not documented in Project vicinity.
Howell's whitlow-grass *Draba howellii*		C	SEN	SEN	Rocky summits, cracks in granite walls, rock crevices; 6,230-8,900 feet.		MD-D	RRS-D		NI	Not documented in Project vicinity.
Short seeded waterwort *Elatine brachysperma*			SEN	SEN	Occurs almost always under natural conditions in wetlands.		LV-D	UMP-S FW-S		NI	Not documented in Project vicinity.
Bolander's spikerush *Eleocharis bolanderi*			SEN	SEN	Fresh, often summer-dry meadows, springs, seeps, stream margins; 3,280-11,150 feet.	Klamath	LV-D	FW-D		NI	Not documented in Project vicinity.
Oregon willow herb *Epilobium oreganum*	SOC	C	SEN	SEN	Grows in bogs at low elevations. Known only from Josephine County.	Douglas	RO-S MD-D	RRS-D		NI	No suitable habitat in Project area.
Siskiyou willow herb *Epilobium siskiyouense*		C		SEN	Scree and talus on Serpentine ridges.	Jackson		RRS-D		NI	No suitable habitat in Project area.

TABLE I-5 (continued)

Special Status Plant (Vascular and Non-Vascular) and Fungi Species That May Occur Near the Jordan Cove Energy Project

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Golden fleece *Ericameria arborescens*			SEN	SEN	Dry foothill slopes, in chaparral; 300-6,560 feet.		CB-D MD-S	RRS-D		NI	Not documented in Project vicinity.
Siskiyou daisy *Erigeron cervinus*			SEN	SEN	Rocky streamsides; dry, stony soil of grasslands, sagebrush steppe, woodlands, fellfields, open forest.	Jackson	CB-S MD-D	RRS-D		NI	Not documented in Project vicinity.
Cliff (rock) daisy *Erigeron petrophilus*				SEN	Rocky foothills to montane forest.	Jackson		RRS-D		NI	Not documented in Project vicinity.
Crosby's buckwheat *Eriogonum crosbyae* var. *crosbyae*		T	SEN		Found in sagebrush scrub, and pinyon-juniper woodlands.		LV-D			NI	Not documented in Project vicinity.
Cusick's buckwheat *Eriogonum cusickii*		C	SEN	SEN	Sandy, volcanic flats, mixed grassland and sagebrush communities, montane conifer woodlands; of conservation concern; 4,265-4,920 feet.		LV-D			NI	Not documented in Project vicinity.
Lobb's buckwheat *Eriogonum lobbii*			SEN	SEN	Gravelly to rocky or talus slopes, mixed grassland, buckbrush, manzanita, and sagebrush communities, montane, subalpine, or alpine conifer woodlands.		MD-S	RRS-D		NI	Not documented in Project vicinity.
Prostrate buckwheat *Eriogonum prociduum*		C	SEN	SEN	Areas of barren rocky or gravelly volcanic soils within juniper or sagebrush habitat.	Klamath	LV-D	FW-D		NI	Not documented in Project vicinity.
Green buckwheat *Eriogonum umbellatum* var. *glaberrimum*	SOC		SEN	SEN	Sandy to gravelly slopes, sagebrush communities, aspen and montane conifer woodlands; 5,250-7,550 feet.		LV-D	FW-D		NI	Not documented in Project vicinity.
Acker Rock wild buckwheat *Eriogonum villosissimum*	SOC			SEN	Grows exclusively on quartz rock at high elevations.	Douglas		UMP-D		NI	Not documented in Project vicinity.
Russet cotton-grass *Eriophorum chamissonis*			SEN	SEN	Bogs along the coast.	Coos	CB-D			NI	No suitable habitat in Project area.
Large-leaved filaree *Erodium macrophyllum*	SOC		SEN		Open sites grassland and shrubland.	Jackson	MD-D			NI	Not documented in Project vicinity.
Howell's adder's tongue *Erythronium howellii*			SEN	SEN	Found in open woods primarily in the upper Illinois River basin, mostly in serpentine soil; April and May.	Jackson	MD-D	RRS-D		NI	Outside of known (or probable) range
Gold poppy *Eschscholzia caespitosa*			SEN	SEN	Grows on dry, brushy slopes and flat areas, mostly along roadsides; known in southern Douglas County; March through early June.	Douglas Jackson	RO-D MD-D	RRS-S		NI	No suitable habitat in Project area.
Wayside aster *Eucephalis vialis* (*Aster vialis*)		T	SEN	SEN S&M-A	Areas of natural and man-made disturbance, edges and openings in woodlands and forests, both in second and old-growth, and shaded roadsides.	Douglas Jackson	CB-S RO-D MD-D	UMP-S	RO BLM approximately 430 plants observed including 95 plants within construction right-of-way between near MP 74.9.	MIIH	Impacts to individuals and habitat.
Umpqua swertia *Frasera umpquaensis*		C	SEN	SEN	Elevations 4,500 – 6,500 feet in conifer forests, in damp, shaded or sometimes open environments.	Douglas Jackson	RO-S MD-D	UMP-D RRS-D		NI	Not documented in Project vicinity.
Gentner's fritillary *Fritillaria gentneri*	E	E			Often occupies grassland and chaparral habitats within, or on the edges of, dry open mixed woodland at elevations below 5,065 feet.	Douglas Jackson	MD-D	RRS-D	Five sites documented in vicinity of Project area; 3 of which occur within botanical analysis area: <u>MD BLM</u> - 2 plants 0.4 mi NE and 1.0 mi SW of MP 128.0; 3 plants adjacent to TEWA 128.01-W near MP 128.1; 2 plants 77 feet NE of MP 129.1 (near TEWA 128.96-N) <u>Private:</u> 2 plants located 1.2 mi SE of MP 134.43; one plant, and other *Fritillaria* leaves, in TEWA 142.07-N (project modified to avoid).	LAA	Impacts to potential habitat that has not been surveyed; impacts to individuals if present.

TABLE I-5 (continued)

Special Status Plant (Vascular and Non-Vascular) and Fungi Species That May Occur Near the Jordan Cove Energy Project

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Boreal bedstraw *Galium kamtschaticum,* (West Cascades)				S&M-A	Inhabits moist, cold, coniferous forests, and mossy places throughout its range. Generally found underneath dense shrub cover.		RO			NI	Not documented in Project vicinity.
Warner mt. bedstraw *Galium serpenticum* ssp. *warnerense*			SEN	SEN	Meadows in subalpine forest.		LV-D	FW-D		NI	Not documented in Project vicinity.
Newberry's gentian *Gentiana newberryi* var. *newberryi*			SEN	SEN	High alpine meadows of the Cascade Mountains; wet meadows and meadow edges, generally 5,000 feet and above. On Fremont-Winema NF found on Klamath RD.	Klamath		UMP-S RRS-D FW-D		NI	Not documented in Project vicinity.
Elegant gentian *Gentiana plurisetosa*	SOC		SEN	SEN	Meadows in lodgepole forest, red fir forest, or yellow pine forest.		MD-S	RRS-D		NI	Not documented in Project vicinity.
Waldo gentian *Gentiana setigera*		C	SEN	SEN	Meadows in yellow pine forest, red fir forest, wetland-riparian. Almost always under natural conditions in wetlands.		CB-D MD-D	RRS-D		NI	Not documented in Project vicinity.
Seaside gilia *Gilia millefoliata*	SOC		SEN	SEN	Stabiilized coastal dunes.	Coos Douglas	CB-D			NI	No suitable habitat in Project area.
Boggs lake hedge-hyssop *Gratiola heterosepala*	SOC	T	SEN	SEN	Restricted to clay soils in or near shallow water such as at the margins of lakes and vernal pools.		LV-D	FW-S		NI	Not documented in Project vicinity.
Beautiful stickseed *Hackelia bella*			SEN	SEN	Forest openings, roadsides.	Jackson Klamath	MD-D	RRS-D		NI	Not documented in Project vicinity.
Purple-flowered rush-lily *Hastingsia bracteosa* var. *atropurpurea*		T	SEN	SEN	Wetland area soils, seeps and rills; seepage areas, *Darlingtonia* bogs, hillside marshes, fens, or small streams.		MD-D	RRS-D		NI	Not documented in Project vicinity.
Large-flowered rush-lily *Hastingsia bracteosa* var. *bracteosa*		T	SEN	SEN	It is found in lowland forests up to an elevation of 1,640 feet.		MD-D	RRS-D		NI	Not documented in Project vicinity.
Salt heliotrope *Heliotropium curassavicum*			SEN	SEN	Moist to dry saline soils.	Klamath	LV-D	FW-D		NI	No suitable habitat in Project area.
Baker's cypress *Hesperocyparis bakeri* (*Cupressus bakeri*)	SOC		SEN	SEN	Open, fire-maintained, scrubby forest similar to the knobcone pine (*Pinus attenuata*) forest.	Jackson	MD-D	RRS-D		NI	Not documented in Project vicinity.
Shaggy hawkweed *Hieracium horridum*			SEN	SEN	Rocky places.	Jackson Klamath	MD-D	RRS-S		NI	Not documented in Project vicinity.
Shaggy horkelia *Horkelia congesta* ssp. *congesta*	SOC	C	SEN		Open dry ground and rocky flats.	Douglas Jackson	RO-D			NI	Not documented in vicinity of project.
Henderson's horkelia *Horkelia hendersonii*	SOC			SEN	Endemic to summits of a few granite peaks in southern Jackson County.	Jackson		RRS-D		NI	No suitable habitat in Project area.
Three-toothed horkelia *Horkelia tridentata* ssp. *tridentata*			SEN	SEN	Granitic soils.	Jackson	RO-S MD-D	RRS-D		NI	Not documented in Project vicinity.
Whorled marsh-pennywort *Hydrocotyle verticillata*			SEN	SEN	Swampy ground, lake margins.	Coos Douglas	CB-S			NI	Not documented in Project vicinity.
California globe mallow *Iliamna latibracteata*			SEN	SEN	Grows in coastal ranges in Coos and Douglas counties; also known from Curry, Jackson, Josephine, and Linn counties.	Coos Douglas Jackson	CB-S RO-D MD-D	UMP-D RRS-D	RO BLM (2017) in ROW near MP 99.9 (Stouts Creek Fire area); UMP (2017) in ROW near MP 106.23; UMP (2017) in ROW near MP 106.74.	MIIH	Potential removal of individuals within ROW; direct and indirect habitat effects.
Shelly's ivesia *Ivesia rhypara* var. *shellyi*			SEN		Found on either light colored ash-tuff or on outcrops of volcanic ash deposited with riverbed gravels. Habitat is very dry and relatively barren with no canopy cover.		LV-D			NI	Not documented in vicinity of project.

TABLE I-5 (continued)

Special Status Plant (Vascular and Non-Vascular) and Fungi Species That May Occur Near the Jordan Cove Energy Project

Common Name and/or Scientific Name	Status a/ Federal	State	BLM	Forest Service	Expected Habitat	Documented or Suspected Occurrence b/ County	BLM	Forest Service	Within Vicinity of Project Area c/	Effect of Impact d/	Impact Reasoning
Shockley's ivesia *Ivesia shockleyi*			SEN	SEN	Subalpine forest, bristle-cone pine forest, alpine fell-fields.		LV-S	FW-D		NI	Not documented in Project vicinity.
Tiehm's rush *Juncus tiehmii*			SEN	SEN	Bare granitic sands of seeps, streambanks, meadows to 10,000 feet.			FW-D		NI	Not documented in Project vicinity.
Fragrant kalmiopsis *Kalmiopsis fragrans*		C	SEN	SEN	Cliffs and rock outcrops; known only from North Umpqua River.	Douglas	RO-S	UMP-D		NI	Not documented in Project vicinity.
Bush beardtongue *Keckiella lemmonii*			SEN	SEN	Rocky slopes, chaparral.	Jackson	MD-S	RRS-D		NI	Not documented in Project vicinity.
Thin -leaved peavine *Lathyrus holochlorus*	SOC		SEN	SEN	Thickets and open woods, low elevations, fence rows.	Douglas	RO-S			NI	Not documented in Project vicinity.
Columbia lewisia *Lewisia columbiana* var. *columbiana*			SEN	SEN	Reported on three mountains in the southeastern portion of Douglas County.	Douglas		UMP-D		NI	Not documented in Project vicinity.
Lee's lewisia *Lewisia leana*			SEN	SEN	Grows on high elevation serpentine ridgest.	Douglas Jackson	RO-S MD-D	UMP-S RRS-D		NI	Not documented in Project vicinity.
Western lily *Lilium occidentale*	E	E			Poorly drained, organic soils on the edges of coastal bogs (0-325 feet) that are within 4 miles of the Pacific Coast.	Coos	CB-D			NLAA	Species has not been documented where surveys have been conducted. Unsurveyed habitat is low quality habitat. If plants are identified within the Project area, conservation measures developed to avoid or minimize potential impacts to identified plants would be applied.
Bellinger's meadowfoam *Limnanthes floccosa* ssp. *bellingeriana*		C	SEN	SEN	Seasonally wet depressions above 2500 feet; seasonally wet meadows in Klamath County.	Jackson Klamath	MD-D	RRS-D	RRS in ROW near MP 154.1, and from 154.71 to MP 154.82; MD BLM greater than 100 feet near MPs 120.28, 128.8, and 129; MD BLM (2017) over 600 plants in/near TEWA 128.79-N.	MIIH	Impacts to individuals and habitat; however, remaining sites would provide a reasonable assurance of species persistence.
Dwarf wooly meadowfoam *Limnanthes floccosa* ssp. *pumila* (*L. pumila* ssp. *pumila*)	SOC	T	SEN		Small depressions in thin clay soil overlying old basalt at the edges of deep vernal pools which dry by mid-summer, generally in full sun. However, the taxon may also be found near the edges of wet trails, roads, and small streams. The soils it inhabits are volcanic in origin.	Jackson	MD-D			NI	Not documented in Project vicinity.
Slender meadow-foam *Limnanthes gracilis ssp. gracilis* (*L. alba* ssp. *gracilis*)		C	SEN	SEN	Found in Douglas, Jackson, and Josephine counties in very wet areas (early spring) and often in serpentine soil; March through May. Vernal pools.	Douglas Jackson	RO-D MD-D	RRS-D		NI	Not documented in Project vicinity.
Large-flowered meadowfoam *Limnanthes pumila* ssp. *grandiflora* (*L. floccosa* ssp. *grandiflora*)	E/CH	E			Periphery of vernal pools at 1,230-1,310 feet, near the wetter, inner edges.	Jackson	MD-S		Documented 0.3 mile E of Burrill Lumber pipe storage yard (2007). Additional documentation within federally-designated critical habitat W of Burrill Lumber pipe storage yard and over 500 feet from other proposed pipe yards.	NLAA	Applicant would avoid using portions of proposed pipe storage yards with high-quality vernal pool habitat and/or identified plants. Effects to suitable habitat by the Pipeline are likely to be insignificant. Construction of the Pipeline is not expected to adversely modify designated critical habitat subunit RV6C.
Western marsh-rosemary *Limonium californicum*			SEN	SEN	Coastal strands, salt marshes.	Coos	CB-D			NI	No suitable habitat in Project area.
Aristulate lipocarpha *Lipocarpha aristulata*			SEN	SEN	Wet soil at an elevation of 325 to 1,315 feet. In Washington, has been found along shorelines and islands below high water on silty substrates.	Klamath	LV-S	FW-S		NI	Not documented in Project vicinity.

TABLE I-5 (continued)

Special Status Plant (Vascular and Non-Vascular) and Fungi Species That May Occur Near the Jordan Cove Energy Project

Common Name and/or Scientific Name	Status a/ Federal	State	BLM	Forest Service	Expected Habitat	Documented or Suspected Occurrence b/ County	BLM	Forest Service	Within Vicinity of Project Area c/	Effect of Impact d/	Impact Reasoning
Cook's lomatium *Lomatium cookii*	E/CH	E			Margins of vernal pools in the Agate Desert, usually with native forbs and introduced annual grasses.	Jackson	MD-D	RRS-S	No documentation within 0.1 mi (500 feet) of Pacific Connector Pipeline Project; however, it has been documented 0.5 mile S of Avenue F & 11th Street and WC Short pipe storage yards and over 1.0 mile S of Burrill Lumber and E of Rouge Aggregates pipe storage yards.	NLAA	Species not documented during surveys of suitable habitat. Unsurveyed habitat is low quality vernal pool habitat located over 0.5 mile from known sites with no apparent hydrologic connectivity. The Pipeline is over 0.5 miles from the nearest critical habitat subunit RV6A.
Englemann's desert-parsley *Lomatium engelmannii*			SEN	SEN	Chaparral, red fir forest, yellow pine forest.		MD-S	RRS-D		NI	No suitable habitat in Project area.
Stipuled trefoil *Lotus stipularis*			SEN	SEN	Open forests, chaparral, disturbed sites.	Douglas Jackson	RO-S MD-D	RRS-D		NI	Not documented in Project vicinity.
Mt. Ashland lupine *Lupinus aridus* ssp. *ashlandensis* (*L. lepidus* var. *ashlandensis*)	SOC	C		SEN	Sandy or gravelly soils at low to alpine elevations.	Jackson		RRS-D		NI	No suitable habitat in Project area.
Nevada lupine *Lupinus nevadensis*			SEN		Sagebrush scrub.		LV-D			NI	Not documented in Project vicinity.
Kincaid's lupine *Lupinus oreganus* var. *kincaidii* (*Lupinus sulphureus* ssp. *kincaidii*)	T/CH	T			Native grasslands and open oak woodlands at low elevations in the Willamette and Umpqua Valleys. Also known to occur on roadsides.	Douglas	RO-D	UMP-D	3 populations documented in project area (2007, 2017): MP 57.84-57.92, MP 59.60, and MP 96.5-96.9 (2015 Stouts Creek fire eliminated most of this population; SBS 2016). Other documentations greater than 500 feet include 1.5 NE of MP 56.06 (Private: T28S,R7W,S31; 1999); 2.2 mi SW of MP 96.11 (RO/Private:T31S,R3W,S4,5,8,9; 2003); 1.5 mile E of MP 98.88 (UMP: T31S,R2W,S8; 1992).	LAA	Impacts to unidentified plants or to suitable habitats, which may be able to support species in the near future. Indirect impacts to documented or unidentified plants outside of ROW and along proposed access roads. All potential suitable habitat has not been surveyed due to landowner access denial.
Tracy's lupine *Lupinus tracyi*			SEN	SEN	Dry open montane forest.	Douglas Jackson Klamath	MD-S	RRS-D		NI	Not documented in Project vicinity.
Bog club-moss *Lycopodiella inundata*			SEN	SEN	Bogs, muddy depressions, and pond margins. On Fremont-Winema NF one site in Yoss Creek drainage on Chiloquin RD.	Coos Douglas Klamath	CB-D	FW-D		NI	Not documented in Project vicinity.
Lyrate malacothrix *Malacothrix sonchoides*			SEN		Usually on dunes or in deep, fine sand in arroyos and on plains in Joshua tree woodlands, grasslands, Ephedra-Coleogyne associations; 985-6,890 feet.		LV-D			NI	Not documented in Project vicinity.
White meconella (fairypoppy) *Meconella oregana*	SOC	C	SEN	SEN	Grows in open areas that are wet in the spring at low elevations. Known from sites in the Willamette Valley and the Columbia Gorge.	Douglas Jackson	RO-S MD-D	RRS-D		NI	Not documented in Project vicinity.
Detling's microseris *Microseris laciniata* ssp. *detlingii*					In moist rocky meadows, open grasslands, and in clay soils.	Jackson	MD-D	RRS-D	Observed in MD BLM (>100 feet W of MP 140.56, 2000).	NI	Surveys conducted within the vicinity of the Pipeline project have not documented this species within 100 feet of proposed disturbance, including proposed access roads
Bolander's monkeyflower *Mimulus bolanderi* (*Diplacus bolanderi*)			SEN	SEN	Openings in chaparral, burns and disturbed areas. Applegate Valley.	Jackson	MD-D	RRS-D		NI	Not documented in Project vicinity.

TABLE I-5 (continued)

Special Status Plant (Vascular and Non-Vascular) and Fungi Species That May Occur Near the Jordan Cove Energy Project

Common Name and/or Scientific Name	Status a/ Federal	State	BLM	Forest Service	Expected Habitat	Documented or Suspected Occurrence b/ County	BLM	Forest Service	Within Vicinity of Project Area c/	Effect of Impact d/	Impact Reasoning
Congdon's monkeyflower *Mimulus congdonii* (*Diplacus congdonii*)			SEN	SEN	Openings in oak woodland and chaparral. Applegate Valley.	Jackson	MD-D	RRS-S		NI	Not documented in Project vicinity.
Disappearing monkeyflower *Mimulus evanescens* (*Erythranthe inflatula*)		C	SEN	SEN	Vernally moist sites along perennial and intermittent streams; receding margins of lakes, ponds, and reservoirs within juniper/sagebrush habitats.	Klamath	LV-D	FW-D		NI	No suitable habitat in Project area.
Broad-toothed monkeyflower *Mimulus latidens* (*Erythranthe latidens*)			SEN		Valley grassland, foothill woodland, wetland-riparian; 0-2,500 feet. Occurs almost always under natural conditions in wetlands.		LV-D			NI	Not documented in Project vicinity.
Tri-colored monkeyflower *Mimulus tricolor* (*Diplacus tricolor*)			SEN	SEN	Grows at low elevations in clay soil, preferreing vernal pools; scattered in Klamath County; late May through June.	Klamath	LV-D	FW-D		NI	Not documented in Project vicinity.
Siskiyou monardella *Monardella purpurea*			SEN	SEN	Mixed evergreen forest, yellow pine forest.	Jackson	CB-D MD-D	RRS-D		NI	Not documented in Project vicinity.
Howell's montia *Montia howellii*		C				Douglas				NI	Not documented in Project vicinity.
Annual dropseed *Muhlenbergia minutissima*			SEN	SEN	Pinyon-juniper woodland, sagebrush scrub, yellow pine forest, wetland-riparian; between 4,000 and 7,500 feet.			FW-S		NI	Not documented in Project vicinity.
Sessile mousetail *Myosurus sessilis*	SOC	C			Vernal pools and alkalai flats; 30-5,250 feet.			FW-S		NI	Not documented in Project vicinity.
Slender nemacladus *Nemacladus capillaris*			SEN	SEN	Dry slopes, burned areas.	Jackson	MD-D	RRS-S		NI	Not documented in Project vicinity.
Wolf's evening primrose *Oenothera wolfii*	SOC	T			Grows in coastal prairie, dunes, and coastal forest and woodland habitat.		CB-S			NI	Species has not been documented within Project area.
Adder's-tongue *Ophioglossum pusilum*			SEN	SEN	Open fens, wet meadows, grassy slopes, roadside ditches.	Coos Douglas Jackson	CB-S	UMP-D RRS-D		NI	Not documented in Project vicinity.
Slender Orcutt grass *Orcuttia tenuis*	T/CH				Vernal Pools with a very well developed soil profile.	Klamath				NI	Not documented in Project vicinity.
Coffee fern *Pellaea andromedifolia*			SEN	SEN	Rock outcrops, cliffs.	Coos Douglas Jackson	CB-D RO-D MD-D	UMP-S RRS-S		NI	Not documented in Project vicinity.
Bird's-foot fern California birds-foot cliff-brake *Pellaea mucronata* ssp. *mucronata*			SEN	SEN	Grows in various types of rocky habitat		MD-D	RRS-S		NI	Not documented in Project vicinity.
Blue-leaved penstemon *Penstemon glaucinus*			SEN	SEN	Openings in mid to high elevation pine, fir, and mt hemlock communities. Well-drained volcanic soils along rocky points and ridges.	Klamath	LV-S	FW-D		NI	Not documented in Project vicinity.
Red-rooted yampah *Perideridia erythrorhiza*		C	SEN	SEN	Moist meadows, forest edges below 4500 feet.	Douglas Jackson Klamath	RO-D MD-D	UMP-S RRS-D FW-D		NI	Not documented in Project vicinity.
Silvery phacelia *Phacelia argentea*	SOC	T	SEN	SEN	Grows on unstabilized or semi-stabilized sand dunes, bluffs, and bases of coastal headlands.	Coos	CB-D			MIIH	Species was not documented during surveys; however, suitable habitat remains to be surveyed.
Playa phacelia *Phacelia inundata*			SEN		Alkaline flats, dry lake margins. Elevation 4,800 – 6,400 feet.	Klamath	LV-D			NI	No suitable habitat in Project area.

TABLE I-5 (continued)

Special Status Plant (Vascular and Non-Vascular) and Fungi Species That May Occur Near the Jordan Cove Energy Project

Common Name and/or Scientific Name	Status a/				Expected Habitat	Documented or Suspected Occurrence b/				Effect of Impact d/	Impact Reasoning
	Federal	State	BLM	Forest Service		County	BLM	Forest Service	Within Vicinity of Project Area c/		
Siskiyou phacelia *Phacelia leonis*			SEN	SEN	Red fir forest.		MD-D	RRS-D		NI	Not documented in Project vicinity.
American pillwort *Pilularia americana*			SEN	SEN	Vernal pools, mud flats, lake margins.	Jackson Klamath	MD-D	RRS-S FW-D		NI	Not documented in Project vicinity.
Whitebark pine *Pinus albicaulis*	C		SEN	SEN	Although its role in the plant community is changing, whitebark pine historically dominated many of the upper subalpine plant communities of the western United States. It showed scattered occurrence on the Olympic Peninsula, the southern Cascades and other ranges of southern Oregon.	Douglas Jackson Klamath		UMP-D RRS-D FW-D		NI	Not documented in Project vicinity.
Austin's plagiobothrys *Plagiobothrys austiniae*			SEN		Vernally wet areas, along road and trail edges.	Jackson	MD-D			NI	Not documented in Project vicinity.
Coral seeded allocarya *Plagiobothrys figuratus* var. *corallicarpus*	SOC	C	SEN	SEN	Low elevation meadows and moist clearings and fields.	Jackson	MD-D	RRS-S		NI	Not documented in Project vicinity.
Greene's popcorn flower *Plagiobothrys greenei*			SEN	SEN	Vernal pools.	Jackson	MD-D	RRS-S		NI	Not documented in Project vicinity.
Rough popcorn flower *Plagiobothrys hirtus*	E	E			Grows in open, seasonal wetlands in poorly- drained clay or silty clay loam soils at elevations ranging from 100 to 900 ft.	Douglas	RO-D	UMP-S		NLAA	Species has not been documented where survey permission has been granted. Surveys in potentially suitable habitat that has not been surveyed due to lack of permission would occur prior to ground-disturbing activities; if plants are identified, conservation measures developed to avoid or minimize potential impacts to identified plants would be applied.
Shiny-fruited popcorn flower *Plagiobothrys lamprocarpus*		E			Unknown.		MD-S			NI	Not documented in Project vicinity.
Desert allocarya *Plagiobothrys salsus*			SEN	SEN	Playas in alkali sink, wetland-riparian.	Klamath	LV-D	FW-S		NI	Not documented in Project vicinity.
Large round-leaved orchid *Platanthera orbiculata* var. *orbiculata*				S&M-C	Infrequent distribution. Generally found in mature to old-growth stands, primarily at lower to mid elevations up to 3,000 feet. Often in rich, damp humus in the deep shade of heavily forested (mature- to old-growth) areas.		RO			NI	Not documented in Project vicinity.
Oregon semaphoregrass *Pleuropogon oregonus* (*Lophochlaena oregana*)	SOC	T	SEN	SEN	Wet meadows, marshlands, and streambanks. Standing or flowing water, at least early in the growing season, is important where populations are present.		LV-D	FW-D		NI	Not documented in Project vicinity.
Timber bluegrass *Poa rhizomata*			SEN	SEN	Dry Douglas-fir/ponderosa pine forests.	Jackson	MD-D	UMP-S RRS-D		NI	Not documented in Project vicinity.
Profuse-flowered mesa mint *Pogogyne floribunda*	SOC		SEN	SEN	Vernal pools, seasonal lakes.	Klamath	LV-D	FW-S		NI	Not documented in Project vicinity.
California sword-fern *Polystichum californicum*			SEN	SEN	Creek banks and canyons in redwoods and mixed evergreen forests.	Coos Douglas	CB-D RO-D	UMP-D RRS-S		NI	Not documented in Project vicinity.
Rafinesque's pondweed *Potamogeton diversifolius*			SEN	SEN	Shallow water, ditches, ponds, lakes.	Klamath		FW-S		NI	Not documented in Project vicinity.
Siskiyou fairy bells *Prosartes parvifolia*			SEN	SEN	Roadsides, disturbed areas, and burned areas.		MD-S	RRS-D		NI	Not documented in Project vicinity.

TABLE I-5 (continued)

Special Status Plant (Vascular and Non-Vascular) and Fungi Species That May Occur Near the Jordan Cove Energy Project

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Toothleaf pyrola *Pyrola dentata*			SEN	SEN	Dry, scrubby edge of coniferous forests.		CB-S	RRS-S		NI	Not documented in Project vicinity.
California chicory *Rafinesquia californica*			SEN	SEN	Chaparral, recent burns, in the Applegate Valley.	Jackson	MD-D	RRS-D		NI	Not documented in Project vicinity.
Southern Oregon buttercup *Ranunculus austrooreganus*		C	SEN		Oak woodlands, chaparral and dry grasslands.	Jackson	MD-D			NI	Not documented in Project vicinity.
Redberry *Rhamnus ilicifolia*			SEN	SEN	Chaparral in Applegate Valley.	Jackson	MD-D	RRS-D		NI	Not documented in Project vicinity.
White beakrush *Rhynchospora alba*			SEN	SEN	Marshes, bogs.	Jackson	CB-S MD-S	RRS-D		NI	Not documented in Project vicinity.
Straggly gooseberry *Ribes divaricatum* var. *pubiflorum*			SEN	SEN	Coastal bluffs, forest edges; 0-4,920 feet.		MD-D	RRS-S		NI	Not documented in Project vicinity.
Thompson's mistmaiden *Romanzoffia thompsonii*			SEN	SEN	Sunny, vernally wet mossy rocks.	Douglas Jackson	CB-D RO-D MD-D	UMP-D RRS-D		NI	Not documented in Project vicinity.
Columbia cress *Rorippa columbiae*		C	SEN	SEN	Along intermittent and perennial streams and lakeshores: banks, sandbars, vernal pools, lakebeds, and ditches.	Klamath	MD-S LV-D	RRS-S FW-D		NI	Not documented in Project vicinity.
Lowland toothcup *Rotala ramosior*			SEN	SEN	Open, wet gravelly soil around ponds (5-400 feet in western Oregon).		LV-S	UMP-S FW-S		NI	Not documented in Project vicinity.
Wolf's willow *Salix wolfii*			SEN	SEN	Stream banks, springs, wet meadows, bogs; 650-12,470 feet (NOTE: this source lists *S. wolfii* var. *wolfii* as the variety occurring in Oregon.)		LV-S			NI	Not documented in Project vicinity.
Joint-leaved saxifrage *Saxifragopsis fragarioides*			SEN	SEN	Grows on dry cliffs in the high Siskiyou Mountains.	Jackson	MD-D	RRS-D		NI	Not documented in Project vicinity.
Scheuchzeria *Scheuchzeria palustris* ssp. *americana*			SEN	SEN	Grows in ponds and along streams in Oregon Cascades.	Douglas Klamath		UMP-D RRS-D FW-D		NI	Not documented in Project vicinity.
Water clubrush *Schoenoplectus subterminalis* (*Scirpus subterminalis*)			SEN	SEN	Lakes, ponds, marshes.	Coos Douglas Klamath	CB-D RO-S MD-S LV-S	UMP-D RRS-D FW-D		NI	Not documented in Project vicinity.
Drooping bulrush *Scirpus pendulus*			SEN	SEN	Marshes, wet meadows, ditches.	Jackson	CB-S RO-S MD-D	RRS-D FW-S		NI	Not documented in Project vicinity.
California fetid adderstongue *Scoliopus bigelovii*				SEN	Redwood and coastal coniferous forests, mossy mountain stream banks, shaded slopes; 0--1,650 feet.			RRS-D		NI	Not documented in Project vicinity.
Rogue River stonecrop *Sedum moranii*		C	SEN	SEN	Steep south to west facing slopes and rock outcrops (650-900 feet).		MD-D	RRS-D		NI	Not documented in Project vicinity.
Verrucose sea-purslane *Sesuvium verrucosum*			SEN	SEN	Valley grassland, coastal sage scrub, alkali sink, wetland riparian.		LV-D	FW-S		NI	Not documented in Project vicinity.
Henderson sidalcea *Sidalcea hendersonii*			SEN	SEN	Wet meadows, tidal marshes and flats at low elevations.	Douglas	CB-D			NI	Not documented in vicinity of project.
Hickman's checkerbloom (Neil Rock sidalcea) *Sidalcea hickmanii* ssp. *petraea*			SEN		Shallow soil in open rocky areas in areas with serpentine soils	Jackson	MD-D			NI	Not documented in vicinity of project.

TABLE I-5 (continued)

Special Status Plant (Vascular and Non-Vascular) and Fungi Species That May Occur Near the Jordan Cove Energy Project

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Coast checkermallow *Sidalcea malviflora* ssp. *patula*	SOC	C	SEN	SEN	Open coastal forest.	Coos	CB-D	RRS-D		NI	Not documented in Project vicinity.
Bolander's catchfly *Silene hookeri* ssp. *bolanderi*			SEN	SEN	Oak and douglas fir woodlands; 330-3,280 feet.		MD-D	RRS-S		NI	Not documented in Project vicinity.
Hitchcock's blue-eyed grass *Sisyrinchium hitchcockii*	SOC	C	SEN		Known in the Umpqua and southern Willamette valleys.	Douglas	RO-D			NI	Not documented in Project vicinity.
Parish's horse-nettle *Solanum parishii*			SEN	SEN	Chaparral, dry conifer openings, recent burns.	Jackson	MD-D	RRS-D		NI	Not documented in Project vicinity.
Western sophora *Sophora leachiana*		C	SEN	SEN	Dry, open areas, open mixed woodlands, roadcuts and clearcuts (460-1,500 feet).		MD-D	RRS-D		NI	Not documented in Project vicinity.
Common jewel flower *Streptanthus glandulosus* ssp. *josephinensis*			SEN	SEN	Serpentine areas. (Note: this source lists the subspecies *S. g. josephinensis* as occurring in Oregon.)		MD-D	RRS-D		NI	Not documented in Project vicinity.
Howell's streptanthus *Streptanthus howellii*		C	SEN	SEN	Dry, serpentine slopes, mixed evergreen forests, open pine woods or brushy areas (1,590-4,000 feet).		CB-S MD-D	RRS-D		NI	Not documented in Project vicinity.
Long-flowered snowberry *Symphoricarpos longiflorus*			SEN		Pinyon-juniper woodland.		LV-D			NI	Not documented in Project vicinity.
Howell's tauschia *Tauschia howellii*	SOC	C		SEN	Granitic gravel ridgetops above 6,000 feet.	Jackson		RRS-D		NI	No suitable habitat in Project area.
Leiberg's clover *Trifolium leibergii*		C	SEN		Grows on a distinct habitat characterized by a thin, gravelly soil layer consisting of decomposing (broken-down) volcanic ash "tuff." Underneath the thin layer of soil is the solid "tuff," which has deep cracks running through it.		LV-D			NI	Not documented in Project vicinity.
Siskiyou trillium *Trillium kurabayashii*			SEN	SEN	Rich, moist conifer-hardwood forest, slopes, especially lower slopes, predominantly deciduous flat woods along streams, edges of Sequoia groves, and alder, vine maple, and fern thickets along streams, especially older, higher flood terraces, not the lowest and wettest; at higher elevations, both in forests and in open grassy meadows with scattered oak trees.	Jackson	CB-S	RRS-D		NI	Not documented in Project vicinity.
Leach's brodiaea *Triteleia hendersonii var. leachiae*		C			Open and wooded slopes in the Siskiyou Mountains of Josephine, Curry, and Douglas counties.	Coos	CB-D MD-S			NI	Not documented in Project vicinity.
Humped bladderwort *Utricularia gibba*			SEN	SEN	Shallow water, mud.	Coos Douglas	CB-D RO-S			NI	Not documented in Project vicinity.
Lesser bladderwort *Utricularia minor*			SEN	SEN	Shallow water.	Coos Douglas Jackson Klamath	CB-S RO-S MD-D	UMP-D RRS-D FW-D		NI	Not documented in Project vicinity.
Northern bladderwort *Utricularia ochroleuca*			SEN	SEN				UMP-S FW-S		NI	Not documented in Project vicinity.
Western bog violet *Viola primulifolia ssp. occidentalis*	SOC	C	SEN	SEN	Serpentine bogs.	Douglas	CB-S MD-D	RRS-D		NI	No suitable habitat in Project area.
Dotted water-meal *Wolffia borealis*			SEN	SEN	Freshwater ponds and slow flowing ditches in which water has somewhat high levels of organic material. Occurs in natural ponds as well as in log and sewage treatment ponds (350-1,500 feet).	Jackson	RO-S MD-D	UMP-S		NI	Not documented in Project vicinity.
Columbia water-meal *Wolffia columbiana*			SEN	SEN	Free floating in quiet water.	Douglas Jackson	RO-S MD-S	UMP-S RRS-S		NI	Not documented in Project vicinity.

TABLE I-5 (continued)

Special Status Plant (Vascular and Non-Vascular) and Fungi Species That May Occur Near the Jordan Cove Energy Project

Common Name and/or Scientific Name	Status a/ Federal	State	BLM	Forest Service	Expected Habitat	Documented or Suspected Occurrence b/ County	BLM	Forest Service	Within Vicinity of Project Area c/	Effect of Impact d/	Impact Reasoning
Small-flowered death camas *Zigadenus fontanus*			SEN	SEN	Rocky openings in chaparral in Applegate Valley.	Jackson	MD-D	RRS-D		NI	Not documented in Project vicinity.

a/ Status Key:
Federal Status: E = Endangered, T = Threatened, C = Candidate, SOC = Species of Concern, CH = Critical Habitat
State Status: E = Endangered, T = Threatened, C = Candidate
BLM and Forest Service Status: SEN = Sensitive, S&M = Survey and Manage species, letter after S&M = Survey and Manage Species Category (A – F; based on the 2003 S&M list); only species listed as S&M in OR included in table; MW = Medford BLM Watch species.

b/ Occurrence Key:
BLM: CB = Coos Bay District, RO = Roseburg District, MD = Medford District, LV = Lakeview District
Forest Service: FW = Fremont-Winema National Forest, RRS = Rogue River-Siskiyou National Forest, UMP = Umpqua National Forest
Other: STF = State Forest Lands; PRV = Private Lands.

D = Documented occurrence: A species located on land administered by the BLM or the Forest Service based on historic or current known sites of a species reported by a credible source for which BLM and the Forest Service have knowledge of written, mapped or specimen documentation of the occurrence.
S = Suspected occurrence: Species is not documented on land administered by the BLM or the Forest Service, but may occur on the unit because: 1) BLM District or National Forest is considered to be within the species' range and 2) appropriate habitat is present or 3) known occurrence of the species (historic or current) in vicinity such that the species could occur on BLM or Forest Service land.

c/ Pacific Connector Pipeline Project: Botanical and fungi species documented within approximately 100 meters (328 feet) of the pipeline corridor and facilities, which generally included the Project ROW, TEWAs, and UCSAs plus a 100-foot buffer. The observations listed are based on project survey reports (SBS – biological survey data from 2008 to 2017), and may differ from the sites discussed in the Survey and Manage Report (appendix F.5 of this EIS).

d/ Effect of Impact:
Species federally listed or proposed for listing:
NE = No Effect
NLAA = Not Likely to Adversely Affect
LAA = Likely to Adversely Affect

All other species:
NI = No Impact
MIIH = May Impact Individuals or Habitat, but is not likely to contribute to a trend toward federal listing or loss of viability of the species
WOFV = Will Impact Individuals or Habitat with a consequence that the action will contribute to a trend toward Federal listing or cause a loss of viability to the population or species

e/ Special Consideration Species:
These species are special consideration species, as directed in Instruction Memorandum No. OR-2014-037 (USDI 2014), and are assigned the Survey and Manage category under the 2001 species list for purposes of this analysis.

f/ This species is not included in the Survey and Manage Report (appendix F.5 of this EIS) because this species was only located on BLM land and the current Resource Management Plans for BLM lands encompassed by the project area removes S&M measures (see appendix F.5 for further details).

References
Status: FWS 2017a, b, 2019; Forest Service 2015; BLM 2015; Forest Service and BLM 2001, 2004-2017; ORBIC 2016, 2017a, 2012; ODA 2018.
Expected Habitat: Arora 1986; BLM 2004; British Columbia Ministry of Environment 2009; Brodo et al. 2001; Calflora 2013; CNPS 2013; Castellano et al. 1999; Castellano and O'Dell, 1997; Castellano et al. 2003; Center for Plant Conservation 2011; Christy and Wagner 1996; Cushman and Huff 2007; eFloras.org, 2013; Eastman 1990; Forest Service 2014; Fryer 2002; Goldenberg 2011; Helliwell 2007; Hibler et al. 2001; Hickman 1993; Hitchcock et al. 1969; Holthausen et al. 1994; Knorr 2007; Huff 2010; Lawton 1971; McCune and Geiser 1997; Nevada Natural Heritage Program 2001; Norris and Shevok 2004a and b; Norvell and Exeter 2008; ORBIC 2004, 2010a; ODA 2013; Oregon Flora Project 2002, 2006, 2007; Oregon Wetlands Explorer 2013; Pojar and MacKinnon 1994; Stone 2007, 2012. The Global Fungal Red List Initiative 2017; Trappe, M.J. pers. comm. 2013; Washington Department of Natural Resources and BLM 2003.
Documented and Suspected Occurrences: BLM 2006, 2010, 2012, 2017, 2019; ORBIC 2017; Forest Service 2017, 2019; ORBIC 2019. Siskiyou BioSurvey various dates; Stantec 2018.

TABLE I-6

Forest Operations Inventory Impacted by the Pacific Connector Gas Pipeline Project

Forest Operations Inventory (FOI)			Project Construction Impacts (Acres)							Project Operation Impacts (acres)			Area Impacted (acres) Within Associated LSR		
Age Range	Age Class a/	FOI Code b/, c/, d/, e/	Construction Right-of-Way	Temporary Extra Work Space	Permanent Access Roads	Temporary Access Roads	Rock Source/Disposal	Uncleared Storage Area	Total f/	30-foot Maintenance Corridor	Aboveground Facilities	50-foot Permanent Easement	Pacific Connector Project Construction	30-foot Maintenance Corridor	50-foot Permanent Easement
Coos Bay BLM District															
Conifers															
	10	FCO D1-=2007	0.94	0.80					1.74	0.31		0.51	1.74	0.31	0.51
		FCO D1RC1-=2010	1.46	0.22					1.68	0.65		1.06	1.68	0.65	1.06
		FCO D1-=1992		0.04					0.04				0.02		
		FCO D1-=1993	1.85	1.00				0.90	3.75	0.23		0.44	3.75	0.23	0.44
	20	FCO D1-=1994	7.02	3.38				0.78	11.18	2.39		3.92	7.60	1.56	2.58
		FCO D1-=1998	1.29	0.63				0.37	2.28	0.34		0.57			
		FCO D1H1RC1-=1996	2.58	0.10				1.06	3.74	0.83		1.41	3.17	0.71	1.21
		FCO D2-=1993	1.26	1.11				0.60	2.97	0.56		0.83	2.29	0.33	0.50
		FCO D1-=1988	5.37	2.91					8.28	1.39		2.53	3.57	0.58	1.04
		FCO D1-=1989		0.19					0.19				0.14		
		FCO D1-=1990	4.40	3.64				2.15	10.19	1.87		3.00	7.19	1.41	2.27
		FCO D3-=1981	1.97	0.20				0.66	2.84	0.70		1.16	2.84	0.70	1.16
<80	30	FCO D3-=1982	4.04	0.89				1.07	6.00	1.20		1.98	6.00	1.20	1.98
		FCO D3-=1983	1.07	0.12					1.18	0.27		0.46	0.94	0.26	0.42
		FCO D3-=1984	1.33					0.56	1.89	0.61		0.97			
		FCO D3-=1985	5.02	0.14				2.27	7.43	2.09		3.40			
		FCO D3S1-=1983	0.83	0.39				0.98	2.20	0.04		0.11			
		FCO D3-=1974	3.43	0.34				0.98	4.75	1.11		1.84			
		FCO D3-=1976	0.99	0.50					1.49	0.28		0.50	0.68	0.08	0.13
	40	FCO D3-=1977	0.09	0.19					0.27	0.01		0.02			
		FCO D3-=1978	6.23	0.82				0.72	7.77	1.92		3.21	5.49	1.33	2.22
		FCO D3-=1979	2.39	0.39				1.03	3.80	0.90		1.47	3.43	0.77	1.26
		FCO D3-=1980	0.28					0.29	0.57	0.14		0.24	0.57	0.14	0.24
		FCO D3-=1961	6.21	1.02				0.57	7.80	1.98		3.29			
	50	FCO D3-=1962					0.73		0.73						
		FCO D3=1964	2.64	2.46					5.10	0.86		1.43			

TABLE I-6 (continued)

Forest Operations Inventory Impacted by the Pacific Connector Gas Pipeline Project

Forest Operations Inventory (FOI)			**Project Construction Impacts (Acres)**							**Project Operation Impacts (acres)**			**Area Impacted (acres) Within Associated LSR**		
Age Range	**Age Class a/**	**FOI Code b/, c/, d/, e/**	**Construction Right-of-Way**	**Temporary Extra Work Space**	**Permanent Access Roads**	**Temporary Access Roads**	**Rock Source/Disposal**	**Uncleared Storage Area**	**Total f/**	**30-foot Maintenance Corridor**	**Aboveground Facilities**	**50-foot Permanent Easement**	**Pacific Connector Project Construction**	**30-foot Maintenance Corridor**	**50-foot Permanent Easement**
		FCO D3-=1964	0.15						0.15	0.06		0.11			
		FCO D3-=1966	3.83	0.93					4.76	1.21		2.02			
		FCO D3H2-=1967	9.63	3.27				2.33	15.23	3.02		5.02	1.32	0.26	0.43
		FCO D3H2-=1968	3.27	0.28					3.55	1.04		1.73			
		FCO D3PC2H3-=1965//H1-1965	0.51	0.06					0.57	0.17		0.29			
		FCO D3-=1953	1.32						1.32	0.79		1.32	0.45	0.26	0.45
		FCO D3-=1960	1.21	0.16					1.38	0.41		0.68	1.38	0.41	0.68
	60	FCO D3C3-=1951	4.20	0.31				0.88	5.39	1.34		2.21	5.39	1.34	2.21
		FCO D3GF3-=1951	6.48	2.14					8.62	2.03		3.34	7.92	1.88	3.10
		FCO D3H3-=1960//H1-1960					0.49		0.49				0.44		
		FCO D3=1940	0.47	0.08				0.36	0.91	0.13		0.22			
	80	FCO D3-=1940	18.81	3.20				4.97	26.97	6.00		10.02	26.97	6.00	10.02
		FCO D4=1940	6.80	1.88				0.53	9.22	2.17		3.62	6.79	1.56	2.60
		FCO D4-=1940	8.62	0.94				0.65	10.22	2.77		4.61	8.66	2.25	3.77
	90	FCO D4-=1930	4.09	0.65				0.07	4.81	1.32		2.19	4.69	1.32	2.19
80-175	100	FCO D4-=1920	1.17	0.74				0.78	2.69	0.02		0.10	1.62		0.02
		FCO D3-=1890	4.97	0.02					4.98	1.58		2.63	4.98	1.58	2.63
	130	FCO D4=1890	5.53	0.27				1.70	7.50	1.72		3.05	7.50	1.72	3.05
		FCO D4-=1890	1.73	0.33				0.68	2.75	0.57		0.93	0.93	0.21	0.35
	140	FCO D4-=1880	2.23	0.58				1.95	4.76	0.50		0.85	4.75	0.50	0.85
	160	FCO D4=1860	0.14					0.09	0.23	0.07		0.11	0.23	0.07	0.11
		FCO D4-=1860	11.83	0.53				3.81	16.17	4.43		7.17	16.17	4.43	7.17
	190	FCO D4=1830					0.35		0.35				0.35		
175+	210	FCO D4=1810//D2=1920					0.07		0.07				0.07		
	240	FCO D4-=1780	3.90	0.09					3.99	1.21		2.02			
	320	FCO D5-=1700	0.89	0.13					1.02	0.28		0.47	1.02	0.28	0.47
		Conifers Total	*164.47*	*38.07*			*1.64*	*33.72*	*237.96*	*53.52*		*89.06*	*152.73*	*34.33*	*57.12*

TABLE I-6 (continued)

Forest Operations Inventory Impacted by the Pacific Connector Gas Pipeline Project

Forest Operations Inventory (FOI)			Project Construction Impacts (Acres)							Project Operation Impacts (acres)			Area Impacted (acres) Within Associated LSR		
Age Range	**Age Class a/**	**FOI Code b/, c/, d/, e/**	**Construction Right-of-Way**	**Temporary Extra Work Space**	**Permanent Access Roads**	**Temporary Access Roads**	**Rock Source/Disposal**	**Uncleared Storage Area**	**Total f/**	**30-foot Maintenance Corridor**	**Aboveground Facilities**	**50-foot Permanent Easement**	**Pacific Connector Project Construction**	**30-foot Maintenance Corridor**	**50-foot Permanent Easement**
Hardwoods															
80-175	100	FHD HD3-=1920	2.65	0.43				1.68	4.77	0.93		1.57	4.77	0.93	1.57
	130	FHD D51780//MY4RA3=1890	1.34	0.42					1.76	0.43		0.71			
		Hardwoods Total	*3.99*	*0.85*				*1.68*	*6.53*	*1.36*		*2.28*	*4.77*	*0.93*	*1.57*
Mixed Conifer and Hardwood															
<80	40	FMX D2RA1-=1980	1.23	0.31				0.70	2.24	0.33		0.57			
	50	FMX D3RA3=1962	1.45	0.85					2.30	0.45		0.76			
		FMX D3RA3M3-=1969	0.77					0.24	1.01	0.01		0.12	0.90	0.01	0.07
		FMX HD3D3=1961	0.17	0.04					0.21	0.04		0.12	0.15	0.02	0.08
	60	FMX RA3D3=1957	2.58	1.04					3.63	0.66		1.12	3.63	0.66	1.12
80-175	80	FMX RA3D3-1940	4.22	0.33				2.77	7.31	1.36		2.27	7.31	1.36	2.27
	130	FMX D4-1890//RA3=1920	0.68	0.62					1.30	0.19		0.31	1.30	0.19	0.31
	140	FMX D4=1880/RA3M3-1900	2.13	0.49				1.13	3.75	0.71		1.18	3.75	0.71	1.18
		FMX D4-1880/HD3=1910	6.74	0.76				1.79	9.30	2.43		4.00	9.27	2.43	4.00
		Mixed Conifer and Hardwood Total	*19.97*	*4.44*				*6.63*	*31.05*	*6.18*		*10.45*	*26.31*	*5.38*	*9.03*
Non-Forest / Other															
	N/A	NA – Agriculture/Range	0.42	0.25		0.69			1.36	0.51		0.85	2.93	0.51	0.85
	N/A	NH – Roads/Maintenance					2.36		2.36	0.08		0.13	1.64		
	N/A	NR – Rock Outcrop	0.41	1.03				0.13	1.57	0.16		0.27	1.57	0.08	0.13
	N/A	NU – Utility Corridor	2.30	1.16				0.12	3.58	0.22		0.37	0.23	0.09	0.14
	N/A	Blank - Unknown	0.14	0.06				0.04	0.24	0.05		0.08	0.07	0.02	0.03
		Non-Forest / Other Total	*3.27*	*2.5*		*0.69*	*2.36*	*0.29*	*9.11*	*1.02*		*1.70*	*6.44*	*0.70*	*1.15*
		Coos Bay District Total	***191.70***	***45.84***		***0.69***	***4.01***	***42.40***	***284.64***	***62.09***		***103.48***	***190.27***	***41.34***	***68.86***
Roseburg BLM District															
Conifers															
<80	10	FCO D1-=2006	0.91	0.31					1.22	0.30		0.48			
		FCO D1P1-=2006	1.42	0.95				0.70	3.07	0.45		0.75			

TABLE I-6 (continued)

Forest Operations Inventory Impacted by the Pacific Connector Gas Pipeline Project

Forest Operations Inventory (FOI)			**Project Construction Impacts (Acres)**							**Project Operation Impacts (acres)**			**Area Impacted (acres) Within Associated LSR**		
Age Range	**Age Class a/**	**FOI Code b/, c/, d/, e/**	**Construction Right-of-Way**	**Temporary Extra Work Space**	**Permanent Access Roads**	**Temporary Access Roads**	**Rock Source/Disposal**	**Uncleared Storage Area**	**Total f/**	**30-foot Maintenance Corridor**	**Aboveground Facilities**	**50-foot Permanent Easement**	**Pacific Connector Project Construction**	**30-foot Maintenance Corridor**	**50-foot Permanent Easement**
		FCO D3IC3-1880//D1P1IC1SP1=2001	1.84	0.53				2.82	5.19	0.61		1.00			
		FCO D4D3-1860//D1SP1IC1-=2002	0.15	0.42					0.57	0.02		0.09			
		FCO D4IC8-1830//D1SP1P1IC1-2001	3.27	0.88				0.50	4.66	0.94		1.56			
		FCO D1=1991	0.11	0.13				0.28	0.52	0.05		0.09			
		FCO D1-=1991	5.08	0.97				3.40	9.45	1.75		2.92	3.79	1.15	1.91
	20	FCO D1-=1992	2.40	0.16				0.14	2.70	0.93		1.53	2.70	0.93	1.53
		FCO D1IC1P1-=1996	1.76	2.33				0.17	4.25	0.54		0.91			
		FCO D1P1-=1994	2.97	3.33				0.61	6.91	0.96		1.63			
		FCO D1P1IC1=1995	1.73	0.49				2.46	4.68	0.55		0.91			
		FCO D1-=1983	1.32	0.12					1.44	0.61		0.99	1.31	0.61	0.99
	30	FCO D1-=1984	2.38	1.49				1.67	5.54	0.70		1.19			
		FCO D1-=1986	2.75	0.61					3.36	0.83		1.39	3.36	0.83	1.39
		FCO D2-=1975	0.32					1.85	2.17	0.11		0.24	0.90	0.06	0.14
		FCO D2-=1976	5.01	0.81					5.83	1.53		2.51			
		FCO D2-=1978	0.17						0.17						
		FCO D2=1980	0.71	0.02				2.87	3.59	0.35		0.59			
	40	FCO D3-=1972	3.11	0.92					4.04	0.97		1.62			
		FCO D3-=1975//D2MA1-1980	4.39	1.65				6.09	12.13	1.29		2.17			
		FCO IC2D2-1976	0.28						0.28	0.17		0.25			
		FCO P2D2=1977	1.43	0.63					2.06	0.43		0.72			
		FCO P2D2IC2=1975	2.18	0.62					2.80	0.57		0.95			
		FCO D2-=1965					1.07		1.07						
	50	FCO D3-=1963/D2=1975/D11975	1.22						1.22	0.38		0.64	1.22	0.38	0.64
		FCO D3=1968	1.18	0.15					1.33	0.42		0.72			
		FCO D3IC3=1964		1.03					1.03						

TABLE I-6 (continued)

Forest Operations Inventory Impacted by the Pacific Connector Gas Pipeline Project

Forest Operations Inventory (FOI)			**Project Construction Impacts (Acres)**							**Project Operation Impacts (acres)**			**Area Impacted (acres) Within Associated LSR**		
Age Range	**Age Class a/**	**FOI Code b/, c/, d/, e/**	**Construction Right-of-Way**	**Temporary Extra Work Space**	**Permanent Access Roads**	**Temporary Access Roads**	**Rock Source/Disposal**	**Uncleared Storage Area**	**Total f/**	**30-foot Maintenance Corridor**	**Aboveground Facilities**	**50-foot Permanent Easement**	**Pacific Connector Project Construction**	**30-foot Maintenance Corridor**	**50-foot Permanent Easement**
	60	FCO D2-=1960					0.02		0.02						
		FCO D3-=1960	0.83	0.09				0.47	1.38	0.19		0.32			
		FCO D3GF3=1960	3.98	0.80	0.13				4.91	1.32	0.09	2.24			
		FCO D3P3-=1960	4.61	3.33				1.52	9.45	1.42		2.34	8.62	1.21	2.00
	70	FCO D2=1950	0.66	0.68					1.35	0.01		0.09			
		FCO D3=1950	0.12	1.31				0.01	1.44	0.05		0.09			
		FCO D4=1945					1.74		1.74						
	110	FCO D3-=1910	0.25					0.83	1.07	0.06		0.09	0.47	0.06	0.09
	120	FCO D3=1900	1.11	0.24				2.27	3.62	0.34		0.57			
		FCO D3-=1900	1.53	0.32				2.30	4.15	0.41		0.63			
		FCO D3-1900//D1-1987	2.13	0.10				5.12	7.35	0.69		1.14			
		FCO D3D4=1900	3.80	0.98				5.03	9.81	1.19		1.98			
		FCO D3D8=1900	6.26	2.53				0.42	9.22	2.03		3.39	8.24	1.82	3.06
80-175		FCO D4IC3-=1780//D3=1900	2.86	0.36					3.22	0.29		0.56	3.22	0.29	0.56
		FCO D4IC4-1780//D3=1900	5.38	1.31				9.76	16.45	1.68		2.76	16.35	1.61	2.66
	130	FCO D3D4-=1890	3.92	1.35				7.43	12.71	1.23		2.05		0.87	1.44
		FCO D3IC3=1890	4.60	0.91					5.52	1.48		2.47		2.94	4.90
		FCO D4-1780//D2IC2P2=1890	2.74	0.58					3.32	0.87		1.44	3.32		
		FCO D4-1870//D3=1890	9.31	2.89				3.98	16.18	2.94		4.90	16.18		
	140	FCO D3IC8-=1880	0.29						0.29	0.15		0.24			
	150	FCO D3=1870	1.09	0.25				2.04	3.38	0.32		0.53	3.38	0.32	0.53
		FCO D3IC4-=1870	0.56					0.80	1.37			0.02	1.37		0.02
		FCO D4-1870//D3=1870	1.66	0.53				1.55	3.75	0.28		0.46	3.71	0.27	0.43
		FCO GF3D3=1870//D2GF2=1950	2.93						2.93	0.93		1.54	2.93	0.93	1.54
	160	FCO D4-1860//D3IC3-1900						0.95	0.95				0.95		
175+	180	FCO D4D3-=1840	0.88	3.12	0.05			2.68	6.74	0.40	0.09	0.65	5.30	0.16	0.31
	190	FCO D4=1830//D3-1870	0.01	0.05				0.10	0.16				0.16		

TABLE I-6 (continued)

Forest Operations Inventory Impacted by the Pacific Connector Gas Pipeline Project

Forest Operations Inventory (FOI)			**Project Construction Impacts (Acres)**							**Project Operation Impacts (acres)**			**Area Impacted (acres) Within Associated LSR**		
Age Range	**Age Class a/**	**FOI Code b/, c/, d/, e/**	**Construction Right-of-Way**	**Temporary Extra Work Space**	**Permanent Access Roads**	**Temporary Access Roads**	**Rock Source/Disposal**	**Uncleared Storage Area**	**Total f/**	**30-foot Maintenance Corridor**	**Aboveground Facilities**	**50-foot Permanent Easement**	**Pacific Connector Project Construction**	**30-foot Maintenance Corridor**	**50-foot Permanent Easement**
	200	FCO D4=1820	0.56	0.13				0.21	0.90	0.26		0.43	0.90	0.26	0.43
	240	FCO D4=1780	9.02	0.77				2.04	11.82	3.00		4.97	11.11	2.91	4.82
		FCO D4-=1780	3.99	1.35					5.34	1.67		2.71	5.34	1.67	2.71
		FCO D4=1780//D2=1940	2.95	0.25					3.20	0.97		1.61	2.89	0.93	1.54
		FCO D4=1780//D3=1870						0.01	0.01				0.01		
		FCO D4=1780//H3D8-1890					0.15		0.15				0.14		0.15
		FCO D4D3-=1780	0.20	0.11				0.67	0.99	0.07		0.15	0.99	0.07	0.15
		FCO D4IC4=1780//D3MA2-1880	5.55	1.80				11.34	18.69	1.63		2.73	14.80	1.44	2.31
		FCO D4MA8-1780//D1=1950	3.44	3.23					6.67	1.19		1.90	4.86	0.27	0.63
		FCO D4P8=1780		0.55					0.55				0.28		
		FCO D4WF8-1780	0.02					0.48	0.50			0.01	0.34		
		Conifers Total	*135.33*	*48.47*	*0.18*		*2.98*	*85.57*	*272.58*	*42.53*	*0.18*	*70.86*	*129.14*	*21.99*	*36.88*
Mixed Conifer and Hardwood															
<80	10	FMX P1D1-=2005	1.59	0.78				3.38	5.75	0.49		0.81			
	50	FMX MA2D3-=1969	2.46	0.68				1.78	4.92	0.79		1.31			
80-175	140	FMX D3MA2=1875	4.30	0.84				2.09	7.23	1.44		2.40			
175+	200	FMX D4IC4=1820//D3MA2=1910	6.20	0.13				12.87	19.21	1.95		3.24	19.21	1.95	3.24
		Mixed Conifer and Hardwood Total	*14.55*	*2.43*				*20.12*	*37.11*	*4.67*		*7.76*	*19.21*	*1.95*	*3.24*
Non-Forest / Other															
	N/A	NG – Natural Grass	2.90	0.75					3.65	0.92		1.53			
	N/A	NU – Utility Corridor	0.52	0.34				1.17	2.03	0.09		0.15			
	N/A	Blank - Unknown	0.81	0.13				0.19	1.14	0.29		0.52	0.16	0.04	0.10
		Non-Forest / Other Total	*4.23*	*1.22*				*1.36*	*6.82*	*1.30*		*2.20*	*0.16*	*0.04*	*0.10*
		Roseburg District Total	***154.11***	***52.12***	***0.18***		***2.98***	***107.05***	***316.51***	***48.47***	***0.17***	***80.84***	***148.52***	***23.99***	***40.20***

TABLE I-6 (continued)

Forest Operations Inventory Impacted by the Pacific Connector Gas Pipeline Project

Forest Operations Inventory (FOI)			Project Construction Impacts (Acres)							Project Operation Impacts (acres)			Area Impacted (acres) Within Associated LSR		
Age Range	**Age Class a/**	**FOI Code b/, c/, d/, e/**	**Construction Right-of-Way**	**Temporary Extra Work Space**	**Permanent Access Roads**	**Temporary Access Roads**	**Rock Source/Disposal**	**Uncleared Storage Area**	**Total f/**	**30-foot Maintenance Corridor**	**Aboveground Facilities**	**50-foot Permanent Easement**	**Pacific Connector Project Construction**	**30-foot Maintenance Corridor**	**50-foot Permanent Easement**
Medford BLM District															
Conifers															
	20	FCO D3D2WF2IC2-1950//P1MA1D1WF1IC1-=1992	1.14	0.23					1.36	0.39		0.66			
		FCO D1CO1CH1WF1P1=1986	0.13	1.69				0.02	1.84	0.01		0.02	1.84	0.01	0.02
		FCO D1IC1NH1P1WF1-=1981	1.23	0.32					1.55	0.45		0.75	1.55	0.45	0.75
		FCO D1P1-=1987	0.84					0.61	1.45	0.44		0.68			
		FCO D1SP1IC1P1WF1-=1988		0.00					0.00						
		FCO P1D1CO1D2P2-=1989		0.03					0.03				0.03		
<80	30	FCO P1D1IC1WF1NH1-=1989	3.14	1.92					5.06	0.99		1.65	5.06	0.99	1.65
		FCO P1D1MA2=1988	5.79	2.12				0.42	8.33	1.80		2.99	5.62	1.28	2.14
		FCO P1D1WF1LP1IC1-=1990	1.95	0.51					2.46	0.61		1.02	2.46	0.61	1.02
		FCO P1NH1D1WF1IC1-=1988	0.21	0.28					0.49	0.10		0.16	0.49	0.10	0.16
		FCO P1PD1IC1WF1D1-=1988	1.16						1.16	0.37		0.61	1.16	0.37	0.61
		FCO P1WF1NH1D1IC1-=1988	2.86	0.77					3.63	0.90		1.50	3.63	0.90	1.50
	60	FCO D3WF3MA3IC3=1955//D2WF2MA2IC2-=1980	1.69	0.84				0.13	2.66	0.53		0.89			
		FCO D4P4-1800//D2-=1940	0.24	0.24					0.48	0.07		0.17			
		FCO D4P4-1850//D2P2-=1940	1.00	0.01				0.63	1.64	0.29		0.48			
	80	FCO P4-1850//D2IC2-=1940	4.43	0.54				2.57	7.24	1.39		2.31			
		FCO D4D3D5WF3WF4-=1937//WF2D1-1989	2.22	0.33				0.86	3.41	0.70		1.16	3.41	0.70	1.16
80-175		FCO D3D4P4=1800//D2D1-1920	0.39	0.02				0.24	0.65	0.12		0.19			
	100	FCO D3WF3-1920//D3D2WF1MA2WF2-=1960	3.16	0.30				0.80	4.26	0.83		1.42			
		FCO D3WF4D4IC4P3-1913	1.19	0.23				0.02	1.43	0.42		0.69	1.43	0.42	0.69

TABLE I-6 (continued)

Forest Operations Inventory Impacted by the Pacific Connector Gas Pipeline Project

Forest Operations Inventory (FOI)			**Project Construction Impacts (Acres)**							**Project Operation Impacts (acres)**			**Area Impacted (acres) Within Associated LSR**		
Age Range	**Age Class a/**	**FOI Code b/, c/, d/, e/**	**Construction Right-of-Way**	**Temporary Extra Work Space**	**Permanent Access Roads**	**Temporary Access Roads**	**Rock Source/Disposal**	**Uncleared Storage Area**	**Total f/**	**30-foot Maintenance Corridor**	**Aboveground Facilities**	**50-foot Permanent Easement**	**Pacific Connector Project Construction**	**30-foot Maintenance Corridor**	**50-foot Permanent Easement**
	110	FCO P4D3-1800//D1-1920	3.80	1.00				1.38	6.19	1.20		2.01			
		FCO P4D4-1890//D2P2-=1920	0.93	0.36					1.30	0.29		0.49			
		FCO D4P4-1850//D2-=1910	2.53	0.72				0.94	4.19	0.65		1.12			
		FCO D4P4-1860//D3P3HD3SP3D2=1910	2.22	1.28					3.51	0.66		1.08			
	120	FCO D3P4-1850//D1-1900	4.69	1.46				1.73	7.88	1.58		2.61			
		FCO P4D3-1800//D2IC1D1=1900	1.06	0.58				0.15	1.79	0.28		0.46			
	130	FCO D3D4D2P2IC4=1888//OM1WF1I C1D1-	1.59	0.32				3.02	4.94	0.82		1.32	4.94	0.82	1.32
		FCO P3D3-1890	1.04	0.90					1.94	0.30	0.01	0.54	1.94	0.30	0.54
	140	FCO D3-=1880		0.09					0.09						
		FCO D3P3-1880//D2HD3-1930	0.51	0.21					0.72	0.16		0.27			
	170	FCO D3=1850	0.05	0.04				0.05	0.14	0.03		0.04			
		FCO D4=1850	2.40	0.94				1.57	4.91	0.98		1.56			
		FCO P3D3=1850	1.77	0.95				0.15	2.87	0.45		0.76			
		FCO P3D3=1850//IC2=1940	1.57	0.33				0.67	2.56	0.39		0.68			
		FCO P3HD3D3-1850	1.78	0.63				0.58	3.00	0.55		0.92			
175+	220	FCO D4IC4=1800//D2IC2=1940	0.91	0.80				0.17	1.89	0.40		0.64			
		FCO D4P4=1800//D2HD2=1940	2.16	0.96				0.91	4.04	0.68		1.13	4.04	0.68	1.13
	270	FCO P4D4=1750//D2IC2=1940	0.81	0.14					0.96	0.34		0.57			
	320	FCO D4=1700//D3D2-1880	3.08	0.80				1.07	4.96	0.99		1.65	4.96	0.99	1.65
		Conifers Total	*65.67*	*22.89*				*18.69*	*107.01*	*21.16*	*0.01*	*35.20*	*42.56*	*8.62*	*14.34*
Hardwoods															
80-175	90	FHD WO2MA1CO1P2-1930	2.01						2.01	0.63		1.04			
	100	FHD WO2-1920	2.99	0.70				0.69	4.38	0.94		1.57			
	120	FHD WO2-1900	10.46	3.98				0.97	15.41	3.43		5.63			
		FHD WO2CO2=1900	2.45	0.02					2.47	0.79		1.31			

TABLE I-6 (continued)

Forest Operations Inventory Impacted by the Pacific Connector Gas Pipeline Project

Forest Operations Inventory (FOI)			**Project Construction Impacts (Acres)**							**Project Operation Impacts (acres)**			**Area Impacted (acres) Within Associated LSR**		
Age Range	**Age Class a/**	**FOI Code b/, c/, d/, e/**	**Construction Right-of-Way**	**Temporary Extra Work Space**	**Permanent Access Roads**	**Temporary Access Roads**	**Rock Source/Disposal**	**Uncleared Storage Area**	**Total f/**	**30-foot Maintenance Corridor**	**Aboveground Facilities**	**50-foot Permanent Easement**	**Pacific Connector Project Construction**	**30-foot Maintenance Corridor**	**50-foot Permanent Easement**
	170	FHD WO2=1850	5.07	1.54				2.08	8.69	1.58		2.63			
	220	FHD WO2=1800		0.18					0.18						
		FHD WO2-1800	0.37	0.02					0.40	0.15		0.26			
		Hardwoods Total	*23.35*	*6.44*				*3.74*	*33.54*	*7.52*		*12.44*			
Mixed Conifer and Hardwoods															
<80	40	FMX NH1D1D2WF1P1-=1977	1.91	0.71					2.61	0.62		1.03	2.61	0.62	1.03
	60	FMX D1MA1-=1958	1.29	0.15				0.60	2.04	0.54		0.86			
	80	FMX D3P3-1850//D2HD2-=1940	1.98	0.83				0.72	3.53	0.22		0.50			
		FMX D4P4-1900//D2HD2=1940	2.48	1.31				0.97	4.75	0.79		1.31			
	100	FMX D3HD3=1915	2.56	0.42				3.30	6.28	1.00		1.60			
		FMX WO2P21920	4.85	1.83					6.69	1.52		2.54			
	110	FMX D3-1850//D2MA2-=1910	1.22	0.52					1.73	0.40		0.66			
	120	FMX WO2D1P2-1900	1.28	1.03					2.31	0.39		0.66			
		FMX WO2D2-1900	1.80	0.89				0.51	3.21	0.45		0.77			
		FMX WO2P3CO2D2-1895	10.89	6.20				2.69	19.78	3.14		5.28	19.78	3.14	5.28
	130	FMX P3HD3D3-1890	3.08	1.67					4.75	0.96		1.60			
	140	FMX P3D3-1880//HD2-1940	0.33	0.54					0.87	0.13		0.22			
		FMX P3WO2-1880//D2-1940	2.06	1.08				0.02	3.16	0.67		1.12			
		FMX WO2P2-1880	2.07	0.24					2.31	0.62		1.05			
		FMX WO2P3-1880	7.91	1.68					9.59	2.42		4.04			
	150	FMX WO3P3-1870//WO2IC1P1-1910	3.03	0.56				0.42	4.01	0.96		1.61			
		FMX WO3P3-1870//WO2P1IC1-1920	3.34	1.54					4.87	1.07		1.78			
	170	FMX HD3D4=1850	0.03	0.02				0.03	0.08	0.01		0.02			
		Mixed Conifer and Hardwood Total	*52.11*	*21.22*				*9.26*	*82.57*	*15.91*		*26.65*	*22.39*	*3.76*	*6.31*
Non-forest / Other															
	N/A	NG – Natural Grass	10.75	5.32				0.45	16.52	3.30		5.50	10.51	2.08	3.47

TABLE I-6 (continued)

Forest Operations Inventory Impacted by the Pacific Connector Gas Pipeline Project

Forest Operations Inventory (FOI)			Project Construction Impacts (Acres)							Project Operation Impacts (acres)			Area Impacted (acres) Within Associated LSR		
Age Range	**Age Class a/**	**FOI Code b/, c/, d/, e/**	**Construction Right-of-Way**	**Temporary Extra Work Space**	**Permanent Access Roads**	**Temporary Access Roads**	**Rock Source/Disposal**	**Uncleared Storage Area**	**Total f/**	**30-foot Maintenance Corridor**	**Aboveground Facilities**	**50-foot Permanent Easement**	**Pacific Connector Project Construction**	**30-foot Maintenance Corridor**	**50-foot Permanent Easement**
	N/A	NH – Roads/Maintenance	2.60	4.83	0.16			0.50	8.09	0.84	0.07	1.37	8.09	0.84	1.37
	N/A	NR – Rock Outcrop	18.44	3.88				1.96	24.28	5.94		9.90			
	N/A	NU – Utility Corridor	1.36	0.15					1.51	0.44		0.73			
	N/A	Blank - Unknown	0.02	0.01					0.04	0.01		0.01			
		Non-forest / Other Total	*33.17*	*14.19*	*0.16*			*2.91*	*50.44*	*10.53*	*0.07*	*17.51*	*18.60*	*2.92*	*4.84*
		Medford District Total	**174.30**	**64.74**	**0.16**			**34.60**	**273.56**	**55.12**	**0.08**	**91.80**	**83.55**	**15.30**	**25.49**
Lakeview BLM District															
Conifers															
80-175	100	FCO J3-1918//NB1-=1952	2.83	0.58					3.41	0.94		1.53			
		FCO WF3D3-=1916/WF3D3=1934/WF1-1993	9.43	2.26					11.69	2.93		4.88			
	130	FCO P4-=1883/P3-1948/WF1-1991	1.63	0.27					1.90	0.54		0.90			
		FCO WF3=1886/D2WF2-1956/WF1P1D2-1995	0.80	0.43					1.23	0.30		0.51			
		Conifers Total	*14.83*	*3.54*					*18.37*	*4.71*		*7.84*			
		Lakeview District Total	**14.83**	**3.54**					**18.37**	**4.71**		**7.84**			

Note: Totals do not necessarily sum correctly due to rounding.

a/ Age Class: Ten-year age class that is managed by BLM and covers a 10-year range. For example, Age 10 includes stands between ages 5-15, Age 20 includes stands between ages 16-25.

b/ Dominant Overstory codes: D = Douglas-fir, P = Ponderosa Pine, WH = Western Hemlock, GF = Grand Fir, WF = White Fir, IC = Incense Cedar, RC = Red Cedar, H = Hardwoods, MA = Pacific Madrone, WO = White Oak, CO = California Black Oak, C = Cherry, NH = Non-commercial hardwood, SP = Sugar Pine, PC = Port-Orford Cedar, J = Juniper, RA = Red Alder, LP = Lodgepole Pine

c/ DBH Class: 1 = 0-5 inch DBH (seedlings and saplings); 2 = 5-11inch DBH (pole timber); 3 = 11-21inch DBH (small sawtimber); 4 = 21+inch DBH (large sawtimber); 5 = 21+ DBH (large old-growth Douglas-fir); 8 = No data.

d/ Stand Stock Level: "-" = poorly stocked, "=" = medium stocked, "-=" = well stocked.

e/ Year corresponds with forest "birth date."

f/ Total excludes "Associated LSR," which is already included in the "PCGP Construction Impacts" acres.

Note: BLM FOI Coverage, June 2016

TABLE I-7

Plant Association Groups on the Umpqua, Rogue River-Siskiyou, and Fremont-Winema National Forests

		Project Construction Impacts (Acres)						**Project Operation Impacts (acres)**			**Area Impacted (acres) within Associated LSR c/**		
USDA Forest Service Forest	**Plant Association Groups (PAGs) a/**	**Construction Right-of-Way**	**Temporary Extra Work Space**	**Temporary Access Road (TAR)**	**Rock Source/Disposal**	**Uncleared Storage Area**	**Total b/**	**30-foot Maintenance Corridor**	**Aboveground Facilities**	**50-foot Permanent Easement**	**PCGP Construction**	**30-foot Maintenance Corridor**	**50-foot Permanent Easement'**
Umpqua National Forest	Douglas fir/poison oak-warm, often low elevation	7.51	1.02		2.00	3.86	14.39	1.96		3.27	6.77	0.63	1.04
	Douglas fir-Canyon live oak-cool, dry - SW Oregon	24.75	5.45	0.24		9.19	39.63	7.60		12.65	9.63	1.93	3.23
	Douglas fir-chinquapin-salal-SW Oregon	32.30	5.12		0.79	7.63	45.84	10.73		17.84	40.95	9.75	16.21
	Douglas-fir-ultramific-SW Oregon	0.36	0.08				0.44	0.16		0.27			
	Grand fir/oceanspray-poison oak-westside low elevation	4.82	0.73			6.05	11.60	1.37		2.35	9.10	1.18	2.02
	Grand fir/warm-westside low elevation (may not be current)	2.86	0.73			1.46	5.05	0.77		1.27	4.95	0.76	1.24
	Grand fir-Canyon live oak	0.95	0.43				1.38	0.32		0.54	1.38	0.32	0.54
	Jeffrey pine/grass	10.46	1.66			5.85	17.97	3.39		5.65	0.29	0.07	0.14
	Western hemlock/rhododendron-SW Oregon Cascades	0.19					0.19	0.02		0.05	0.19	0.02	0.05
	Western hemlock/salal-Oregon grape-SW Oregon Cascades	2.75	0.23			1.37	4.35	0.80		1.34	2.43	0.71	1.19
	White fir/Oregon grape	25.45	21.81			5.12	52.44	8.20	0.06	13.67	3.97	0.74	1.27
	White fir-cool, dry	0.06					0.06	0.03		0.05	0.06	0.03	0.05
	White fir-Douglas fir-warm, dry	1.65	0.53			0.34	2.52	0.52		0.86	0.17		
	White fir-western hemlock/Oregon grape	3.94	1.34		0.84	0.87	6.99	1.50		2.47	1.41	0.24	0.38
	Not currently in model d/	6.02	1.48		0.72	0.36	8.58	1.93		3.22	7.30	1.75	2.88
	Umpqua National Forest Total	***124.07***	***40.61***	***0.24***	***4.35***	***42.10***	***211.43***	***39.30***	***0.06***	***65.50***	***88.60***	***18.13***	***30.24***
Rogue River–Siskiyou National Forest	Douglas fir-Canyon live oak-cool, dry-SW Oregon	20.06	4.18			10.24	34.48	6.11		10.18	34.42	6.10	10.16
	Mountain hemlock/grouse whortleberry-big huckleberry-cool, dry	2.85	0.52			1.45	4.82	1.03		1.72	4.82	1.03	1.72
	Mountain hemlock/rhododendron-warm	3.29	0.72			1.70	5.71	1.04		1.73	5.71	1.04	1.73
	Mountain hemlock/sidebells pyrola-high elevation-SW Oregon	0.07				0.07	0.14				0.14		
	Shasta red fir-Cascade Province, SW Oregon	19.60	5.89			7.90	33.39	6.16		10.27	33.38	6.16	10.27

TABLE I-7 (continued)

Plant Association Groups on the Umpqua, Rogue River-Siskiyou, and Fremont-Winema National Forests

USDA Forest Service Forest	Plant Association Groups (PAGs) a/	Project Construction Impacts (Acres)						Project Operation Impacts (acres)			Area Impacted (acres) within Associated LSR c/		
		Construction Right-of-Way	Temporary Extra Work Space	Temporary Access Road (TAR)	Rock Source/Disposal	Uncleared Storage Area	Total b/	30-foot Maintenance Corridor	Aboveground Facilities	50-foot Permanent Easement	PCGP Construction	30-foot Maintenance Corridor	50-foot Permanent Easement'
	White fir/Oregon grape	51.14	11.33		4.63	24.74	91.84	16.28		27.13	86.95	16.25	27.09
	White fir-Douglas fir-warm, dry	5.86	8.12			2.14	16.12	1.93		3.15	16.12	1.93	3.15
	White fir-Shasta red fir	49.39	19.32		0.28	19.93	88.92	15.71		26.25	88.65	15.71	26.25
	Not currently in model d/	0.20	0.02			0.01	0.23	0.07		0.11	0.22	0.07	0.11
	Rogue River National Forest Total	***152.46***	***50.10***		***4.91***	***68.18***	***275.65***	***48.33***		***80.54***	***270.42***	***48.29***	***80.48***
Fremont-Winema National Forest	Lodgepole pine	30.53	3.75			6.49	40.77	10.03		16.66			
	Mountain hemlock/Alaska huckleberry	1.22				0.35	1.57	0.41		0.67	1.57	0.41	0.67
	Mountain hemlock/grouse whortleberry-big huckleberry-cool, dry	0.06					0.06				0.06		
	Mountain hemlock/rhododendron-warm	0.04				0.07	0.11			0.03	0.11		0.03
	Shasta red fir-Cascade Province, SW Oregon	1.89	0.01			0.39	2.29	0.62		1.04	2.29	0.62	1.04
	White fir	37.65	7.78			5.04	50.47	11.83		19.77			
	White fir/Oregon grape	0.49	0.03			0.15	0.67	0.20		0.34	0.67	0.20	0.34
	White fir-Shasta red fir	0.80	0.45			0.27	1.52	0.32		0.53	1.52	0.32	0.53
	Not currently in model d/	0.55	0.03			0.13	0.71	0.16		0.26	0.20		
	Fremont-Winema National Forest Total	***73.23***	***12.05***			***12.89***	***98.17***	***23.57***		***39.29***	***6.42***	***1.55***	***2.61***
	Overall Total	**349.76**	**102.76**	**0.24**	**9.26**	**123.17**	**585.25**	**111.20**	**0.06**	**185.33**	**365.42**	**67.99**	**113.33**

Note: Totals do not necessarily sum correctly due to rounding.
a/ Description of PAGs can be found within Section 3.3.1.2 in Pacific Connector's Resource Report 3.
b/ Total includes impacted area in "Associated LSR".
c/ Acres of LSR impacted are also included in the total "Pipeline Construction Impacts".
d/ Not all acreages in National Forests crossed by the Pipeline were defined in the GIS PAG data (Forest Service 2003, 2010)

TABLE I-8

Total Terrestrial Habitat (acres) Affected/Removed (a/) by Construction within Riparian Zones (One Site-Potential Tree Height Wide) Adjacent to Perennial and Intermittent Waterbodies on Federal and Non-Federal Lands Crossed by and Adjacent to (b/) the Pacific Connector Pipeline Project

	Forest Habitat c/					Other Habitat c/						
Fifth-Field Watershed (Hydrologic Unit Code [HUC]) and Landowner	Late Successional Old Growth Forest	Mid-Seral Forest	Regenerating Forest	Clearcut, Forest	Forest Total	Forested Wetland	Nonforested Wetland	Unaltered Nonforested Habitat	Agriculture	Altered Habitat	Other Total	Total Riparian Zone Impact (acres)
Coos Bay Frontal Pacific Ocean (HUC 1710030403)												
BLM-Coos Bay District	2.57	0.50	3.68	0	**6.76**	0	0	0	0	1.91	**1.91**	**8.66**
Non-Federal	0.82	5.65	10.58	2.36	**19.79**	0	31.27	0	17.49	40.62	**89.38**	**109.17**
Watershed Total	**3.39**	**6.5**	**14.26**	**2.36**	**26.55**	**0**	**31.27**	**0**	**17.49**	**42.52**	**91.28**	**117.83**
South Fork Coos River (HUC 1710030401)												
BLM-Coos Bay District	0.63	0.07	0.37	0	**1.07**	0	0	0	0	0.64	**0.64**	**1.71**
Non-Federal	0	0	0.68	0	**0.68**	0	0	0	0	0.09	**0.09**	**0.77**
Watershed Total	**0.63**	**0.07**	**1.05**	**0**	**1.75**	**0**	**0**	**0**	**0**	**0.73**	**0.73**	**2.48**
North Fork Coquille River (HUC 1710030504)												
BLM-Coos Bay District	1.22	2.86	0.24	0	**4.32**	0	0.03	0	0.32	0.15	**0.51**	**4.84**
Non-Federal	0	1.91	1.10	0	**3**	0	0	0	1.27	0.28	**1.55**	**4.55**
Watershed Total	**1.22**	**4.76**	**1.34**	**0**	**7.33**	**0**	**0.03**	**0**	**1.59**	**0.44**	**2.06**	**9.39**
East Fork Coquille River (HUC 1710030503)												
BLM-Coos Bay District	0.25	0	1.16	0	**1.4**	0	0	0	0	0.4	**0.4**	**1.8**
Non-Federal	0	2.9	14.90	0	**17.80**	0	0.02	0	2	0.82	**2.84**	**20.65**
Watershed Total	**0.25**	**2.9**	**16.06**	**0**	**19.20**	**0**	**0.02**	**0**	**2**	**1.22**	**3.24**	**22.45**
Middle Fork Coquille River (HUC 1710030501)												
BLM-Coos Bay District	2.47	0.67	5.08	0	**8.21**	0	0	0	0	1.4	**1.4**	**9.62**
BLM-Roseburg District	0.96	2.25	0.1	0	**3.31**	0	0.01	0	0	0	**0.01**	**3.32**
Non-Federal	0.4	3.05	2.35	0	**5.79**	0.07	0	1.18	3.92	0.22	**5.38**	**11.17**
Watershed Total	**3.82**	**5.96**	**7.53**	**0**	**17.31**	**0.07**	**0.01**	**1.18**	**3.92**	**1.62**	**6.80**	**24.11**
Olalla Creek-Lookingglass Creek (HUC 1710030212)												
Non-Federal	1.4	2.31	1.38	0.04	**5.13**	0	0.6	0.73	14.73	0.29	**16.36**	**21.49**
Watershed Total	**1.4**	**2.31**	**1.38**	**0.04**	**5.13**	**0**	**0.6**	**0.73**	**14.73**	**0.29**	**16.36**	**21.49**
Clark Branch-South Umpqua River (HUC 1710030211)												
Non-Federal	0	5.21	1.27	0	**6.48**	0	0.25	21.60	0.22	0.50	**22.58**	**29.06**
Watershed Total	**0**	**5.21**	**1.27**	**0**	**6.48**	**0**	**0.25**	**21.60**	**0.22**	**0.50**	**22.58**	**29.06**
Myrtle Creek (HUC 1710030210)												
BLM-Roseburg District	1.42	0.03	0	0	1.46	0	0	0	0	0	**0**	**1.46**
Non-Federal	2.20	7.12	0.25	0.09	9.66	0	0.16	6.89	5.00	0.70	**12.75**	**22.40**
Watershed Total	**3.62**	**7.15**	**0.25**	**0.09**	**11.11**	**0**	0.16	6.89	**5.00**	**0.70**	**12.75**	**23.86**

TABLE I-8 I(continued)

Total Terrestrial Habitat (acres) Affected/Removed (a/) by Construction within Riparian Zones (One Site-Potential Tree Height Wide) Adjacent to Perennial and Intermittent Waterbodies on Federal and Non-Federal Lands Crossed by and Adjacent to (b/) the Pacific Connector Pipeline Project

	Forest Habitat c/					Other Habitat c/						
Fifth-Field Watershed (Hydrologic Unit Code [HUC]) and Landowner	**Late Successional Old Growth Forest**	**Mid-Seral Forest**	**Regenerating Forest**	**Clearcut, Forest**	**Forest Total**	**Forested Wetland**	**Nonforested Wetland**	**Unaltered Nonforested Habitat**	**Agriculture**	**Altered Habitat**	**Other Total**	**Total Riparian Zone Impact (acres)**
Days Creek-South Umpqua River (HUC 1710030205)												
BLM-Roseburg District	0.36	0	0.24	0.09	**0.69**	0	0	0	0	0.11	**0.11**	**0.8**
Non-Federal	0.15	6.33	2.37	3.69	12.53	0	0.43	3.83	5.19	1.55	**11.00**	**23.53**
Watershed Total	**0.51**	**6.33**	**2.61**	**3.78**	**13.22**	**0**	**0.43**	**3.83**	**5.19**	**1.66**	**11.11**	**24.33**
Upper Cow Creek (HUC 1710030206)												
Forest Service-Umpqua National Forest	1.74	3.51	1.83	0	7.09	0	0.16	0	0	0.49	**0.66**	**7.75**
Watershed Total	**1.74**	**3.51**	**1.83**	**0**	**7.09**	**0**	**0.16**	**0**	**0**	**0.49**	**0.66**	**7.75**
Trail Creek (HUC 1710030706)												
BLM-Medford District	1.24	0.64	0	0	**1.88**	0	0	0.2	0	0	**0.21**	**2.09**
Forest Service-Umpqua National Forest	0	1.47	0	0	**1.47**	0	0	0	0	2.45	**2.45**	**3.92**
Non-Federal	0.86	1.93	0.02	0	**2.82**	0	0	1.48	0	0.47	**1.96**	**4.77**
Watershed Total	**2.1**	**4.04**	**0.02**	**0**	**6.17**	**0**	**0**	**1.69**	**0**	**2.93**	**4.61**	**10.78**
Shady Cove-Rogue River (HUC 1710030707)												
BLM-Medford District	2.92	0.12	0	0	**3.04**	0	0	0.75	0	0	**0.75**	**3.79**
Non-Federal	1.19	3.48	0.48	0	**5.15**	0	0.32	7.75	0	0.35	**8.42**	**13.57**
Watershed Total	**4.11**	**3.60**	**0.48**	**0**	**8.19**	**0**	**0.32**	**8.50**	**0**	**0.35**	**9.17**	**17.36**
Big Butte Creek (HUC 1710030704)												
BLM-Medford District	3.97	0.07	0	0	**4.04**	0	0	0.88	0	0.04	**0.92**	**4.96**
Non-Federal	0	1.7	0	0	**1.7**	0.08	0.29	2.2	0.51	0.72	**3.81**	**5.51**
Watershed Total	**3.97**	**1.77**	**0**	**0**	**5.74**	**0.08**	**0.29**	**3.08**	**0.51**	**0.77**	**4.73**	**10.47**
Little Butte Creek (HUC 1710030708)												
BLM-Medford District	3.8	0	0	0	**3.8**	0	0	4.12	0	0.2	**4.32**	**8.12**
Forest Service-Rogue River National Forest	1.85	0.12	1.07	0	3.04	0	0	0.19	0	0.12	**0.31**	**3.35**
Non-Federal	5.82	10.25	0	0	16.07	0	4.33	24.77	0.49	0.93	**30.53**	**46.60**
Watershed Total	**11.47**	**10.36**	**1.07**	**0**	**22.90**	**0**	**4.33**	**29.09**	**0.49**	**1.25**	**35.17**	**58.07**
Spencer Creek (HUC 1801012601)												
BLM-Lakeview District	1.26	0	0	0	1.26	0	0	0.11	0	0	**0.11**	**1.37**
Forest Service-Fremont-Winema National Forest	1.11	0.43	1.64	0	3.18	0	0.26	0.01	0	0.12	**0.39**	**3.57**
Non-Federal	0	0.77	1.09	0	1.86	0	0.24	0	0	0.02	**0.26**	**2.12**
Watershed Total	**2.37**	**1.20**	**2.73**	**0**	**6.29**	**0**	**0.50**	**0.12**	**0**	**0.15**	**0.77**	**7.06**

TABLE I-8 I(continued)

Total Terrestrial Habitat (acres) Affected/Removed (a/) by Construction within Riparian Zones (One Site-Potential Tree Height Wide) Adjacent to Perennial and Intermittent Waterbodies on Federal and Non-Federal Lands Crossed by and Adjacent to (b/) the Pacific Connector Pipeline Project

	Forest Habitat c/					Other Habitat c/						
Fifth-Field Watershed (Hydrologic Unit Code [HUC]) and Landowner	**Late Successional Old Growth Forest**	**Mid-Seral Forest**	**Regenerating Forest**	**Clearcut, Forest**	**Forest Total**	**Forested Wetland**	**Nonforested Wetland**	**Unaltered Nonforested Habitat**	**Agriculture**	**Altered Habitat**	**Other Total**	**Total Riparian Zone Impact (acres)**
J.C. Boyle Reservoir-Klamath River (HUC 1801012602)												
Non-Federal	0	0.72	0	0	**0.72**	0	0	6.17	0	0.56	**6.73**	**7.45**
Watershed Total	**0**	**0.72**	**0**	**0**	**0.72**	**0**	**0**	**6.17**	**0**	**0.56**	**6.73**	**7.45**
Lake Ewauna-Klamath River (HUC 1801020412)												
Non-Federal	0	0.88	0	0	**0.88**	0	0.81	0	7.31	0.70	**8.82**	**9.69**
Watershed Total	**0**	**0.88**	**0**	**0**	**0.88**	**0**	**0.81**	**0**	**7.31**	**0.70**	**8.82**	**9.69**
Mills Creek-Lost River (HUC 1801020409)												
Non-Federal	0.56	3.76	0	0	4.32	0	0.08	10.81	27.66	1.22	**39.76**	**44.08**
Watershed Total	**0.56**	**3.76**	**0**	**0**	**4.32**	**0**	**0.08**	**10.81**	**27.66**	**1.22**	**39.76**	**44.08**
All Fifth Field Watersheds and Jurisdictions												
BLM-Coos Bay District	7.14	4.10	10.53	0	21.77	0	0.03	0	0.32	4.50	**4.86**	**26.63**
BLM-Roseburg District	2.74	2.28	0.34	0.09	5.46	0	0.01	0	0	0.11	**0.12**	**5.58**
BLM-Medford District	11.92	0.83	0	0	12.75	0	0	5.96	0	0.25	**6.21**	**18.96**
BLM-Lakeview District	1.26	0	0	0	1.26	0	0.00	0.11	0	0.00	**0.11**	**1.37**
Forest Service-Umpqua National Forest	1.74	4.98	1.83	0	8.56	0	0.16	0	0	2.94	**3.10**	**11.66**
Forest Service-Rogue River-Siskiyou National Forest	1.85	0.12	1.07	0	3.04	0	0	0.19	0	0.12	**0.31**	**3.35**
Forest Service-Fremont-Winema National Forest	1.11	0.43	1.64	0	3.18	0	0.26	0.01	0	0.12	**0.39**	**3.57**
Federal Subtotal	**27.77**	**12.73**	**15.43**	**0.09**	**56.02**	**0**	**0.46**	**6.27**	**0.32**	**8.04**	**15.10**	**71.12**
Non-Federal Subtotal	**13.40**	**57.94**	**36.46**	**6.55**	**114.36**	**0.15**	**38.80**	**87.43**	**85.79**	**50.06**	**262.22**	**376.58**
Overall Total	**41.17**	**70.68**	**51.89**	**6.65**	**170.38**	**0.15**	**39.26**	**93.70**	**86.11**	**58.10**	**277.33**	**447.70**

a/ Project components considered in calculation of habitat "Removed:" Pipeline project construction right-of-way, temporary extra work areas, aboveground facilities, and permanent and temporary access roads (PAR, TAR).
b/ Includes riparian zones of adjacent streams within the construction right-of-way that are not crossed and streams off the right-of-way.
c/ Habitat Types within Riparian Zones generally categorized as: Late Successional (Mature) or Old Growth Forest (coniferous, deciduous, mixed ≥80 years old); Mid-Seral Forests (coniferous, deciduous, mixed ≥40 but ≤80 years old); Regenerating Forest (coniferous, deciduous, mixed ≥5 but ≤40 years old); Clearcut Forests; Forested and Nonforested Wetland, Unaltered Nonforested Habitat (grasslands, sagebrush, shrublands), Agriculture and Altered Habitats (urban, industrial, residential, roads, utility corridors, quarries).

TABLE I-9

Total Terrestrial Habitat (acres) (a/) Within the 30-Foot-Wide Corridor Maintained During the Pacific Connector Pipeline Project Within Riparian Zones (One Site-Potential Tree Height Wide) Adjacent to Perennial and Intermittent Waterbodies on Federal and Non-Federal Land Crossed by and Adjacent to (b/) the Pipeline Project

	Forest Habitat c/					Other Habitat c/						
Fifth-Field Watershed (Hydrologic Unit Code [HUC]) and Landowner	**Late Successional Old Growth Forest**	**Mid-Seral Forest**	**Regenerating Forest**	**Clearcut, Forest**	**Forest Total**	**Forested Wetland**	**Nonforested Wetland**	**Unaltered Nonforested Habitat**	**Agriculture**	**Altered Habitat**	**Other Total**	**Total Riparian Zone Impact (acres)**
Coos Bay Frontal Pacific Ocean (HUC 1710030403)												
BLM-Coos Bay District	0.48	0.13	1.17	0	1.78	0	0	0	0	0.42	0.42	2.20
Non-Federal	0.28	1.09	2.28	0.78	4.42	0	5.44	0	3.14	0.69	9.26	13.68
Watershed Total	**0.75**	**1.22**	**3.45**	**0.78**	**6.20**	**0**	**5.44**	**0**	**3.14**	**1.10**	**9.67**	**15.87**
South Fork Coos River (HUC 1710030401)												
BLM-Coos Bay District	0.01	0	0.08	0	0.08	0	0	0	0	0.32	0.32	0.40
Non-Federal	0	0	0.30	0	0.30	0	0	0	0	0.04	0.04	0.34
Watershed Total	**0.01**	**0**	**0.37**	**0**	**0.38**	**0**	**0**	**0**	**0**	**0.36**	**0.36**	**0.74**
North Fork Coquille River (HUC 1710030504)												
BLM-Coos Bay District	0.3	0.91	0.01	0	**1.22**	0	0.01	0	0.07	0.02	**0.0**	**1.32**
Non-Federal	0	0.49	0.48	0	**0.97**	0	0	0	0.18	0.08	**0.25**	**1.23**
Watershed Total	**0.3**	**1.4**	**0.49**	**0**	**2.2**	**0**	**0.01**	**0**	**0.24**	**0.1**	**0.35**	**2.55**
East Fork Coquille River (HUC 1710030503)												
BLM-Coos Bay District	0.11	0	0.28	0	**0.39**	0	0	0	0	0	**0**	**0.39**
Non-Federal	0	0.74	3.71	0.93	**4.45**	0	0.01	0	0.23	0.19	**0.42**	**4.87**
Watershed Total	**0.11**	**0.74**	**3.99**	**0.93**	**4.84**	**0**	**0.01**	**0**	**0.23**	**0.19**	**0.42**	**5.27**
Middle Fork Coquille River (HUC 1710030501)												
BLM-Coos Bay District	0.8	0.17	0.81	0	**1.78**	0	0	0	0	0.75	**0.75**	**2.53**
BLM-Roseburg District	0.27	0.56	0.05	0	**0.88**	0	0	0	0	0	**0**	**0.88**
Non-Federal	0.14	0.97	0.52	0	**1.64**	0.03	0	0.27	0.98	0.04	**1.31**	**2.95**
Watershed Total	**1.22**	**1.69**	**1.38**	**0**	**4.29**	**0.03**	**0**	**0.27**	**0.98**	**0.79**	**2.06**	**6.36**
Olalla Creek-Lookingglass Creek (HUC 1710030212)												
Non-Federal	0.24	0.69	0.21	0.02	**1.07**	0	0.2	0.16	3.37	0.07	**3.81**	**4.87**
Watershed Total	**0.24**	**0.69**	**0.21**	**0.02**	**1.07**	**0**	**0.2**	**0.16**	**3.37**	**0.07**	**3.81**	**4.87**
Clark Branch-South Umpqua River (HUC 1710030211)												
Non-Federal	0	1.11	0.26	0	**1.37**	0	0.04	4.22	0.03	0.1	**4.39**	**5.75**
Watershed Total	**0**	**1.11**	**0.26**	**0**	**1.37**	**0**	**0.04**	**4.22**	**0.03**	**0.1**	**4.39**	**5.75**
Myrtle Creek (HUC 1710030210)												
BLM-Roseburg District	0.57	0.03	0	0	0.60	0	0	0	0	0	**0**	**0.60**
Non-Federal	0.48	2.03	0.10	0	2.62	0	0.06	0.80	0.86	0.06	**1.78**	**4.40**
Watershed Total	**1.05**	**2.06**	**0.10**	**0**	**3.22**	**0**	**0.06**	**0.80**	**0.86**	**0.06**	**1.78**	**5.00**

TABLE I-9 (continued)

Total Terrestrial Habitat (acres) (a/) Within the 30-Foot-Wide Corridor Maintained During the Pacific Connector Pipeline Project Within Riparian Zones (One Site-Potential Tree Height Wide) Adjacent to Perennial and Intermittent Waterbodies on Federal and Non-Federal Land Crossed by and Adjacent to (b/) the Pipeline Project

Fifth-Field Watershed (Hydrologic Unit Code [HUC]) and Landowner	Forest Habitat c/					Other Habitat c/						Total Riparian Zone Impact (acres)
	Late Successional Old Growth Forest	Mid-Seral Forest	Regenerating Forest	Clearcut, Forest	Forest Total	Forested Wetland	Nonforested Wetland	Unaltered Nonforested Habitat	Agriculture	Altered Habitat	Other Total	
Days Creek-South Umpqua River (HUC 1710030205)												
BLM-Roseburg District	0.06	0	0.08	0.02	**0.16**	0	0	0	0	0.09	**0.09**	**0.25**
Non-Federal	0	1.31	0.54	0.61	2.46	0	0.10	0.55	0.88	0.20	**1.73**	**4.19**
Watershed Total	**0.06**	**1.31**	**0.61**	**0.63**	**2.61**	**0**	**0.10**	**0.55**	**0.88**	**0.30**	**1.82**	**4.44**
Upper Cow Creek (HUC 1710030206)												
Forest Service-Umpqua National Forest	0.46	0.95	0.46	0	1.87	0	0.03	0	0	0.11	**0.14**	**2.02**
Watershed Total	**0.46**	**0.95**	**0.46**	**0**	1.87	**0**	**0.03**	**0**	**0**	0.11	**0.14**	**2.02**
Trail Creek (HUC 1710030706)												
BLM-Medford District	0.36	0.2	0	0	**0.56**	0	0	0.06	0	0	**0.06**	**0.62**
Forest Service-Umpqua National Forest	0	0	0	0	**0**	0	0	0	0	0	**0**	**0**
Non-Federal	0.23	0.62	0	0	**0.85**	0	0	0.29	0	0.13	**0.42**	**1.27**
Watershed Total	**0.59**	**0.82**	**0**	**0**	**1.42**	**0**	**0**	**0.35**	**0**	**0.13**	**0.48**	**1.89**
Shady Cove-Rogue River (HUC 1710030707)												
BLM-Medford District	0.72	0.01	0	0	**0.72**	0	0	0.33	0	0	**0.33**	**1.05**
Non-Federal	0.22	0.52	0.12	0	**0.86**	0	0.09	0.68	0	0.02	**0.79**	**1.65**
Watershed Total	**0.94**	**0.53**	**0.12**	**0**	**1.59**	**0**	**0.09**	**1.01**	**0**	**0.02**	**1.12**	**2.70**
Big Butte Creek (HUC 1710030704)												
BLM-Medford District	0.75	0.01	0	0	**0.76**	0	0	0.16	0	0.01	**0.17**	**0.92**
Non-Federal	0	0.39	0	0	**0.39**	0.02	0.1	0.5	0.14	0.07	**0.82**	**1.22**
Watershed Total	**0.75**	**0.4**	**0**	**0**	**1.15**	**0.02**	**0.1**	**0.66**	**0.14**	**0.07**	**0.99**	**2.14**
Little Butte Creek (HUC 1710030708)												
BLM-Medford District	0.90	0	0	0	0.90	0	0	1.08	0	0.04	1.12	2.02
Forest Service-Rogue River National Forest	0.49	0	0.36	0	0.85	0	0	0.06	0	0.10	0.16	1.01
Non-Federal	1.45	2.73	0	0	4.18	0	0.79	6.28	0.08	0.17	7.33	11.51
Watershed Total	**2.84**	**2.73**	**0.36**	**0**	**5.93**	**0**	**0.79**	**7.43**	**0.08**	**0.30**	**8.61**	**14.54**
Spencer Creek (HUC 1801012601)												
BLM-Lakeview District	0.35	0	0	0	0.35	0	0	0	0	0	**0**	0.35
Forest Service-Fremont-Winema National Forest	0.26	0.10	0.35	0	0.70	0	0.10	0	0	0.02	0.12	0.82
Non-Federal	0	0.28	0.37	0	0.64	0	0.08	0	0	0	0.08	0.73
Watershed Total	**0.60**	**0.38**	**0.72**	**0**	**1.70**	**0**	**0.18**	**0**	**0**	**0.02**	**0.21**	**1.90**

TABLE I-9 (continued)

Total Terrestrial Habitat (acres) (a/) Within the 30-Foot-Wide Corridor Maintained During the Pacific Connector Pipeline Project Within Riparian Zones (One Site-Potential Tree Height Wide) Adjacent to Perennial and Intermittent Waterbodies on Federal and Non-Federal Land Crossed by and Adjacent to (b/) the Pipeline Project

	Forest Habitat c/					Other Habitat c/						
Fifth-Field Watershed (Hydrologic Unit Code [HUC]) and Landowner	**Late Successional Old Growth Forest**	**Mid-Seral Forest**	**Regenerating Forest**	**Clearcut, Forest**	**Forest Total**	**Forested Wetland**	**Nonforested Wetland**	**Unaltered Nonforested Habitat**	**Agriculture**	**Altered Habitat**	**Other Total**	**Total Riparian Zone Impact (acres)**
J.C. Boyle Reservoir-Klamath River (HUC 1801012602)												
Non-Federal	0	0.18	0	0	**0.18**	0	0	1.92	0	0	**1.92**	**2.10**
Watershed Total	**0**	**0.18**	**0**	**0**	**0.18**	**0**	**0**	**1.92**	**0**	**0**	**1.92**	**2.10**
Lake Ewauna-Klamath River (HUC 1801020412)												
Non-Federal	0	0.21	0	0	**0.21**	0	0.08	0	1.18	0.13	**1.38**	**1.60**
Watershed Total	**0**	**0.21**	**0**	**0**	**0.21**	**0**	**0.08**	**0**	**1.18**	**0.13**	**1.38**	**1.60**
Mills Creek-Lost River (HUC 1801020409)												
Non-Federal	0.14	1.05	0	0	1.19	0	0.02	2.82	4.32	0.33	**7.48**	**8.67**
Watershed Total	**0.14**	**1.05**	**0**	**0**	**1.19**	**0**	**0.02**	**2.82**	**4.32**	**0.33**	**7.48**	**8.67**
All Fifth Field Watersheds and Jurisdictions												
BLM-Coos Bay District	1.70	1.21	2.35	0	5.26	0	0.01	0	0.07	1.50	1.58	6.84
BLM-Roseburg District	0.91	0.59	0.12	0.02	1.64	0	0	0	0	0.09	0.09	1.73
BLM-Medford District	2.72	0.22	0	0	2.94	0	0	1.63	0	0.04	1.68	4.62
BLM-Lakeview District	0.35	0	0	0	0.35	0	0	0	0	0	0	0.35
Forest Service-Umpqua National Forest	0.46	0.95	0.46	0	1.87	0	0.03	0	0	0.11	0.14	2.02
Forest Service-Rogue River-Siskiyou National Forest	0.49	0	0.36	0	0.85	0	0	0.06	0	0.10	0.16	1.01
Forest Service-Fremont-Winema National Forest	0.26	0.10	0.35	0	0.70	0	0.10	0	0	0.02	0.12	0.82
Federal Subtotal	**6.89**	**3.06**	**3.65**	**0.02**	**13.61**	**0**	**0.14**	**1.70**	**0.07**	**1.87**	**3.77**	**17.39**
Non-Federal Subtotal	3.18	14.34	8.88	1.41	27.81	**0.05**	7.01	18.49	15.37	2.30	43.22	71.03
Overall Total	**10.07**	**17.40**	**12.53**	**1.42**	**41.42**	**0.05**	**7.15**	**20.19**	**15.43**	**4.17**	**46.99**	**88.41**

a/ Considers terrestrial habitats that were present prior to construction within the 30-foot-wide maintenance corridor.
b/ Includes riparian zones of adjacent streams within the construction right-of-way that are not crossed and streams off the right-of-way.
c/ Habitat Types within Riparian Zones generally categorized as: Late Successional (Mature) or Old Growth Forest (coniferous, deciduous, mixed ≥80 years old); Mid-Seral Forests (coniferous, deciduous, mixed ≥40 but ≤80 years old); Regenerating Forest (coniferous, deciduous, mixed ≥5 but ≤40 years old); Clearcut Forests; Forested and Nonforested Wetland, Unaltered Nonforested Habitat (grasslands, sagebrush, shrublands), Agriculture and Altered Habitats (urban, industrial, residential, roads, utility corridors, quarries).

TABLE I-10

Numbers of Streams within Four Width Classes that would be Crossed by Dry Open-Cuts and Estimated Durations (Worst Case) for In-stream Sediment

Subbasin and Fifth-Field Watersheds	Total Number of Streams, Width Data	Total Streams Crossed with Salmonids a/	Number by Width Class and Duration			
			≤10 ft 2 hours	>10 to ≤25 ft 4 hours	>25 to ≤50 ft 5 hours	>50 ft 6 hours
Coos						
Coos Bay-Frontal Pacific Ocean	10	10	7	3	0	0
Coquille						
North Fork Coquille River	7	5	3	2	2	0
East Fork Coquille River	14	8	8	5	0	1
Middle Fork Coquille River	16	4	13	1	2	0
South Umpqua						
Olalla Creek-Lookingglass Creek	17	5	13	2	1	1
Clark Branch-South Umpqua River	12	4	6	4	1	1
Myrtle Creek	14	5	9	3	2	0
Days Creek-South Umpqua River	15	6	5	8	1	1
Upper Cow Creek	8	0	4	2	2	0
Upper Rogue						
Trail Creek	6	3	4	2	0	0
Shady Cove-Rogue River	10	2	9	1	0	0
Big Butte Creek	8	2	6	1	1	0
Little Butte Creek	47	4	31	11	5	0
Upper Klamath						
Spencer Creek	6	2	4	2	0	0

a/ Includes streams with known and assumed fish presence.

TABLE I-11

Maximum Distances Downstream to Attain SEV Scores 1 to 8 with TSS Concentrations and Durations due to Wet Open-Cut, Flume, and Dam-and-Pump Crossing Procedures in Each Fish-bearing Watershed to be Crossed by the Pacific Connector Pipeline

Construction Method Stream Widths	Duration a/	Concentration	SEV=1	SEV=2	SEV=3	SEV=4	SEV=5	SEV=6	SEV=7	SEV=8
Wet Open Cut										
All Stream Widths	**6 hours**	**TSS (mg/L) =**	**0.11**	**0.41**	**1.60**	**6.21**	**24.1**	**93.2**	**361**	**1,399**
Watersheds:			**Maximum Distance (m) to Equal SEV Level with Duration and Concentration b/**							
Coos Bay-Frontal Pacific Ocean			1,346	1,345	1,341	1,326	1,268	1,065	542	40
North Fork Coquille River			4,701	4,695	4,674	4,593	4,290	3,295	1,185	23
East Fork Coquille River			9,092	9,081	9,035	8,862	8,223	6,152	1,999	26
Middle Fork Coquille River			7,867	7,856	7,814	7,655	7,066	5,182	1,559	15
Olalla Creek-Lookingglass Creek			8,743	8,731	8,681	8,490	7,790	5,582	1,534	10
Clark Branch-South Umpqua River			7,107	6,065	5,023	3,981	2,940	1,898	856	0
Myrtle Creek			4,946	4,941	4,923	4,850	4,579	3,663	1,544	54
Days Creek-South Umpqua River			6,731	6,697	6,565	6,078	4,508	1,417	16	0
Upper Cow Creek			8,474	7,243	6,012	4,781	3,549	2,318	1,087	0
Trail Creek			21,279	17,893	14,507	11,122	7,736	4,351	965	0
Shady Cove-Rogue River			16,763	14,055	11,346	8,638	5,929	3,221	512	0
Big Butte Creek			10,970	9,278	7,585	5,892	4,199	2,506	813	0
Little Butte Creek			12,638	10,704	8,769	6,834	4,900	2,965	1,030	0
Spencer Creek			17,116	14,407	11,699	8,990	6,282	3,573	865	0
Fluming										
Widths ≤10 ft =	**2 hours**	**TSS (mg/L) =**	**0.26**	**1.02**	**3.95**	**15.3**	**59.4**	**230**	**9,520**	**12,906**
Watersheds:			**Maximum Distance (m) to Equal SEV Level with Duration and Concentration b/**							
Coos Bay-Frontal Pacific Ocean			1,323	1,257	1,031	478	24	0	0	0
North Fork Coquille River			4,578	4,236	3,135	977	11	0	0	0
East Fork Coquille River			8,830	8,107	5,824	1,617	11	0	0	0
Middle Fork Coquille River			7,625	6,960	4,887	1,243	6	0	0	0
Olalla Creek-Lookingglass Creek			8,454	7,664	5,241	1,202	4	0	0	0
Clark Branch-South Umpqua River			3,881	2,839	1,797	755	0	0	0	0
Myrtle Creek			4,836	4,529	3,512	1,312	29	0	0	0
Days Creek-South Umpqua River			5,991	4,262	1,139	7	0	0	0	0
Upper Cow Creek			4,661	3,430	2,199	968	0	0	0	0
Trail Creek			10,794	7,409	4,023	637	0	0	0	0
Shady Cove-Rogue River			8,376	5,667	2,958	250	0	0	0	0
Big Butte Creek			5,728	4,035	2,342	649	0	0	0	0
Little Butte Creek			6,647	4,712	2,778	843	0	0	0	0
Spencer Creek			8,728	6,020	3,311	602	0	0	0	0

TABLE I-11 (continued)

Maximum Distances Downstream to Attain SEV Scores 1 to 8 with TSS Concentrations and Durations due to Wet Open-Cut, Flume, and Dam-and-Pump Crossing Procedures in Each Fish-bearing Watershed to be Crossed by the Pacific Connector Pipeline

Construction Method Stream Widths	Duration a/	Concentration	SEV=1	SEV=2	SEV=3	SEV=4	SEV=5	SEV=6	SEV=7	SEV=8
Widths >10 ft to ≤25 ft =	**4 hours**	**TSS (mg/L) =**	**0.15**	**0.58**	**2.24**	**8.67**	**33.6**	**130**	**504**	**1,952**
Watersheds:			**Maximum Distance (m) to Equal SEV Level with Duration and Concentration b/**							
Coos Bay-Frontal Pacific Ocean			1,333	1,295	1,158	749	139	0	0	0
North Fork Coquille River			4,632	4,433	3,739	1,934	150	0	0	0
East Fork Coquille River			8,945	8,523	7,068	3,424	206	0	0	0
Middle Fork Coquille River			7,731	7,342	6,011	2,770	138	0	0	0
Olalla Creek-Lookingglass Creek			8,581	8,117	6,547	2,847	113	0	0	0
Clark Branch-South Umpqua River			4,319	3,277	2,235	1,193	152	0	0	0
Myrtle Creek			4,885	4,707	4,076	2,335	270	0	0	0
Days Creek-South Umpqua River			6,307	5,202	2,466	137	0	0	0	0
Upper Cow Creek			5,179	3,948	2,717	1,486	255	0	0	0
Trail Creek			12,218	8,833	5,447	2,061	0	0	0	0
Shady Cove-Rogue River			9,515	6,806	4,098	1,389	0	0	0	0
Big Butte Creek			6,440	4,747	3,054	1,362	0	0	0	0
Little Butte Creek			7,461	5,526	3,591	1,657	0	0	0	0
Spencer Creek			9,867	7,159	4,450	1,742	0	0	0	0
Widths >25 ft to ≤50 ft =	**5 hours**	**TSS (mg/L) =**	**0.12**	**0.48**	**1.86**	**7.21**	**28**	**108**	**419**	**1,625**
Watersheds:			**Maximum Distance (m) to Equal SEV Level with Duration and Concentration b/**							
Coos Bay-Frontal Pacific Ocean			1,335	1,304	1,187	826	203	1	0	0
North Fork Coquille River			4,644	4,477	3,885	2,244	268	0	0	0
East Fork Coquille River			8,970	8,616	7,374	4,033	389	0	0	0
Middle Fork Coquille River			7,754	7,428	6,289	3,299	271	0	0	0
Olalla Creek-Lookingglass Creek			8,608	8,220	6,873	3,436	234	0	0	0
Clark Branch-South Umpqua River			4,460	3,418	2,376	1,334	293	0	0	0
Myrtle Creek			4,895	4,746	4,211	2,648	439	0	0	0
Days Creek-South Umpqua River			6,378	5,433	2,919	263	0	0	0	0
Upper Cow Creek			5,346	4,115	2,884	1,652	421	0	0	0
Trail Creek			12,677	9,291	5,905	2,520	0	0	0	0
Shady Cove-Rogue River			9,881	7,173	4,464	1,756	0	0	0	0
Big Butte Creek			6,669	4,976	3,284	1,591	0	0	0	0
Little Butte Creek			7,723	5,788	3,853	1,919	0	0	0	0
Spencer Creek			10,234	7,525	4,817	2,108	0	0	0	0
Widths >50 ft =	**6 hours**	**TSS (mg/L) =**	**0.11**	**0.41**	**1.60**	**6.21**	**24.1**	**93.2**	**361**	**1,399**
Watersheds:			**Maximum Distance (m) to Equal SEV Level with Duration and Concentration b/**							
Coos Bay-Frontal Pacific Ocean			1,337	1,310	1,208	885	264	2	0	0

TABLE I-11 (continued)

Maximum Distances Downstream to Attain SEV Scores 1 to 8 with TSS Concentrations and Durations due to Wet Open-Cut, Flume, and Dam-and-Pump Crossing Procedures in Each Fish-bearing Watershed to be Crossed by the Pacific Connector Pipeline

Construction Method Stream Widths	Duration a/	Concentration	SEV=1	SEV=2	SEV=3	SEV=4	SEV=5	SEV=6	SEV=7	SEV=8
North Fork Coquille River			4,652	4,508	3,990	2,487	399	0	0	0
East Fork Coquille River			8,987	8,682	7,592	4,516	604	0	0	0
Middle Fork Coquille River			7,770	7,488	6,488	3,724	433	0	0	0
Olalla Creek-Lookingglass Creek			8,628	8,291	7,107	3,913	387	0	0	0
Clark Branch-South Umpqua River			4,575	3,533	2,491	1,450	408	0	0	0
Myrtle Creek			4,903	4,774	4,306	2,889	615	2	0	0
Days Creek-South Umpqua River			6,428	5,599	3,280	413	0	0	0	0
Upper Cow Creek			5,482	4,251	3,020	1,789	557	0	0	0
Trail Creek			13,051	9,666	6,280	2,894	0	0	0	0
Shady Cove-Rogue River			10,181	7,473	4,764	2,055	0	0	0	0
Big Butte Creek			6,857	5,164	3,471	1,778	0	0	0	0
Little Butte Creek			7,937	6,002	4,067	2,133	198	0	0	0
Spencer Creek			10,534	7,825	5,117	2,408	0	0	0	0
Dam-and-Pump										
Widths ≤10 ft =	**2 hours**	**TSS (mg/L) =**	**0.26**	**1.02**	**3.95**	**15.3**	**59.4**	**230**	**9520**	**12,906**
Watersheds:			**Maximum Distance (m) to Equal SEV Level with Duration and Concentration b/**							
Coos Bay-Frontal Pacific Ocean			1,246	996	419	15	0	0	0	0
North Fork Coquille River			4,180	2,978	801	5	0	0	0	0
East Fork Coquille River			7,989	5,503	1,299	5	0	0	0	0
Middle Fork Coquille River			6,851	4,600	983	2	0	0	0	0
Olalla Creek-Lookingglass Creek			7,536	4,911	935	2	0	0	0	0
Clark Branch-South Umpqua River			2,747	1,705	663	0	0	0	0	0
Myrtle Creek			4,478	3,363	1,108	15	0	0	0	0
Days Creek-South Umpqua River			4,020	909	3	0	0	0	0	0
Upper Cow Creek			3,322	2,090	859	0	0	0	0	0
Trail Creek			7,118	3,733	347	0	0	0	0	0
Shady Cove-Rogue River			5,422	2,714	5	0	0	0	0	0
Big Butte Creek			3,886	2,193	500	0	0	0	0	0
Little Butte Creek			4,542	2,607	672	0	0	0	0	0
Spencer Creek			5,781	3,072	363	0	0	0	0	0
Widths >10 ft to ≤25 ft =	**4 hours**	**TSS (mg/L) =**	**0.15**	**0.58**	**2.24**	**8.67**	**33.6**	**130**	**504**	**1,952**
Watersheds:			**Maximum Distance (m) to Equal SEV Level with Duration and Concentration b/**							
Coos Bay-Frontal Pacific Ocean			1,289	1,136	695	104	0	0	0	0
North Fork Coquille River			4,400	3,632	1,727	97	0	0	0	0
East Fork Coquille River			8,451	6,845	3,024	128	0	0	0	0

TABLE I-11 (continued)

Maximum Distances Downstream to Attain SEV Scores 1 to 8 with TSS Concentrations and Durations due to Wet Open-Cut, Flume, and Dam-and-Pump Crossing Procedures in Each Fish-bearing Watershed to be Crossed by the Pacific Connector Pipeline

Construction Method Stream Widths	Duration a/	Concentration	SEV=1	SEV=2	SEV=3	SEV=4	SEV=5	SEV=6	SEV=7	SEV=8
Middle Fork Coquille River			7,276	5,808	2,426	82	0	0	0	0
Olalla Creek-Lookingglass Creek			8,040	6,310	2,468	65	0	0	0	0
Clark Branch-South Umpqua River			3,185	2,143	1,102	60	0	0	0	0
Myrtle Creek			4,676	3,977	2,122	186	0	0	0	0
Days Creek-South Umpqua River			5,032	2,170	83	0	0	0	0	0
Upper Cow Creek			3,839	2,608	1,377	146	0	0	0	0
Trail Creek			8,542	5,157	1,771	0	0	0	0	0
Shady Cove-Rogue River			6,562	3,853	1,144	0	0	0	0	0
Big Butte Creek			4,598	2,905	1,212	0	0	0	0	0
Little Butte Creek			5,355	3,421	1,486	0	0	0	0	0
Spencer Creek			6,920	4,211	1,503	0	0	0	0	0
Widths >25 ft to ≤50 ft =	**5 hours**	**TSS (mg/L) =**	**0.12**	**0.48**	**1.86**	**7.21**	**28**	**108**	**419**	**1,625**
Watersheds:			**Maximum Distance (m) to Equal SEV Level with Duration and Concentration b/**							
Coos Bay-Frontal Pacific Ocean			1,298	1,168	777	160	0	0	0	0
North Fork Coquille River			4,449	3,793	2,043	186	0	0	0	0
East Fork Coquille River			8,556	7,178	3,637	261	0	0	0	0
Middle Fork Coquille River			7,373	6,111	2,955	177	0	0	0	0
Olalla Creek-Lookingglass Creek			8,155	6,665	3,051	148	0	0	0	0
Clark Branch-South Umpqua River			3,326	2,284	1,243	201	0	0	0	0
Myrtle Creek			4,721	4,125	2,446	323	0	0	0	0
Days Creek-South Umpqua River			5,285	2,624	174	0	0	0	0	0
Upper Cow Creek			4,006	2,775	1,544	313	0	0	0	0
Trail Creek			9,001	5,615	2,229	0	0	0	0	0
Shady Cove-Rogue River			6,928	4,220	1,511	0	0	0	0	0
Big Butte Creek			4,827	3,134	1,441	0	0	0	0	0
Little Butte Creek			5,617	3,683	1,748	0	0	0	0	0
Spencer Creek			7,287	4,578	1,869	0	0	0	0	0
Widths >50 ft =	**6 hours**	**TSS (mg/L) =**	**0.11**	**0.41**	**1.60**	**6.21**	**24.1**	**93.2**	**361**	**1,399**
Watersheds:			**Maximum Distance (m) to Equal SEV Level with Duration and Concentration b/**							
Coos Bay-Frontal Pacific Ocean			1,305	1,192	839	215	1	0	0	0
North Fork Coquille River			4,484	3,908	2,294	292	0	0	0	0
East Fork Coquille River			8,629	7,419	4,131	428	0	0	0	0
Middle Fork Coquille River			7,440	6,330	3,386	300	0	0	0	0
Olalla Creek-Lookingglass Creek			8,235	6,922	3,533	261	0	0	0	0
Clark Branch-South Umpqua River			3,441	2,400	1,358	316	0	0	0	0

TABLE I-11 (continued)

Maximum Distances Downstream to Attain SEV Scores 1 to 8 with TSS Concentrations and Durations due to Wet Open-Cut, Flume, and Dam-and-Pump Crossing Procedures in Each Fish-bearing Watershed to be Crossed by the Pacific Connector Pipeline

Construction Method Stream Widths	Duration a/	Concentration	SEV=1	SEV=2	SEV=3	SEV=4	SEV=5	SEV=6	SEV=7	SEV=8
Myrtle Creek			4,752	4,231	2,698	472	1	0	0	0
Days Creek-South Umpqua River			5,467	2,992	290	0	0	0	0	0
Upper Cow Creek			4,142	2,911	1,680	449	0	0	0	0
Trail Creek			9,375	5,990	2,604	0	0	0	0	0
Shady Cove-Rogue River			7,228	4,519	1,811	0	0	0	0	0
Big Butte Creek			5,014	3,322	1,629	0	0	0	0	0
Little Butte Creek			5,831	3,897	1,962	27	0	0	0	0
Spencer Creek			7,586	4,878	2,169	0	0	0	0	0

a/ Durations for wet open-cut indicate time to repair isolation structures after failure. Durations for dry open-cut from Table 3.2-25.
b/ Maximum downstream distances derived by solving SEV equation (Y = e ((z – a) – b (loge x)) / c) for concentration (Y) by minimizing SEV scores (Z -0.5)
c/ Maximum downstream distances derived by solving SEV equation (Y = e ((z - a) - b (loge x)) /c) for concentration (Y) by minimizing SEV scores (Z -0.5) and using durations (hours) from table I-10.

TABLE I-12

Waterbodies with ESA Critical Habitat and Known or Assumed to Support ESA-Listed and Non-Listed Juvenile and Adult Salmonids with Risks of TSS Effects Downstream Generated during Crossing and Risks of TSS Effects Generated by Crossing Nearest Neighbor Waterbodies

Waterbodies Supporting ESA Critical Habitat and Known or Assumed Habitat for Salmonids								Nearest Neighbor with Risk of Downstream Effects to Fish Habitat				
Waterbodies Crossed and Waterbody ID	**Pipeline Milepost (MP)**	**Critical Habitat**	**Habitat for Salmonids**	**Proposed Crossing Method**	**Stream Width (feet)**	**Risk of TSS Downstream During Crossing (rationale) a/**	**Maximum Distance (m) Downstream from Crossing with Highest SEV Score b/**	**Crossing Distance (m) from Salmonid Stream c/**	**Proposed Crossing Method**	**Stream Width (feet)**	**Risk of TSS at Confluence by Crossing Nearest Neighbor (rationale) a/**	**Maximum Distance (m) Downstream from Nearest Neighbor with Highest SEV Score b/**
Coos Subbasin (HUC 17100304), Coos Bay-Frontal Pacific Ocean (HUC 1710030403) Fifth-Field Watershed, Coos County												
Coos Bay (NE-26)	0.28 to 1.00	Yes	Known	HDD	N/A	None (HDD)	N/A	N/A	N/A	N/A	None (distance)	N/A
Coos Bay (NE-26)	1.46 to 3.02	Yes	Known	HDD	N/A	None (HDD)	N/A	N/A	N/A	N/A	None (distance)	N/A
Trib to Coos Bay (NW-117/EE-6)	6.39R	No	Known	Fluming	11	Moderate-High (perennial)	139 SEV=5	3,026	Fluming	24	None-Low (distance)	>1,333 SEV=0
Willanch Slough (EE-7)	8.27R	Yes	Known	Fluming	24	Moderate-High (perennial)	139 SEV=5	338	Fluming	13	None-Low (intermittent)	749 SEV=4
Trib. to Cooston Channel (Echo Creek) (SS-100-002)	10.21R	No	Known	Fluming	9	None-Low (intermittent)	24 SEV=5	1,481	HDD	650	None (HDD)	N/A
Coos River (BSP-119)	11.13R	Yes	Known	HDD	650	None (HDD)	N/A	676	Fluming	6	Moderate-High (perennial)	1,031 SEV=3
Vogel Creek (SS-100-005)	11.55BR	Yes	Known	Fluming	6	Moderate-High (perennial)	24 SEV=5	531	Fluming	10	None-Low (intermittent)	1,031 SEV=3
Trib. to Vogel Creek (BR-S-06)	12.11BR	No	Assumed	Fluming	2	None-Low (intermittent)	24 SEV=5	370	Fluming	10	None-Low (intermittent)	478 SEV=4
Stock Slough (BR-S-36)	15.11BR	Yes	Known	Fluming	8	None-Low (intermittent)	24 SEV=5	338	Fluming	9	None-Low (intermittent)	478 SEV=4
Stock Slough (EE-SS-9068)	15.32BR	Yes	Known	Fluming	9	None-Low (intermittent)	24 SEV=5	338	Fluming	8	None-Low (intermittent)	478 SEV=4
Coquille Subbasin (HUC 17100305), North Fork Coquille River (HUC 1710030504) Fifth-Field Watershed, Coos County												
Steinnon Creek (SS-500-003; BR-S-63)	20.20BR	No	Assumed	Fluming	8	Moderate-High (perennial)	11 SEV=5	6,632	Fluming	17	None (distance)	>4,632 SEV=0
Steinnon Creek (BR-S-63)	24.32BR	Yes	Known	Fluming	17	Moderate-High (perennial)	150 SEV=5	6,632	Fluming	8	None (distance)	>4,578 SEV=0
Trib to NF Coquille River (NW-40)	22.78	No	Assumed	Fluming	17	None-Low (intermittent)	150 SEV=5	451	Fluming	47	Moderate-High (perennial)	2,244 SEV=4
North Fork Coquille River (BSP-207)	23.06	Yes	Known	Fluming	47	Moderate-High (perennial)	268 SEV=5	451	Fluming	17	None-Low (intermittent)	1,934 SEV=4
Middle Creek (BSP-133)	27.04	Yes	Known	Fluming	48	Moderate-High (perennial)	268 SEV=5	48	Fluming	7	None-Low (intermittent)	977 SEV=4
Coquille Subbasin (HUC 17100305), East Fork Coquille River (HUC 1710030503) Fifth-Field Watershed, Coos County												
Trib. To E. Fork Coquille (BSP-77)	28.86	No	Assumed	Dam-and-Pump	8	None-Low (bedrock)	5 SEV=4	708	Fluming	6	None-Low (intermittent	1,617 SEV=4
Trib. To E. Fork Coquille (BSP-74)	29.30	No	Assumed	Fluming	6	None-Low (intermittent)	11 SEV=5	274	Dam-and-Pump	4	None-Low (bedrock)	1,299 SEV=3
Trib. To E. Fork Coquille (BSI-76)	29.47	No	Assumed	Dam-and-Pump	4	None-Low (intermittent)	5 SEV=4	274	Fluming	6	None-Low (intermittent)	1,617 SEV=4
East Fork Coquille River (BSP-71)	29.85	Yes	Known	Fluming	75	Moderate-High (perennial)	604 SEV=5	596	Fluming	10	Moderate-High (perennial)	1,617 SEV=4
Trib. To E. Fork Coquille (AA-003-007B)	30.29	No	Assumed	Fluming	10	Moderate-High (perennial)	11 SEV=5	113	Fluming	10	Moderate-High (perennial)	1,617 SEV=4
Elk Creek (BSP-57)	32.40	No	Assumed	Fluming	10	Moderate-High (perennial)	11 SEV=5	64	Dam-and-Pump	5	None-Low (bedrock)	1,299 SEV=3
Trib. To Elk Creek (BSP-55)	32.44	No	Assumed	Dam-and-Pump	5	None-Low (bedrock)	5 SEV=4	64	Dam-and-Pump	10	None-Low (bedrock)	1,299 SEV=3
South Fork Elk Creek (CSP-5)	34.46	Yes	Known	Dam-and-Pump	15	None-Low (bedrock))	128 SEV=4	1,690	Fluming	4	None-Low (intermittent)	1,617 SEV=4
Coquille Subbasin (HUC 17100305), Middle Fork Coquille River (HUC 1710030501) Fifth-Field Watershed, Coos County												
Upper Rock Creek (BSP-41)	44.21	No	Assumed	Fluming	25	Moderate-High (perennial)	138 SEV=5	3,783	Fluming	5	Moderate-High (perennial)	4,887 SEV=3
Deep Creek (BSP-257)	48.27	No	Known	Fluming	40	Moderate-High (perennial)	271 SEV=5	96	Fluming	5	None-Low (intermittent)	1,243 SEV=4
Middle Fork Coquille River (BSP-30)	50.28	No	Known	Dam-and-Pump	30	None-Low (bedrock))	177 SEV=4	273	Fluming	4	None-Low (intermittent)	1,243 SEV=4

TABLE I-12

Waterbodies with ESA Critical Habitat and Known or Assumed to Support ESA-Listed and Non-Listed Juvenile and Adult Salmonids with Risks of TSS Effects Downstream Generated during Crossing and Risks of TSS Effects Generated by Crossing Nearest Neighbor Waterbodies

Waterbodies Supporting ESA Critical Habitat and Known or Assumed Habitat for Salmonids								Nearest Neighbor with Risk of Downstream Effects to Fish Habitat				
Waterbodies Crossed and Waterbody ID	**Pipeline Milepost (MP)**	**Critical Habitat**	**Habitat for Salmonids**	**Proposed Crossing Method**	**Stream Width (feet)**	**Risk of TSS Downstream During Crossing (rationale) a/**	**Maximum Distance (m) Downstream from Crossing with Highest SEV Score b/**	**Crossing Distance (m) from Salmonid Stream c/**	**Proposed Crossing Method**	**Stream Width (feet)**	**Risk of TSS at Confluence by Crossing Nearest Neighbor (rationale) a/**	**Maximum Distance (m) Downstream from Nearest Neighbor with Highest SEV Score b/**
Belieu Creek (BSP-61/GSI-37)	50.71	No	Known	Fluming	6	Moderate-High (perennial)	6 SEV=5	418	Fluming	4	None-Low (intermittent)	1,243 SEV=4
South Umpqua (HUC 17100302) Subbasin, Olalla Creek-Lookingglass Creek (HUC 1710030212) Fifth-Field Watershed, Douglas County												
Trib. to Shields Creek (BSI-202)	55.90	No	Assumed	Fluming	20	None-Low (intermittent)	113 SEV=5	64	Fluming	8	None-Low (intermittent)	1,202 SEV=4
Trib. to Olalla Creek (BSI-138)	57.31	No	Assumed	Fluming	8	None-Low (intermittent)	4 SEV=5	274	Dam-and-Pump	5	None-Low (bedrock)	935 SEV=3
Olalla Creek (BSP-155)	58.78	Yes	Known	Fluming	87	Moderate-High (perennial)	387 SEV=5	370	Dam-and-Pump	11	None-Low (bedrock)	2,468 SEV=3
Trib. to Olalla Creek (BSI-129)	59.65	No	Assumed	Fluming	16	None-Low (intermittent)	113 SEV=5	579	Fluming	8	None-Low (intermittent)	1,202 SEV=4
McNabb Creek (NSP-13)	60.48	Yes	Known	Dam-and-Pump	12	None-Low (bedrock)	65 SEV=4	563	Dam-and-Pump	6	None-Low (bedrock)	935 SEV=3
South Umpqua (HUC 17100302) Subbasin, Clark Branch-South Umpqua River (HUC 1710030211) Fifth-Field Watershed, Douglas County												
Kent Creek (BSP-240)	63.97	Yes	Known	Fluming	17	Moderate-High (perennial)	1,285 SEV=4	2,881	Dam-and-Pump	25	None-Low (bedrock)	4,162 SEV=1
Rice Creek (S2-04; BSP-227)	65.76	Yes	Known	Dam-and-Pump	25	None-Low (bedrock)	1,152 SEV=3	1,916	Dam-and-Pump	30	None-Low (bedrock)	2,861 SEV=2
Willis Creek (BSP-168)	66.95	Yes	Known	Dam-and Pump	30	None-Low (bedrock)	1,356 SEV=3	80	Dam-and-Pump	3	None-Low (bedrock)	519 SEV=3
South Umpqua River (BSP-26)	71.27	Yes	Known	Direct Pipe	35	None (Direct Pipe	N/A	129	Fluming	3	None-Low (intermittent)	652 SEV=4
South Umpqua (HUC 17100302) Subbasin, Myrtle Creek (HUC 1710030210) Fifth-Field Watershed, Douglas County												
Rock Creek (EE-SS-9032)	75.33	No	Assumed	Fluming	17	Moderate-High (perennial)	270 SEV=5	11	Fluming	16	Moderate-High (perennial)	270 SEV=5
Trib. to Rock Creek (EE-SS-9033)	75.34	No	Assumed	Fluming	16	Moderate-High (perennial)	270 SEV=5	11	Fluming	17	Moderate-High (perennial)	270 SEV=5
Bilger Creek (BSP-1)	76.38	Yes	Known	Fluming	6	Moderate-High (perennial)	29 SEV=5	1,674	Fluming	21	Moderate-High (perennial)	2,335 SEV=4
North Myrtle Creek (NSP-37)	79.12	Yes	Known	Dam-and-Pump	31	None-Low (bedrock)	323 SEV=4	48	Dam-and-Pump	8	None-Low (bedrock)	1,108 SEV=3
South Myrtle Creek (BSP-172)	81.19	Yes	Known	Dam-and-Pump	41	None-Low (bedrock)	323 SEV=4	306	Fluming	2	None-Low (intermittent)	1,312 SEV=4
South Umpqua (HUC 17100302) Subbasin, Days Creek-South Umpqua River (HUC 1710030205) Fifth-Field Watershed, Douglas County												
Wood Creek (BSP-226)	84.17	No	Known	Dam-and-Pump	8	None-Low (bedrock)	3 SEV=3	1,948	Fluming	14	None-Low (intermittent)	2,466 SEV=3
Trib. to Wood Creek (EE-SS-9041)	85.69	No	Known	Fluming	20	None-Low (intermittent)	137 SEV=4	32	Fluming	23	Moderate-High (perennial)	137 SEV=4
Fate Creek (BSP-232)	88.48	Yes	Known	Dam-and-Pump	20	None-Low (bedrock)	83 SEV=3	193	Dam-and-Pump	23	None-Low (bedrock)	2,170 SEV=2
Days Creek (BSP-233)	88.60	Yes	Known	Dam-and-Pump	23	None-Low (bedrock)	83 SEV=3	193	Dam-and-Pump	20	None-Low (bedrock)	2,170 SEV=2
Saint John Creek (ASP-303)	92.62	Yes	Known	Fluming	15	Moderate-High (perennial)	137 SEV=4	3,880	Diverted Open-Cut	160	Moderate-High (perennial)	N/A
South Umpqua River (ASP-196)	94.73	Yes	Known	Diverted Open-Cut	160	Moderate-High (perennial)	N/A	193	Fluming	10	None-Low (intermittent)	1,139 SEV=3
South Umpqua (HUC 17100302) Subbasin, Upper Cow Creek (HUC 1710030206) Fifth field Watershed, Douglas County												
None												
Upper Rogue (HUC 17100307) Subbasin, Trail Creek (HUC 1710030706) Fifth-Field Watershed, Jackson County												
West Fork Trail Creek (ASP-202)	118.89	Yes	Known	Dam-and-Pump	24	None-Low (bedrock)	1,771 SEV= 3	145	Fluming	2	None-Low (intermittent)	637 SEV= 4
Canyon Creek (NSP-11)	120.45	Yes	Known	Dam-and-Pump	4	None-Low (bedrock)	347 SEV= 3	724	Fluming	5	None-Low (intermittent)	4,023 SEV= 3

TABLE I-12

Waterbodies with ESA Critical Habitat and Known or Assumed to Support ESA-Listed and Non-Listed Juvenile and Adult Salmonids with Risks of TSS Effects Downstream Generated during Crossing and Risks of TSS Effects Generated by Crossing Nearest Neighbor Waterbodies

Waterbodies Supporting ESA Critical Habitat and Known or Assumed Habitat for Salmonids								Nearest Neighbor with Risk of Downstream Effects to Fish Habitat				
Waterbodies Crossed and Waterbody ID	**Pipeline Milepost (MP)**	**Critical Habitat**	**Habitat for Salmonids**	**Proposed Crossing Method**	**Stream Width (feet)**	**Risk of TSS Downstream During Crossing (rationale) a/**	**Maximum Distance (m) Downstream from Crossing with Highest SEV Score b/**	**Crossing Distance (m) from Salmonid Stream c/**	**Proposed Crossing Method**	**Stream Width (feet)**	**Risk of TSS at Confluence by Crossing Nearest Neighbor (rationale) a/**	**Maximum Distance (m) Downstream from Nearest Neighbor with Highest SEV Score b/**
Trib. to Trail Creek (ASI-206)	121.57	Yes	Known	Fluming	8	None-Low (intermittent)	637 SEV= 4	1,079	Fluming	5	None-Low (intermittent)	4,023 SEV= 3
Upper Rogue (HUC 17100307) Subbasin, Shady Cove-Rogue River (HUC 1710030707) Fifth-Field Watershed, Jackson County												
Rogue River (ASP-235)	122.65	Yes	Known	HDD	50	None (HDD)	N/A	5,248	Fluming	4	None-Low (intermittent)	5,667 SEV= 2
Indian Creek (AW-278)	128.61	No	Assumed	Fluming	12	Moderate-High (perennial)	1,389 SEV= 4	113	Dam-and-Pump	15	None-Low (bedrock)	1,144 SEV= 3
Upper Rogue (HUC 17100307) Subbasin, Big Butte Creek (HUC 1710030704) Fifth field Watershed, Jackson County												
Neil Creek (ASP-252)	132.12	Yes	Spawning, Rearing	Dam-and-Pump	5	None-Low (bedrock)	500 SEV = 3	145	Fluming	2	None-Low (intermittent)	649 SEV = 4
Quartz Creek (ASI-265)	132.75	Yes	Spawning, Rearing	Dam-and-Pump	1	None-Low (bedrock)	500 SEV = 3	32	Dam-and-Pump	1	None-Low (bedrock)	500 SEV = 3
Upper Rogue (HUC 17100307) Subbasin, Little Butte Creek (HUC 1710030708) Fifth field Watershed, Jackson County												
Salt Creek (ESP-34)	142.57	Yes	Known	Fluming	40	Moderate-High (perennial)	1,919 SEV = 4	129	Fluming	1	None-Low (intermittent	843 SEV = 4
Trib. to Long Branch Ck. (ESI-38)	144.11	No	Known	Fluming	1	None-Low (intermittent)	843 SEV = 4	48	Fluming	3	None-Low (intermittent)	843 SEV = 4
NF Little Butte Creek (ESP-66)	145.69	Yes	Known	Fluming	49	Moderate-High (perennial)	1,919 SEV = 4	193	Fluming	2	None-Low (intermittent)	843 SEV = 4
Trib. to NF Little Butte Ck. (ESI-56)	146.05	No	Assumed	Fluming	17	None-Low (intermittent)	1,657 SEV = 4	531	Fluming	3	None-Low (intermittent)	843 SEV = 4
SF Little Butte Creek (ASP-165)	162.45	No	Known	Fluming	30	Moderate-High (perennial)	1,919 SEV=4	6,053	Fluming	26	None-Low (intermittent)	7,723 SEV=1
Daley Creek (ESI-76/ ESI-84)	166.21	No	Known	Fluming	26	None-Low (intermittent)	1,919 SEV=4	6,053	Fluming	30	Moderate-High (perennial)	7,723 SEV=1
Upper Klamath River (HUC 18010206) Subbasin, Spencer Creek (HUC 1801020601) Fifth field Watershed, Klamath County												
Clover Creek (SS-502-EW-103)	177.76	No	Known	Fluming	5	None-Low (intermittent)	602 SEV=4	57	Fluming	5	None-Low (intermittent)	602 SEV=4
Clover Creek (GSI-11)	177.76	No	Known	Fluming	5	None-Low (intermittent)	602 SEV=4	57	Fluming	5	None-Low (intermittent)	602 SEV=4

a/ Risks from downstream TSS by crossing all streams with bedrock substrate are considered None to Low; risks of downstream TSS crossing intermittent streams are considered None to Low; risks from downstream TSS by crossing perennial streams are considered Moderate to High.
b/ Highest SEV scores for each given crossing method and stream width category in specific watershed provided in table I-11.
c/ Distance for confluence of nearest neighbor with fish-bearing stream is assumed to be the same as the distance between the two stream crossing sites, forming an equilateral triangle.

TABLE I-13

Numbers of Migratory Birds Potentially Nesting in Habitats Affected by the Pacific Connector Pipeline

	Migratory Bird Nesting Habitats Present in the Pipeline Project Area														
Estimate	**Westside Lowland Conifer-Hardwood-Forest**	**Montane Mixed Conifer Forest**	**Southwest Oregon Mixed Conifer-Hardwood Forest**	**Ponderosa Pine Forest and Woodlands**	**Westside Oak, Dry Douglas-fir Forest and Woodlands**	**Western Juniper/Mountain Mahogany Woodlands**	**Shrub-Steppe**	**Westside Grasslands**	**Eastside Grasslands**	**Herbaceous Wetlands**	**Westside Riparian-Wetlands-Eastside Riparian-Wetlands**	**Developed—Urban and Mixed Environs**	**Agriculture, Pastures, and Mixed Environs**	**Total Birds**	**Total Nests c/**
MP 0.00-51.60															
Miles of Habitat Affected	**33.6**	**0**	**5.2**	**0**	**0**	**0**	**0**	**0.2**		**1.7**	**0.1**	**0.7**	**3.3**	∑ = 44.7 miles	
Total Birds in Habitat, All Species	593		87					0		2	0	1	42	**725**	**389**
Total with Adequate Data a/	561		87					0		2	0	1	42	**693**	**365**
Total Birds Likely Nesting b/	443		69					0		2	0	1	33	**548**	**288**
Total Birds Possible Nesting c/	5		1					0		0	0	0	0	**6**	**3**
Total Birds Likely or Possible	**448**	**0**	**70**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**1**	**33**	**554**	**291**
MP 51.60 to 94.67															
Miles of Habitat Affected	**24.7**	0	**3.6**	**0**	**0**	**0**	**1.0**	**5.1**	**0**	**0.5**	**0.1**	**0.1**	**4.6**	∑ = 39.7 miles	
Total Birds in Habitat, All Species	425		64				1	27		0	0	0	61	**578**	**312**
Total with Adequate Data a/	404		64				1	27		0	0	0	61	**557**	**296**
Total Birds Likely Nesting b/	320		51				0	22		0	0	0	46	**439**	**233**
Total Birds Possible Nesting c/	4		1				0	0		0	0	0	0	**5**	**3**
Total Birds Likely or Possible	**324**	**0**	**52**	**0**	**0**	**0**	**0**	**22**	**0**	**0**	**0**	**0**	**46**	**444**	**236**

TABLE I-13 (continued)

Numbers of Migratory Birds Potentially Nesting in Habitats Affected by the Pacific Connector Pipeline in Construction Spreads 1 through 5

Estimate	Migratory Bird Nesting Habitats Present in the Pipeline Project Area														
	Westside Lowland Conifer-Hardwood-Forest	**Montane Mixed Conifer Forest**	**Southwest Oregon Mixed Conifer-Hardwood Forest**	**Ponderosa Pine Forest and Woodlands**	**Westside Oak, Dry Douglas-fir Forest and Woodlands**	**Western Juniper/Mountain Mahogany Woodlands**	**Shrub-Steppe**	**Westside Grasslands**	**Eastside Grasslands**	**Herbaceous Wetlands**	**Westside Riparian-Wetlands-Eastside Riparian-Wetlands**	**Developed—Urban and Mixed Environs**	**Agriculture, Pastures, and Mixed Environs**	**Total Birds**	**Total Nests c/**
MP 94.67 to 132.47															
Miles of Habitat Affected	**2.2**	**0**	**22.9**	**2.7**	**2.2**	**0**	**2.9**	**1.4**	**<0.1**	**0.2**	**<0.1**	**0.1**	**0.1**	**∑ = 34.8 miles**	
Total Birds in Habitat, All Species	30		407	33	32		6	3		0	0	0	0	**511**	**281**
Total with Adequate Data a/	29		393	33	31		6	3		0	0	0	0	**495**	**267**
Total Birds Likely Nesting b/	23		312	25	24		2	3		0	0	0	0	**389**	**209**
Total Birds Possible Nesting c/	0		4	0	0		0	0		0	0	0	0	**4**	**2**
Total Birds Likely or Possible	**23**	**0**	**316**	**25**	**24**	**0**	**2**	**3**	**0**	**0**	**0**	**0**	**0**	**393**	**211**
MP 132.47 to 169.50															
Miles of Habitat Affected	**0.1**	**5.0**	**13.0**	**6.0**	**2.2**	**0**	**4.1**	**5.1**	**<0.1**	**0.5**	**<0.1**	**0**	**<0.1**	**∑ = 36.0 miles**	
Total Birds in Habitat, All Species	0	27	229	84	30		11	29	0	0	0		0	**410**	**223**
Total with Adequate Data a/	0	25	224	84	29		11	29	0	0	0		0	**391**	**210**
Total Birds Likely Nesting b/	0	19	183	61	23		5	24	0	0	0		0	**307**	**166**
Total Birds Possible Nesting c/	0	1	2	1	1		0	0	0	0	0		0	**4**	**2**
Total Birds Likely or Possible	**0**	**20**	**185**	**62**	**24**	**0**	**5**	**24**	**0**	**0**	**0**	**0**	**0**	**311**	**168**

TABLE I-13 (continued)

Numbers of Migratory Birds Potentially Nesting in Habitats Affected by the Pacific Connector Pipeline in Construction Spreads 1 through 5

Estimate	Migratory Bird Nesting Habitats Present in the Pipeline Project Area														
	Westside Lowland Conifer-Hardwood-Forest	**Montane Mixed Conifer Forest**	**Southwest Oregon Mixed Conifer-Hardwood Forest**	**Ponderosa Pine Forest and Woodlands**	**Westside Oak, Dry Douglas-fir Forest and Woodlands**	**Western Juniper/Mountain Mahogany Woodlands**	**Shrub-Steppe**	**Westside Grasslands**	**Eastside Grasslands**	**Herbaceous Wetlands**	**Westside Riparian-Wetlands-Eastside Riparian-Wetlands**	**Developed—Urban and Mixed Environs**	**Agriculture, Pastures, and Mixed Environs**	**Total Birds**	**Total Nests c/**
MP 169.50 to 228.81															
Miles of Habitat Affected	**0**	**1.1**	**4.8**	**5.4**	**0**	**8.1**	**9.7**	**0**	**4.5**	**2.4**	**<0.1**	**1.3**	**18.9**	**∑ = 56.4 miles**	
Total Birds in Habitat, All Species		29	193	233		317	357		162	143	0	57	1070	**2,561**	**1,315**
Total with Adequate Data a/		28	184	221		301	339		152	103	0	54	988	**2,370**	**1,209**
Total Birds Likely Nesting b/		11	91	110		143	127		45	42	0	22	450	**1,041**	**536**
Total Birds Possible Nesting c/		0	2	3		2	41		28	20	0	4	139	**239**	**121**
Total Birds Likely or Possible	**0**	**11**	**93**	**113**	**0**	**145**	**168**	**0**	**73**	**62**	**0**	**26**	589	**1,280**	**657**

a/ Adequate data determined for a species if observed (Pardieck et al. 2017) on an average of 5 or more BBS routes per year with an average of 1 bird or more counted per route per year during the 20-year period, 1996 to 2015.

b/ Species nesting on right-of-way likelihood based on proportion of the home range/territory area (Johnson and O'Neil 2001; Rodewald 2015) that would overlap the pipeline right-of-way, high proportions for small home ranges, low proportions for large home ranges. Nesting on the right-of-way would be "Likely" if home range is <10 ha, "Possible" if the home range (for species) was from ≥1 to ≤100 hectares. Bird species with larger home ranges were assumed to be unlikely to nest in the pipeline right-of-way.

c/ Number of nests present is assumed to be equivalent to half the number of birds present (assuming equal sex ratio and equal visibility of sexes regardless of plumage dimorphism or territorial behavior).

EFFECTS OF THE PROJECT ON ESSENTIAL FISH HABITAT

EFFECTS OF THE PROJECT ON ESSENTIAL FISH HABITAT

INTRODUCTION

Section 305(b)(2) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) requires federal agencies to consult on all actions or proposed actions authorized, funded, or undertaken by that agency, which could adversely affect essential fish habitat (EFH). The MSA defines EFH as "those waters and substrates necessary to fish for spawning, breeding, feeding, or growth to maturity" (50 Code of Federal Regulations [CFR] 600). For the purposes of this definition, "waters" means aquatic areas and their associated physical, chemical, and biological properties; "substrate" includes sediment, hard bottom, structures underlying the waters, and associated biological communities; "necessary" means the habitat required to support a sustainable fishery and healthy ecosystem; and "spawning, feeding, and breeding" is meant to encompass the complete life cycle of a species (50 CFR 600). The MSA establishes guidelines for Regional Fisheries Management Councils to describe and identify EFH in Fisheries Management Plans (FMP) to managed exploited fish and invertebrate species in federal waters. The Pacific Fishery Management Council has developed four FMPs that address the EFH for managed species that occur in portions of the Jordan Cove Liquefied Natural Gas (LNG) Project and Pacific Connector Pipeline Project (Project) action area.

Generally, the EFH consultation process includes the following steps.

1. Notification – The action agency should clearly state the process being used for EFH consultations (e.g., incorporating EFH consultation into an environmental impact statement [EIS]).
2. EFH Assessment – The action agency should prepare an EFH Assessment that includes both identification of affected EFH and an assessment of impacts. Specifically, the EFH Assessment should include:
   a. a description of the proposed action;
   b. an analysis of the effects (including cumulative effects) of the proposed action on EFH, managed fish species, and major prey species;
   c. the federal agency's views regarding the effects of the action on EFH; and
   d. proposed mitigation, if applicable.
3. EFH Conservation Recommendations – After reviewing the EFH Assessment, the National Oceanic and Atmospheric Administration National Marine Fisheries Service (NMFS) should provide recommendations to the action agency regarding measures that can be taken by that agency to conserve EFH.
4. Agency Response – Within 30 days of receiving the recommendations, the action agency must respond to NMFS. The action agency may notify NMFS that a full response to the conservation recommendations would be provided by a specified completion date agreeable to all parties. The response must include a description of measures proposed by the agency to avoid, mitigate, or offset the impact of the activity on EFH. For any

conservation recommendation that is not adopted, the action agency must explain its reason to NMFS for not following the recommendation.

The Federal Energy Regulatory Commission (FERC) proposes to incorporate EFH consultation for the Project with the interagency coordination procedures required under the National Environmental Policy Act (NEPA). For the Jordan Cove LNG Project, we have determined that EFH may be affected, and have submitted this EFH Assessment to NMFS to begin consultation.

EFH has been designated in or near areas where Project activities would occur under the following FMPs:

- Highly Migratory Species (PFMC 2007),
- Pacific Coast Groundfish (PFMC 2008),
- Coastal Pelagic Species (PFMC 2006a), and
- Pacific Coast Salmon (PFMC 1999).

The EFH Assessment was included with our Biological Assessment (BA) and was submitted in conjunction with that BA (FERC 2019). The EFH Assessment summary included here is presented in three subsections that are characterized as three major Project areas and components:

- Waterway for LNG Carrier Traffic
- Jordan Cove LNG Project
- Pacific Connector Gas Pipeline

Each subsection includes a description of the EFH in that Project area and the effect of that Project component on EFH in that area, including a determination of effects to EFH to the relevant FMP species groups. An overall determination of effects is presented at the end of this appendix.

ESSENTIAL FISH HABITAT AND EFFECTS AT THE WATERWAY FOR LNG CARRIER TRAFFIC

Within the waterway, EFH occurs in both the Pacific Ocean off the southwestern Oregon coast and in Coos Bay, including the Kentuck Slough development. The aquatic analysis area within the waterway for LNG carrier transit to the Jordan Cove LNG terminal includes EFH and is illustrated in figure 1. The area of greatest concern for potential effects to EFH from LNG carrier–related actions is along the nearshore marine and Coos Bay route to and from the LNG terminal. Additional EFH habitat of concern would occur along the potential LNG carrier transit route extending out to the 200-mile economic exclusion zone (EEZ). Species with EFH in the area affected by the Project are summarized below.

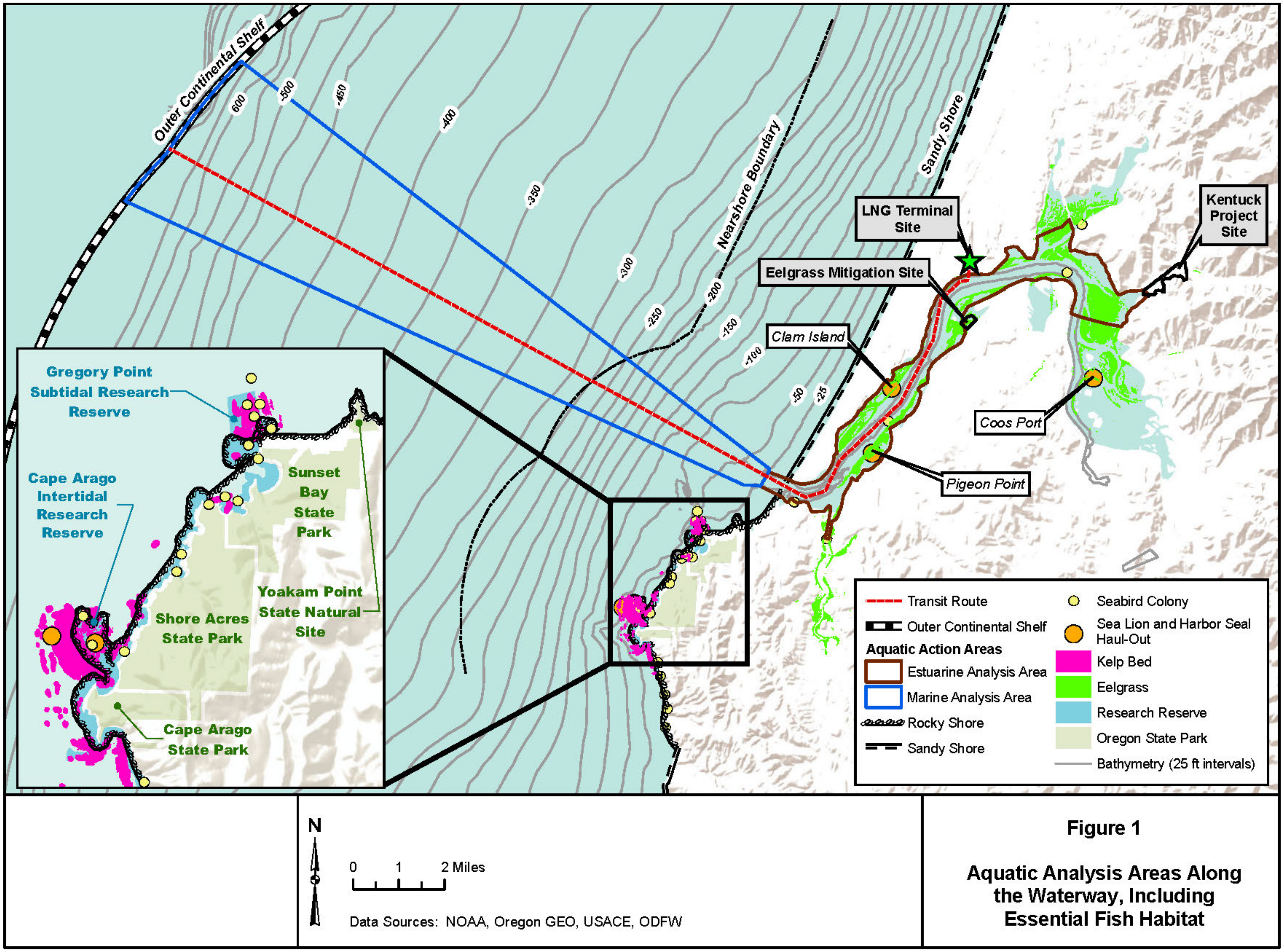

Figure 1

Aquatic Analysis Areas Along the Waterway, Including Essential Fish Habitat

Pacific Coast Groundfish EFH

The groundfish group includes 82 species. For the Pacific coast groundfish fishery, the EFH determination is based on habitat use by life stage for all 82 species in each composite EFH shown in Appendices B-1 and B-3 of the Pacific Coast Groundfish Management Plan (PFMC 2008). The life history descriptions and maps showing species distributions are also available in Appendices B-2 and B-4, respectively, of the Management Plan (PFMC 2008). The EFH of groundfish species is listed and effects assessed in the completed EFH assessment that is part of our BA.

Coastal Pelagic Species EFH

The EFH for coastal pelagic species is defined by the species' temperature and geographic range during all life stages in the past, present, and where they could occur in the future. In addition to all marine and estuarine waters off the Pacific Coast to the limits of the EEZ, EFH for coastal pelagic species also includes portions of the water column where sea surface temperatures range between 50 degrees Fahrenheit (°F; near the U.S./Mexico maritime boundary) and 79°F (seasonally and annually variable) (PFMC 2006a). The coastal pelagic species fishery management plans include five species: northern anchovy (*Engraulis mordax*), Pacific sardine (*Sardinops sagax*), Pacific (chub) mackerel (*Scomber japonicus*), jack mackerel (*Trachurus symmetricus*), and market squid (*Loligo opalescens*). Of these, two species (market squid and Pacific sardine) are known to occur in estuaries (PFMC 1998). The others would be found in the marine waters off the Oregon Coast along the shipping route. The EFH of coastal pelagic species is listed and effects assessed in the completed EFH assessment that is provided as part of our completed BA.

Pacific Coast Salmon EFH

For the Pacific salmon fishery, the PFMC identified EFH using U.S. Geological Survey hydrologic units as well as habitat association tables and life history descriptions for each life stage (PFMC 1999, Appendix A, Amendment 14 to the Pacific Coast Salmon Plan). These areas encompass all streams, lakes, ponds, wetlands, and other currently viable waterbodies and most of the habitat historically accessible to salmon in Washington, Oregon, Idaho, and California. In estuarine and marine areas, EFH for Pacific salmon extends from the nearshore and tidal submerged environments within state waters out to the full extent of the EEZ (200 nautical miles). Three species are included in the PFMC management plan: coho (*Oncorhynchus kisutch*), Chinook (*O. tshawytscha*), and pink salmon (*O. gorbuscha*). The EFH of salmon is listed and effects assessed in the completed EFH assessment that is provided as part of our completed BA.

Highly Migratory Species EFH

Highly migratory fish EFH may exist along the outer portion of the transit route for LNG marine traffic. This EFH is found in temperate waters in the Pacific Council's region. Variations in the distribution and abundance of these species are affected by ever-changing oceanic environmental conditions including water temperature, current patterns, and the availability of food. Sea surface temperatures and habitat boundaries vary seasonally and from year to year, with some of the species much more abundant from northern California to Washington waters during the summer and warm water years than during winter and cold water years, due to increased habitat availability in the EEZ. The species include five species of shark, tuna, striped marlin (*Kajikia audax*), swordfish (*Xiphias gladius*), and dolphinfish (*Coryphaena hippurus*). Based on the EFH habitat defined for these species, few if any of these species are off the Coos Bay at coastal depths less than 100 fathoms (100 fathoms is the approximate edge of the shipping route defined area in Oregon coastal waters to three miles offshore). However, in waters farther offshore, some habitat is available for some of these species and life stages out to the 200-mile EEZ. Overall, little EFH for these managed species would be present along the shipping route to the EEZ near Coos Bay. However, depending on the shipping route traveled, additional EFH of the highly migratory species may occur in southern west coast waters where more of these species' habitat may be present. The EFH of highly migratory species is listed and effects assessed in the completed EFH assessment as part of our completed BA.

Project Area–Specific EFH Species Characteristics

Within or near Coos Bay, a subset of these managed species is present including 2 salmon (Chinook and coho salmon), 3 pelagic (northern anchovy, Pacific sardine, and Pacific mackerel), and 29 groundfish species, based on typical habitat use of these species. The general life history and expected habitat use is shown in our BA and EFH assessment (FERC 2019).

Based on sampling (e.g., Oregon Department of Fish and Wildlife [ODFW] data from 1996 to 2000), 13 groundfish, 2 salmon, and 1 pelagic species would be considered common. The information below provides details on most of these fish species use of the bay, relative to the Project site.

Managed groundfish and coastal pelagic species are not estuarine resident species and therefore utilize Coos Bay seasonally, primarily in summer months. During the summer, the estuary may be utilized as a forage area for juveniles and adults and as a nursery area for larvae and juveniles. Starry flounder spawn near river mouths and sloughs. Juvenile starry flounder (*Platichthys stellatus*) are found exclusively in estuaries. Sampling in upper Coos Bay from 1979 to 1990 showed that young-of-the-year flounder are present at least in the spring and summer months (Wagoner et al. 1990). Flounder and sole are found in sandy or muddy substrate, and juveniles are found in shallow water near rivers and in estuaries in eelgrass beds. Adults generally are found in deeper waters in the winter and migrate to shallower water in the spring. English sole (*Parophrys vetulus*) juveniles depend heavily on inter-tidal areas, estuaries, and shallow nearshore waters for food and shelter.

Adult Chinook and coho salmon may utilize habitat in the transit route in Coos Bay for migration and offshore for migration and feeding. Adults would return to the rivers in late summer and fall. Juveniles and smolts may use the transit route in Coos Bay for resting and foraging during emigration in the spring and summer, and offshore for migration and feeding. ODFW (2005) has captured coho and Chinook salmon, starry flounder, northern anchovy, and sand sole (*Psettichthys melanostictus*) in the Jordan Cove area adjacent to the Project site.

The black rockfish (*Sebastes melanops*) is the only member of the rockfish family that is consistently caught in Coos Bay (Wagoner et al. 1990). The copper (*S. caurinuys*), blue (*S. mystinus*), grass (*S. rastrelliger*), and canary rockfishes (*S. pinniger*), as well as bocaccio (*S. paucispinis*), are occasionally caught. The rockfishes are in the lower areas of Coos Bay, mainly during the late spring and summer months (Wagoner et al. 1990). Black rockfish are not known to spawn in estuaries. Rockfish recruit to seagrass beds in shallow, soft bottom embayments (Love et al. 1991). Johnson et al. (2003) reported that juveniles of many commercially important species utilize eelgrass habitat in Southeastern Alaska. Rockfish juveniles settle into shallow, vegetated habitats for rearing. Vegetated habitats (eelgrass and kelp) provide refuge from predators and access to prey. Juvenile rockfish may also be closely associated with seagrass drift for both feeding and refugia while they move between pelagic and near shore habitat (Nightingale and Simenstad 2001a). Rockfish have not been seined by ODFW in or near the immediate Project slip area, indicating that this area is not likely utilized by rockfish.

Black rockfish and cabezon (*Scorpaenichthys marmoratus*) were the most abundant juvenile rockfish species captured in Coos Bay (near the entrance) between June 2003 and December 2005 (Schlosser and Bloeser 2006). Trap sites were in eelgrass beds, along dock pilings and in sandy bottom habitat near the entrance to Coos Bay. Juvenile chilipepper (*Sebastes goodei*), copper, grass, yellowtail (*Sebastes flavidus*), and kelp greenling were also captured near the entrance.

Lingcod begin life in near-surface marine waters and estuarine areas. Juvenile lingcod primarily use estuaries, entering to feed, while adults are usually found in marine waters of 100 to 150 meters (328 to 492 feet) deep. Lingcod lay eggs in rocky, marine subtidal areas. Larvae are found in the near-surface marine waters and estuarine areas. In this life stage, lingcod feed primarily on copepods, eggs, and other crustaceans. As it matures, lingcod are commonly found in shallow, inter-tidal areas of bays near algae and seagrass beds.

Phillips (1984) described northern anchovy to be transient users of eelgrass. Eelgrass provides indirect benefits to these species as well through contributions to productivity in the estuary, and eelgrass drift may provide cover for coastal pelagic species (Nightingale and Simenstad 2001b).

Other species managed by the PFMC that occur in Coos Bay include sand sole and big skate (*Beringraja binoculata*). Sand sole require a sand-mud-eelgrass type of habitat; however, they have not been captured in or near the area affected by the Project. Big skate occur nearshore and occasionally in the bay (Wagoner et al. 1990).

In offshore waters, along the shipping route out to the 200-mile EEZ, additional species and life stages of groundfish, coastal pelagic species, Pacific Coast salmon and highly migratory species would be present. The details of the species and life stages and likelihood of being present in the EEZ analysis area will be provided in our pending BA.

A variety of habitats of importance occurs along the transit route for LNG marine traffic. They include fresh, estuarine, and marine waters. Coos Bay contains estuarine environments of freshwater streams and slough. The habitat in the marine environment includes shallow sandy shorelines, and nearshore and offshore rocky environments. The coasts also contain rocky reefs and kelp forest regions but pelagic and deep ocean waters with soft bottoms habitats are most common directly along the route outside of the bay (ODFW 2005). The fish and other aquatic organisms along this route are highly diverse and abundant containing very important EFH habitat for many species.

The following discussion summarizes the potential effects to habitats for groups of species that are provided in detail in the EFH included with our BA (FERC 2019). Table 1 provides a summary of the EFH habitat description, Project actions that may contribute to adverse effects to EFH, and overall determination of adverse effects for each EFH group.

TABLE 1

Potential Impacts to EFH due to Construction and Operation of the Project

EFH	Description of EFH a/	Potential Impacts	Determination of Effects
Highly Migratory Species	EFH is defined by temperature ranges, salinity, oxygen levels, currents, shelf edges, and sea mounts. Based on species characteristics, the closest EFH would be beyond the 40-fathom depth off of Coos Bay. b/	• Accidental spills of hazardous substances	Minimal adverse effects or negligible effects to highly migratory species EFH
Coastal Pelagic Species	All marine and estuarine waters from the coast to the limits of the EEZ and above the thermocline where sea surface temperatures range between 50°F and 79°F	• Accidental spills of hazardous substances • Dredging of 62.7 acres of estuarine habitat in Coos Bay • Installation of two HDDs across Coos Bay • Potential impingement or entrainment of small fish, food and larval organisms from dredging and LNG carrier cooling water intake	Habitat effects minimal; significant adverse effects to coastal pelagic species (northern anchovy, Pacific sardine) EFH unlikely
Groundfish	All waters from the extent of the high tide line (and parts of estuaries) to offshore to the 3,500-meter (1,914-fathom) depth.	• Accidental spills of hazardous substances • Dredging of 62.7 acres of estuarine habitat in Coos Bay • Short-term water quality degradation should a low-probability inadvertent return occur during installation of two HDDs across Coos Bay • Potential impingement or entrainment of small fish, food, and larval organisms	Habitat effects minimal; significant adverse effects to multiple groundfish species (e.g., rockfish, English sole, starry flounder) EFH unlikely
Pacific Coast Salmon	All streams, lakes, ponds, wetlands, and other waterbodies currently and historically accessible to salmon. Estuaries and marine areas extending to the EEZ and beyond.	• Accidental spills of hazardous substances • Dredging of 62.7 acres of estuarine habitat in Coos Bay • Installation of two HDDs across Coos Bay • Periodic channel dredging and disposal • Short-term increase in noise associated with land based pile driving at the MOF and in-water pile driving at various temporary construction activities • Potential impingement or entrainment of small fish, food and larval organisms • Fish salvage during stream crossings • Short-term loss of nearshore cover, prey species, and long-term loss of sources of large wood recruitment from riparian vegetation removal • Elevated suspended sediment at pipeline stream crossings • Diverted open-cut across South Umpqua River, installation of HDD across Coos River and Rogue River	Isolated and localized adverse effects to Pacific coastal salmon species (coho and Chinook salmon) EFH

a/ PFMC (2006; updated version July 24, 2006)
b/ PFMC (2007)

Effects on EFH Along the Waterway for LNG Carrier Transit and Measures to be Implemented to Avoid or Reduce Effects on Aquatic Resources

A summary of potential impacts on EFH is included in table 1. The details of the effects on EFH and aquatic species that occupy that habitat from ship grounding, propeller wash, wake waves, fish strandings, introduction of non-native species, and cargo, fuel, and oil spills related to LNG carrier transit in the waterway, as well as measures that would be implemented to minimize these effects, are discussed in the EFH assessment included with our BA (FERC 2019).

ESSENTIAL FISH HABITAT AND EFFECTS AT THE JORDAN COVE LNG TERMINAL

EFH and species present in Coos Bay, including near the LNG terminal, are described in detail in subsection above on the waterway. EFH effects from construction and operation of the LNG terminal and maintenance dredging are summarized in table 1. Three habitat types occur in the slip site that would be affected by the slip, access channel, and navigation channel that are tidally influenced and function as EFH: the shoreline habitat, SAV, and the open water of Coos Bay. The effects of the LNG terminal, navigation channel widening, Eelgrass Mitigation site, Kentuck project site, and road widening on aquatic resources as described above also apply to EFH species.

Approximately 82 acres of EFH in Coos Bay would be affected by construction-related activities (table 4.5.2.2-2 of the EIS). This would include about 37 acres from development of the slip, access channel, MOF, and pile rock dike apron and 40 acres from the marine waterway modifications; there would also be another 6 acres affected by development of the eelgrass and Kentuck mitigation sites, Trans-Pacific Parkway widening, and dredge pipelines used for transport of dredged material to storage areas. Habitat affected includes about 5 acres of shallow subtidal, 14 acres of intertidal unvegetated muds and sands, and 2 acres eelgrass, most of which is from the slip and access channel development. The remaining 62 acres of habitat affected is deep subtidal, which, while disturbed from dredging or tailings transmission pipelines, would remain as deepwater habitat. However, most of the non-deepwater habitat affected would be converted to deepwater habitat (about 19 acres at the access channel and slip). While Project construction would adversely affect EFH primarily from conversion of intertidal and shallow water habitat to deepwater habitat, including the loss of a narrow band of about 2 acres of eelgrass (figure 4.5-3 of the EIS), the potential adverse effects on EFH would be short term as most habitat types affected would remain similar to pre-Project habitat types.

Several of the EFH species known for Coos Bay are not present near the Jordan Cove LNG terminal. Rockfish and lingcod have not been seined by ODFW near the terminal location; however, they are known to be present in the bay. Juvenile chilipepper, copper, grass, yellowtail, and kelp greenling were captured near the mouth of Coos Bay only, so habitat they utilize in the bay would be unlikely to be disturbed by the terminal, but some short-term loss of benthic food sources would occur from dredging.

During operation of the terminal, LNG carriers at the berth could entrain or impinge aquatic species while taking in engine cooling water. This could result in mortality to early life stages and juvenile species and their local food organisms. Effects on EFH species would not be substantial and would be similar to those described above for other species during the operation of the Jordan Cove terminal.

All associated activities, including construction and operation of the LNG terminal, dredging of the slip and navigation channel widening, maintenance dredging of the channel, and docking and loading of marine vessels, carry the risk of accidental spills or leaks of hazardous substances occurring. Should these occur, they could have adverse effects to coastal pelagic, groundfish, or Pacific Coast salmon species that may be present near the spill. Effects would be slight because of the procedures that would be in place in Jordan Cove's Spill Prevention, Containment, and Countermeasures (SPCC) Plan to reduce the chance of spills occurring and magnitude of a spill should one occur.

EFH Conservation and Mitigation Measures for LNG Terminal Construction and Operation

The following measures would be implemented to minimize effects on EFH from construction and operation of the Jordan Cove LNG terminal:

- the bulk of the slip construction would take place in isolation from Coos Bay by maintaining a portion of the existing shoreline as a berm;
- all dredging in Coos Bay during construction of the marine slip, access channel, and marine waterway modifications would occur during the ODFW preferred work windows (October 1 through February 15) to minimize effects on vulnerable life stages of important fish species;
- an SPCC Plan would be implemented;
- Jordan Cove would develop about 3 acres of new eelgrass habitat at a site in Coos Bay near the Southwestern Oregon Regional Airport to mitigate for the loss of 2 acres of eelgrass removed during construction of the access channel to the terminal;
- about 91 acres of intertidal habitats, would be restored at the Kentuck project site, with the goal of producing 73 acres of final estuarine habitat to mitigate for about 12 acres of intertidal mudflats, 4 acres of shallow subtidal habitat, less than 1 acre of salt marsh, and other Coos Bay sites affected by construction of the Jordan Cove LNG Project; and
- acoustic noise-dampening methods would be implemented for sheetpile and piling installation locations where they were likely to exceed NMFS criteria.

ESSENTIAL FISH HABITAT AND EFFECTS AT THE PACIFIC CONNECTOR GAS PIPELINE ROUTE

EFH and species present in Coos Bay are described in the earlier section addressing the Waterway. In Coos Bay, there are no planned disturbance of the estuarine environment from either right-of-way construction or TEWAs. However, should frac-out occur at either of the two Coos Bay crossings, some burial of non-mobile organisms such as clams, oysters, and worms would occur. Additional areas would be affected from sediment and turbidity from frac-out if it occurred during HDD pipeline installation at river crossings. The directly disturbed areas would likely be small as monitoring would detect this issue and the process would be shut down until corrections could be made. Flowing tidal water would dilute and disperse turbidity plumes.

The PFMC EFH species groups that may be in the pipeline area at waterbody crossings are summarized in table 1. These species are described in more detail in our BA (FERC 2019).

Construction-related effects on the estuarine region of Coos Bay and its EFH would be reduced by Pacific Connector following its HDD construction plans and *Drilling Fluid Contingency Plan for Horizontal Directional Drilling Operations*, which includes the in-water work window developed by ODFW and other measures discussed above.

A list of the waterbodies crossed by the proposed pipeline route and EFH assumed or known for coho and Chinook salmon species is shown in table I-2 in appendix I. About 54 of the stream and estuary crossing areas (either directly crossed or near the pipeline) contain or are assumed to contain EFH for either one or both species. Coos Bay would be crossed by HDD, while all streams that would be directly crossed would have all construction work done in the dry (four would be passed by HDD, one with conventional bore, and one using a diverted open cut [South Umpqua River]). In-water work for the pipeline crossings would temporarily affect EFH in approximately 48 streams that would be crossed using dry open-cut methods that are potentially designated as EFH for Chinook and/or coho salmon. Waterbody crossings that involve open trenching would be constructed during established in-water work windows. However, some streams may have spawning Chinook salmon present during the crossing period, which would increase the risk of spawning effects from turbidity and sediment.

In freshwater, EFH for Chinook and coho salmon includes habitats for spawning, rearing, and migration corridors (PFMC 2003). Components of the pipeline with the potential to adversely affect designated EFH include removal of terrestrial and riparian vegetation, in-water pipeline construction increasing turbidity and sediment, accidental spills and leaks of hazardous materials, and hydrostatic testing. Construction adjacent to EFH could also result in increased stormwater runoff and/or an inadvertent spill of hazardous materials, either of which could result in substantial adverse effects on EFH. A detailed discussion of measures that would be implemented to avoid or minimize effects on aquatic resources (including EFH) because of pipeline construction is presented in section 4.5 of the EIS and the EFH assessment included with our BA (FERC 2019).

The effects on EFH resulting from the Pacific Connector Pipeline Project for actions in the estuary would be similar to those described for the LNG terminal slip. Additional adverse effects would occur at freshwater crossings that would affect Pacific Coast salmon. For coastal pelagic, groundfish, and Pacific coast salmon, effects would be similar although magnitude would vary.

The FERC, as the lead federal agency, has consolidated the EFH and the ESA process for all portions of the Project. This includes development of an EFH Assessment and BA together as submitted to NMFS and U.S. Fish and Wildlife Service with a request to initiate formal consultation.

EFFECTS DETERMINATION

Highly Migratory Species EFH

The Project **would not adversely affect** EFH for highly migratory species because accidental spills and releases at sea, if they should occur, are not expected to diminish water quality within the marine analysis area. The volumes of hydraulic oil and fuel spills from a single LNG carrier would be very small in relation to the size of the ocean.

Coastal Pelagic Species EFH

The Project **may adversely affect** EFH for coastal pelagic species in the short term due to loss of eelgrass habitat until such habitat is re-established at the Eelgrass Mitigation site and until disturbed estuarine habitat is restored and recovers. Short-term loss of benthic food resources would also result from construction and maintenance dredging of the access channel and marine waterway modifications areas. Small juvenile and larval stages of fish could be entrained or impinged and suffer mortality from the cooling water intakes of LNG carriers while at berth; but a substantive loss is unlikely.

Groundfish EFH

The Project **may adversely affect** EFH for groundfish species in the short term due to loss of eelgrass habitat until such habitat is re-established at the Eelgrass Mitigation site and until disturbed estuarine habitat is restored and recovers. Short-term loss of benthic food resources would also result from construction and maintenance dredging of the access channel and marine waterway modification areas. Over the long term, eggs, larval, and small juvenile life stages of fish occupying waters near the LNG carriers at the terminal dock could be entrained or impinged, and suffer mortality by cooling water intakes, but a substantive loss is unlikely.

Pacific Salmon EFH

Effects to freshwater Pacific Coast Salmon EFH by the Project **may adversely affect** riverine habitats by impacting substrates and suspended sediment water quality over the short term, as well as by removal of riparian vegetation, which could affect LW supply over the long term. Also, juvenile coho or Chinook salmon entrapped in isolated areas at pipeline stream crossings, as well as removal from stream crossing areas, would result in minor fish mortalities. Short-term loss of benthic food resources would also occur from construction and maintenance dredging of slip and access channel, marine waterway modification areas, and other bay sites. Juvenile salmon stages could be entrained or impinged and suffer mortality from cooling water withdrawal in the estuary.

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BIOLOGICAL ASSESSMENT

Note: The BA was filed July 29, 2019. Supplemental information was later provided separately to the U.S. Fish and Wildlife Service.

BIOLOGICAL ASSESSMENT

and

ESSENTIAL FISH HABITAT ASSESSMENT

for the

Jordan Cove Liquefied Natural Gas Project and Pacific Connector Gas Pipeline Project

Jordan Cove Energy Project, L.P.	Docket Nos. CP17-495-000
Pacific Connector Gas Pipeline Project, LP	CP17-494-000

July 2019

EXECUTIVE SUMMARY

In September 2017, Jordan Cove Energy Project L.P. (Jordan Cove) filed an application with the Federal Energy Regulatory Commission (FERC or Commission), under Section 3 of the Natural Gas Act, seeking authorization to site, construct, and operate a liquefied natural gas (LNG) export terminal on the North Spit of Coos Bay, in Coos County, Oregon (LNG Project). Simultaneously, under Section 7 of the NGA, Pacific Connector Gas Pipeline LP (Pacific Connector) filed an application with the FERC seeking a Certificate of Public Convenience and Necessity (Certificate) to construct and operate an approximately 229-mile-long, 36-inch-diameter natural gas transmission pipeline and associated facilities from interconnections with the existing pipeline infrastructure near Malin, Oregon to the LNG Terminal (Pipeline Project). The proposed Pipeline Project would cross through portions of Klamath, Jackson, Douglas, and Coos Counties, Oregon. Hereafter, Jordan Cove and Pacific Connector are also referred to as the applicant, and their proposals are collectively referred to as the Jordan Cove Energy Project, or the Project.

Federal agencies, in consultation with the U.S. Fish and Wildlife Service (FWS) and/or the National Marine Fisheries Service (NMFS), are required by the Endangered Species Act (ESA) section 7(a)(2) to ensure that any action authorized, funded, or carried out by the agency would not jeopardize the continued existence of a federally listed threatened or endangered species or species proposed for listing, or result in the destruction or adverse modification of designated critical habitat. As the lead federal agency, the FERC is responsible for consulting with the FWS and NMFS to determine the Project's effects on federally listed endangered or threatened species and designated critical habitat(s). For actions involving major construction activities with the potential to affect listed species or critical habitats, the lead federal agency must prepare a Biological Assessment (BA) for those species that may be affected. The lead federal agency must submit its BA to the FWS and NMFS and, if it is determined that the action may adversely affect a federally listed species, the lead agency must submit a request for formal consultation to comply with section 7 of the ESA. In response, the FWS and NMFS would issue a Biological Opinion as to whether or not the federal action would likely adversely affect or jeopardize the continued existence of a listed species, or result in the destruction or adverse modification of designated critical habitat. As discussed in this document, we[1] have determined that constructing and operating the Project may affect federally listed species and designated critical habitat. Therefore, as required, we are providing this BA to the FWS and NMFS and request the initiation of formal consultation for species that may be adversely affected by the Project.

The Magnuson-Stevens Fishery Conservation and Management Act, as amended, 16 United States Code (U.S.C.) §§ 1361 et seq. (MSA) established procedures designed to identify, conserve, and enhance essential fish habitat (EFH) for those species regulated under a federal fisheries management plan. The MSA requires federal agencies to consult with the NMFS on all actions or proposed actions authorized, funded, or undertaken by the agency that may adversely affect EFH, 16 U.S.C. § 305(b)(2); 50 Code of Federal Regulations (CFR) § 600.920. The applicable regulations encourage consolidation of environmental review procedures to reduce duplication and improve efficiency, 50 CFR § 600.920(f). For this Project, we are consolidating the EFH Assessment with the BA, on behalf of the federal cooperating agencies.

[1] "We," "us," and "our" refer to the environmental staff of the Federal Energy Regulatory Commission's Office of Energy Projects.

SUMMARY OF EFFECTS DETERMINATIONS

Endangered Species Act

Based on our review, and as identified in the table below, the Project may affect, but is not likely to adversely affect, 17 listed species and/or their designated critical habitat, including five whales, one mammal, two birds, four sea turtles, one amphibian, and four plants.

The Project may affect, and is likely to adversely affect, 15 listed species, including three whales, two birds and their designated critical habitat, six fish and designated critical habitat for three of the fish species/populations, one invertebrate, and three plants. The Project is not likely to jeopardize the continued existence of two proposed species.

TABLE ES-1

Determinations of Effect for Federally Listed and Proposed Endangered and Threatened Species Potentially Occurring In the Project Area

Listed Species	Determination of Effect a/	
	Species	**Critical Habitat**
Mammals		
Blue whale *Balaenoptera musculus*	LAA	N/A
Fin whale *Balaenoptera physalus*	LAA	N/A
Killer whale (Eastern Northern Pacific Southern Resident Stock) *Orcinus orca*	NLAA	NE
Humpback whale *Megaptera novaeangliae* (Central American and Mexican DPSs)	LAA	N/A
Sei whale *Balaenoptera borealis*	NLAA	N/A
Sperm whale *Physeter macrocephalus*	NLAA	N/A
North Pacific right whale *Eubalaena japonica*	NLAA	NE
Gray whale (Western North Pacific Stock) *Eschrichtius robustus*	NLAA	N/A
Gray wolf (Western Washington, Western Oregon, Northern California) *Canis lupus*	NLAA	NE
Pacific marten (Coastal DPS b/) *Martes caurina*	NJ/LAA c/	N/A
Pacific fisher (West Coast DPS b/) *Pekania pennanti*	NJ/LAA c/	N/A
Birds		
Short-tailed albatross *Phoebastria albatraus*	NLAA	N/A
Western snowy plover (Pacific Coast Population) *Charadrius alexandrinus nivosus*	NLAA	NLAA
Marbled murrelet *Brachyramphus marmoratus*	LAA	LAA
Northern spotted owl *Strix occidentalis caurina*	LAA	LAA
Herpetofauna		
Green turtle *Chelonia mydas*	NLAA	NE
Leatherback turtle *Dermochelys coriacea*	NLAA	NLAA

TABLE ES-1 (continued)

Determinations of Effect for Federally Listed and Proposed Endangered and Threatened Species Potentially Occurring In the Project Area

Listed Species	Determination of Effect a/	
	Species	**Critical Habitat**
Olive Ridley turtle *Lepidochelys olivacea*	NLAA	N/A
Loggerhead turtle *Caretta caretta*	NLAA	N/A
Oregon spotted frog *Rana pretiosa*	NLAA	NLAA
Fish		
Green sturgeon (Southern DPS b/) *Acipenser medirostris*	LAA	LAA
Eulachon (Southern DPS b/) *Thaleichthys pacificus*	LAA	NE
Coho salmon (Southern Oregon/Northern California Coast Evolutionarily Significant Unit d/) *Oncorhynchus kisutch*	LAA	LAA
Coho salmon (Oregon Coast ESU d/) *Oncorhynchus kisutch*	LAA	LAA
Lost River sucker *Deltistes luxatus*	LAA	NLAA
Shortnose sucker *Chasmistes brevirostris*	LAA	NLAA
Invertebrates		
Vernal pool fairy shrimp *Branchinecta lynchi*	LAA	NLAA
Plants		
Applegate's milk-vetch *Astragalus applegatei*	LAA	N/A
Gentner's fritillary *Fritillaria gentneri*	LAA	N/A
Large-flowered woolly meadowfoam *Limnanthes pumila ssp. grandiflora*	NLAA	NLAA
Cook's lomatium *Lomatium cookii*	NLAA	NLAA
Kincaid's lupine *Lupinus sulphureus var. kincaidii*	LAA	NE
Western lily *Lilium occidentale*	NLAA	N/A
Rough popcornflower *Plagiobothrys hirtus*	NLAA	N/A

a/ LAA = May affect, likely to adversely affect.
N/A = Not applicable (critical habitat has not been designated or proposed).
NE = No effect.
NLAA = May affect, not likely to adversely affect.
NJ = Not likely to jeopardize the continued existence for proposed species.
b/ DPS = Distinct Population Segment
c/ This represents a provisional effect determination for this ESA proposed species. This provisional effect determination would apply if the species becomes listed prior to the completion of consultaion on the Project.
d/ Evolutionarily Significant Unit

Magnuson-Stevens Fishery Conservation and Management Act (MSA)

The Pacific Fishery Management Council (PFMC) has developed four Fishery Management Plans (FMPs) that address EFH for managed species in the Project action area. The four fisheries managed by the PFMC contain highly migratory species, coastal pelagic species, groundfish, and Pacific Coast salmon. The analysis of potential adverse effects to EFH coincides with the Project action area under the ESA, and the EFH Assessment has been incorporated into this BA, including the required contents as listed in 50 CFR § 600.920(e)(3).

The MSA defines EFH as those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity. Within the marine, estuarine and riverine analysis areas, EFH has been designated for two salmonid species, five pelagic species, 70 groundfish species, and over a dozen highly migratory species as described in section 4.0 of this BA. According to the PFMC, all habitats accessible to these managed species, including spawning and incubation, juvenile rearing, juvenile migration corridors, and adult migration corridors, are considered EFH. Highly migratory species defined by the PFMC include tunas (three species), sharks (five species), and billfish/swordfish (one species). Based on our review and as identified in table ES-2, the Project would have no adverse effect on EFH for highly migratory species, but may adversely affect EFH within the Project action area for coastal pelagic species, groundfish, and Pacific Coast salmon.

TABLE ES-2

Determinations of Effect for Essential Fish Habitat

Fishery	Analysis Area			Determination of Effect a/
	Marine/EEZ	Estuarine	Riverine	
Highly Migratory Species	X	–	–	NAE
Coastal Pelagic Species	X	X	–	MAA
Groundfish	X	X	–	MAA
Pacific Coast Salmon	X	X	X	MAA

a/ – = Not applicable.
NAE = No adverse effect.
MAA = May adversely affect.

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ACRONYMS AND ABBREVIATIONS

°C	degrees Celsius
°F	degrees Fahrenheit
μPa	micropascal
ACS	Aquatic Conservation Strategy
agl	above ground level
AKWA	Area of Known Wolf Activity
APCO	Al Pierce Company
BA	biological assessment
BLM	U.S. Department of Interior Bureau of Land Management
BMP	best management practices
BWE	ballast water exchange
CBC	Christmas Bird Count
CBNBWB	Coos Bay North Bend Water Board
CBNS RMA	Coos Bay North Spit Recreation Management Area
CEQ	Council on Environmental Quality
Certificate	Certificate of Public Convenience and Necessity
CFR	Code of Federal Regulations
cfs	cubic feet per second
CHE	Coast and Harbor Engineering
CHU	critical habitat unit
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
cm	centimeter
CM	channel mile
Coast Guard	U.S. Department of Homeland Security Coast Guard
COE	U.S. Army Corps of Engineers
Commission	Federal Energy Regulatory Commission
CORI	Coastal Ocean Research Institute
CP	cathodic protection
CSA	Conservation Support Area
CSO	California spotted owl
CWA	Clean Water Act
cy	cubic yard
D/D	Disruption-Disturbance
dB	decibel
dBA	A-weighted sound level
dbh	diameter-at-breast-height
DCA	designated conservation area
DDD	dicholordiphenyldichloroethane
DDE	dichlorodiphenyl-dichloroethylene
DDT	dichlorodiphenyltrichloroethane
DEMIS	Dynamic Estuary Management Information System
DFDE	dual fuel diesel electric
DMEF	Dredged Material Evaluation Framework
DMMP	Dredged Material Management Plan

DO	dissolved oxygen
DOE	U.S. Department of Energy
DP	Direct Pipe
DPS	Distinct Population Segment
DTR	daily timing restriction
EAR	existing access road
ECRP	Erosion Control and Revegetation Plan
EEZ	Exclusive Economic Zone
EFH	essential fish habitat
EI	environmental inspector
EIS	environmental impact statement
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
ESCA	Endangered Species Conservation Act
ESCP	Erosion and Sediment Control Plan
ESU	Evolutionarily Significant Units
FAA	Federal Aviation Administration
FEMAT	Forest Ecosystem Management Assessment Team
FERC	Federal Energy Regulatory Commission
FERC's Plan	FERC's *Upland Erosion Control, Revegetation, and Maintenance Plan*
FERC's Procedures	FERC's *Wetland and Waterbody Construction and Mitigation Procedures*
FMA	*Fritillaria* Management Area
FMP	Fishery Management Plan
FOI	Forest Operations Inventory
Forest Service	U.S. Department of Agriculture Forest Service
ft/sec	feet per second
FWS	United States Fish and Wildlife Service
GC	glucocorticoid
GDR	Green Diamond Resources
GIS	geographic information system
GNN	gradient nearest neighbor
gpm	gallons per minute
GTN	Gas Transmissions Northwest LLC
HADD	harmful alteration, disturbance or destruction
HDD	horizontal directional drill
HRSG	heat recovery steam generator
HUC	hydrologic unit code
Hz	hertz
I	Interstate
IMO	International Maritime Organization
IPM	Integrated Pest Management
IWWP	industrial wastewater pipeline
Jordan Cove	Jordan Cove Energy Project L.P.

Jordan Cove Energy Project	Jordan Cove LNG Project and Pacific Connector Gas Pipeline Project
Jordan Cove's Plan	Jordan Cove's *Upland Erosion Control, Revegetation, and Maintenance Plan*
Jordan Cove's Procedures	Jordan Cove's *Wetland and Waterbody Construction and Mitigation Procedures*
km	kilometer
km^2	square kilometer
KOAC	known owl activity centers
LAA	may affect and is likely to adversely affect
LASAR	Laboratory Analytical Storage and Retrieval
LC_{50}	lethal concentration for 50 percent of the subjects
LCM	lost circulation materials
LEMMA	Landscape Ecology, Modeling, Mapping & Analysis
L_{eq}	night time energy equivalent sound level
LiDAR	light detection and ranging
LMP	land management plan
LNG	liquefied natural gas
LRMP	Land and Resource Management Plan
LSOG	late successional and old growth
LSR	late-successional reserves
LWD	large woody debris
m/sec	meter per second
m^2	square meter
m^3	cubic meter
m^3/hr	cubic meters per hour
mi^2	square miles
MAMU	marbled murrelet
MAOP	maximum allowable operating pressure
mcy	million cubic yards
mg/l	milligram per liter
MLLW	mean lower low water
MLV	mainline valve
mm	millimeters
MMPA	Marine Mammal Protection Act
MOCA	Managed Owl Conservation Area
MOF	material offloading facility
MP	milepost
mph	miles per hour
MSA	Magnuson-Stevens Fishery Conservation and Management Act
MSNO	master site number
MSO	Mexican spotted owl
MTBM	microtunnel boring machine
NAS	non-indigenous aquatic species
NAVD88	North American Vertical Datum of 1988
NCM	navigation channel mile

NE	no effect
NEPA	National Environmental Policy Act
NFPA	National Fire Protection Association
NFS	National Forest System
NGA	Natural Gas Act
NHD	National Hydrography Dataset
NLAA	may affect but not likely to adversely affect
NMFS	National Marine Fisheries Service
nmi	nautical mile
nmi^2	square nautical mile
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
NRF	nesting, roosting, and foraging
NRM	Northern Rocky Mountain
NSA	noise-sensitive area
NSO	northern spotted owl
NSOOM	Northern Spotted Owl Occupancy Map
NSR	North State Resources
NTU	nephelometric turbidity unit
NWFP	Northwest Forest Plan
NWI	National Wetland Inventory
NWR	National Wildlife Refuge
NWS	National Weather Service
OCS	Outer Continental Shelf
ODA	Oregon Department of Agriculture
ODE	Oregon Department of Energy
ODEQ	Oregon Department of Environmental Quality
ODFW	Oregon Department of Fish and Wildlife
ODLCD	Oregon Department of Land Conservation and Development
ODSL	Oregon Department of State Lands
OEM	Owl Estimation Model
OHV	off-highway vehicle
OHWM	ordinary high water mark
OPRD	Oregon Parks and Recreation Department
ORBIC	Oregon Biodiversity Information Center
ORV	off-road vehicle
OSTF	Oil Spill Task Force
OWRD	Oregon Water Resources Department
Pacific Connector	Pacific Connector Gas Pipeline, LP
PAH	polycyclic aromatic hydrocarbon
PAR	permanent access road
PBR	potential biological removal
PCB	polychlorinated biphenyl
PCE	primary constituent element
PFMC	Pacific Fishery Management Council

PHMSA	Pipeline and Hazardous Materials Safety Administration
PLF	product loading facility
POD	Plan of Development
Port	Oregon International Port of Coos Bay
ppm	part per million
propwash	propeller wash
PSET	Portland Sediment Evaluation Team
psi	pounds per square inch
psig	pounds per square inch gauge
PTS	permanent threshold shift
PVC	polyvinyl chloride
R&A	Rogers and Associates
Reclamation	Bureau of Reclamation
RM	river mile
RMP	Resource Management Plan
RMS	root mean square
RMZ	regulatory mixing zone
SBS	Siskiyou BioSurvey, LLC
SEL	sound exposure level
SEL_{cum}	cumulative sound exposure level
Services	FWS and NMFS
SE	severity of ill effect
SEV	severity-of-ill-effects
SHN	SHN Consulting Engineers and Geologists, Inc.
SHU	suitable habitat unit
SONCC	Southern Oregon/Northern California Coast
SORSC	Southwest Oregon Regional Safety Center
SPCCP	Spill Prevention, Containment, and Countermeasures Plan
SPI	Sierra Pacific Industries
SPL_{peak}	single-strike peak level
SPTH	one site potential tree height
SSA	species status assessment
SSTEMP	Stream Segment Temperature Model
TAR	temporary access road
TEWA	temporary extra work area
TMBB	Temporary Materials Barge Berth
TMMP	turbidity monitoring and management plan
TMP	*Transportation Management Plan*
TNC	The Nature Conservancy
TSS	total suspended solids
TTS	temporary threshold shift
U.S.C.	Unites States Code
UCSA	uncleared storage area
US-101	U.S. Highway 101
USDOT	U.S. Department of Transportation
USGS	U.S. Geological Survey

WARSEM	Washington Road Surface Erosion Model
WDFW	Washington Department of Fish and Wildlife
WMA	Wildlife Management Area
WMZ	Wolf Management Zone
WSREM	Whale Strike Risk Estimation Model

1.0 INTRODUCTION

1.1 PROJECT BACKGROUND

In September 2017, Jordan Cove Energy Project L.P. (Jordan Cove) filed an application with the Federal Energy Regulatory Commission (FERC or Commission), under Section 3 of the Natural Gas Act (NGA), seeking authorization to site, construct, and operate a liquefied natural gas (LNG) export terminal (LNG Project) on the North Spit of Coos Bay, in Coos County, Oregon. Simultaneously, under Section 7 of the NGA, Pacific Connector Gas Pipeline LP (Pacific Connector) filed an application with the FERC, seeking a Certificate of Public Convenience and Necessity (Certificate) to construct and operate an approximately 229-mile-long, 36-inch-diameter, natural gas transmission pipeline from interconnections with the existing Ruby pipeline and Gas Transmission Northwest (GTN) pipeline (Pipeline Project) near Malin, Oregon to the LNG Project. Hereafter, Jordan Cove and Pacific Connector are also referred to as the applicant, and their inter-related proposals are collectively referred to as the Jordan Cove Energy Project, or the Project.

For actions involving major construction activities with the potential to affect listed species or critical habitats, the lead federal agency must prepare a Biological Assessment (BA) for those species that may be affected. The lead federal agency must submit its BA to the United States Fish and Wildlife Service (FWS) and the National Marine Fisheries Service (NMFS) and, if it is determined that the action may adversely affect a federally listed species, the lead agency must submit a request for formal consultation to comply with section 7 of the Endangered Species Act (ESA). We[1] have determined that constructing and operating the Project may affect federally listed species and designated critical habitat. Therefore, as required, we are providing this BA to the FWS and NMFS and request the initiation of formal consultation for species that may be adversely affected by the Project.

The Magnuson-Stevens Fishery Conservation and Management Act, as amended, 16 United States Code (U.S.C.) §§ 1361 et seq. (MSA) established procedures designed to identify, conserve, and enhance essential fish habitat (EFH) for those species regulated under a federal fisheries management plan. The MSA requires federal agencies to consult with the NMFS on all actions or proposed actions authorized, funded, or undertaken by the agency that may adversely affect EFH, 16 U.S.C. § 305(b)(2); 50 Code of Federal Regulations (CFR) § 600.920. The applicable regulations encourage consolidation of environmental review procedures to reduce duplication and improve efficiency, 50 CFR § 600.920(f). For this Project, we are consolidating the EFH Assessment with this BA.

In January 2018, Pacific Connector submitted a Right-of-Way Grant application, under the Mineral Leasing Act, 30 U.S.C. §§181 et seq. to the U.S. Department of the Interior Bureau of Land Management (BLM), U.S. Department of Agriculture Forest Service (Forest Service), and Bureau of Reclamation (Reclamation). The Pipeline route would cross National Forest System (NFS) lands within the Umpqua, Rogue River, and Winema National Forests, and portions of the BLM's Coos Bay, Roseburg, Medford, and Lakeview Districts, and land and features within the Klamath Project managed by Reclamation. Actions that would be taken by the BLM, Forest

[1] "We," "us," and "our" refer to the environmental staff of the Federal Energy Regulatory Commission's Office of Energy Projects.

Service, and Reclamation with respect to this Right-of-Way Grant application are included in this BA.

1.2 PROPOSED ACTION

Jordan Cove and Pacific Connector propose to site, construct, and operate a liquefied natural gas export terminal and an interstate natural gas transmission pipeline in southern Oregon. To increase the efficiency and ensure consistency among numerous federal reviews, we are incorporating by reference the description of the proposed action (section 2.0) that is provided in the draft environmental impact statement for the Project (issued on March 29, 2019) in FERC Docket Nos. CP17-494-000 and CP17-495-000. The main components of the Project include: the LNG Terminal and associated facilities in Coos County, Oregon; and the Pipeline and associated facilities, which would cross portions of Klamath, Jackson, Douglas, and Coos Counties, Oregon.

Terminology in this document is defined as follows:

- "LNG Terminal site" refers to the terminal site footprint on the North Spit of Coos Bay and "LNG Project" refers to the terminal and associated components, many of which are not located at the terminal site (e.g., the Al Pierce Company [APCO] Sites, Kentuck project site, Panhandle mitigation site, Lagoon mitigation site, North Bank site, Trans-Pacific Parkway widening site).
- "Pipeline" and "Pipeline Project" refer to the construction right-of-way, temporary extra work areas (TEWAs), uncleared storage areas (UCSAs), aboveground facilities, contractor and pipe storage yards, quarries and rock source disposal sites, permanent and temporary access roads (PARs and TARs, respectively), existing access roads (EARs), communication facilities, 30-foot maintenance/operation corridor, and 50-foot permanent easement.
- "in the vicinity of the Pipeline Project" or in the "Pipeline Project area" generally refer to adjacent or nearby lands, including areas where impacts to fish, wildlife, and vegetation could occur outside of the Pipeline Project. In many instances, these terms are used generally, as the extent (or distance from the Pipeline Project) of impact that can occur beyond the Pipeline Project varies by species . Similarly, discussion of survey areas (i.e., distance from the Pipeline Project) conducted for the Pipeline varies depending on the resource, landowner (federal or non-federal), and expected extent of impact (i.e., proposed blasting and/or helicopter use).

1.3 ACTION AREA

The action area includes all areas that would be affected directly or indirectly by the proposed action. Because the proposed action would affect several species inhabiting marine, estuarine, riverine, and terrestrial habitats, there are multiple components of the action area that have been defined as species' analysis areas. Species' analysis areas are described in detail in each species' respective assessment in section 3 (i.e., in the environmental baselines text and associated figures). For some species there may be more than one analysis area if the listed species utilizes multiple habitats in diverse locations. Analysis areas and associated species include:

- the marine analysis area is a fan shape beginning at the entrance to Coos Bay extending approximately 12 nautical miles (nm) off the coast of Oregon to the edge of the Outer Continental Shelf (OCS). The northern border of the fan extends from the North Jetty to the point located at the edge of the OCS near 43°28′39″ -124°33′34″, and the southern border extends from the South Jetty to point located at the edge of the OCS near 43°24′49″, -124°35′8″. The analysis area is approximately 33.1 square miles. The marine analysis area applies to all listed marine mammals, short-tailed albatross, marbled murrelet (MAMU), green sturgeon, eulachon, coho salmon (Oregon Coast Evolutionary Significant Unit [ESU] and in the Southern Oregon/Northern California Coast [SONCC] ESU), and listed sea turtles;
- the gray wolf analysis area is based on the Area of Known Wolf Activity initially designated for OR-7, and applies only to the gray wolf;
- the fisher analysis area extends as far as pipeline construction-related noise attenuates to ambient noise in Klamath, Jackson, Douglas, Coos Counties, where the fisher is currently and historically known to occur, and applies only to the fisher;
- the marten analysis area extends as far as construction-related noise attenuates to ambient noise within the range of the Coastal Distinct Population Segment (DPS) of Pacific marten in Coos County, and applies only to the Pacific marten;
- the estuarine analysis area (see figure 3.3.3-3) which encompasses all estuarine waters (and substrates) that are within the estuary between the North Jetty and South Jetty at the Coos Head entrance to the Upper Coos Bay. The estuarine analysis area is approximately 15 square miles. The estuarine analysis area applies to MAMU, snowy plover, green sturgeon, eulachon, and coho salmon (Oregon Coast ESU);
- the LNG terminal analysis area extends for 1.5 miles beyond the perimeter of the LNG Terminal site (see figure 3.3.2-2) to include project components on the North Spit and APCO Site, which historically provided western snowy plover nesting habitat;
- the terrestrial nesting analysis area extends inland along the Pipeline route to include MAMU Inland Zone 1 – mileposts (MP) 0.00 to 53.76 - and MAMU Inland Zone 2 – MPs 53.76 to 75.40 (see figure 3.3.3-2). and applies only to MAMU;
- the provincial analysis area is located within four Physiographic Provinces (Burns 1998): Oregon Coast Range, Oregon Klamath Mountains, West Oregon Cascades, and East Oregon Cascades (see figure 3.3.4-1), and applies only to northern spotted owls (NSO);
- the riverine analysis area encompasses fifth-field (watershed-level) hydrological unit codes (HUCs) (USGS 2018) and reflects an estimate of the average downstream extent that suspended sediment from any stream crossing generated by the Pipeline could equal ambient conditions within the 5th field watershed crossed. Several riverine analysis areas that are in specific geographic locations each in the respective ranges of coho salmon in the Oregon Coast ESU and in the Southern Oregon/Northern California Coast (SONCC) ESU, listed suckers, and Oregon spotted frogs; and
- the botanical analysis areas extend to 30 meters (98 feet) each side of the Pipeline Project on lands that have potential habitat for listed plant species, except vernal pool-associated species (fairy shrimp and two listed plants) where the area extends out 250 feet. For the LNG Project, the botanical analysis area includes the terminal footprint and potential habitat for western lily extending north to the Trans-Pacific Parkway, as well as within 30 meters (98 feet) of the associated temporary construction work areas and mitigation sites (e.g., Port laydown site, Kentuck project site).

1.4 ESA CONSULTATION BACKGROUND

1.4.1 Species Lists

Thirty-two federally listed threatened and endangered species and two species proposed (threatened) for listing were identified as occurring in the Project area, based on publicly available information and input from the FWS (2018a and 2018b; FERC 2013) and NMFS (Wheeler 2006a and 2006b; NMFS 2009a, 2018a). Table 1.4.1-1 summarizes these species, including critical habitat where designated, availability of recovery plans, and the general component of the Project where they may occur. In addition, there are six other listed or proposed species that occur within the counties crossed by the Project, but on which the proposed action would have no effect. Those species include the Contiguous United States DPS of Canada lynx (*Lynx canadensis*), Coterminous United States Population of bull trout – Klamath River DPS (*Salvelinus confluentus*), yellow-billed cuckoo – Western DPS (*Coccyzus americanus*), streaked horned lark (*Eremophila alpestris strigata*), slender orcutt grass (*Orcuttia tenuis*), and the North American wolverine (*Gulo gulo*). Brief synopses of the rationales for the no effects determinations for these species are provided in section 3.1.2.

TABLE 1.4.1-1

Listed and Proposed Species that May Be Present within the Project Area

Listed Species	Federal Status a/	General Area of Potential Occurrence	Critical Habitat within the Project Area	Recovery Plan Drafted	Effects Determination Species b/	Effects Determination Critical Habitat b/
Mammals						
Blue whale *Balaenoptera musculus*	E	Oregon Coast	None Designated	Yes	LAA	N/A
Fin whale *Balaenoptera physalus*	E	Oregon Coast	None Designated	Yes	LAA	N/A
Killer whale (Eastern Northern Pacific Southern Resident Stock) *Orcinus orca*	E-CH	Oregon Coast	Not in Action Area	Yes	NLAA	NE
Humpback whale *Megaptera novaeangliae* (Central American and Mexican DPSs)	T, E	Oregon Coast	None Designated	Yes	LAA	N/A
Sei whale *Balaenoptera borealis*	E	Oregon Coast	None Designated	Yes	NLAA	N/A
Sperm whale *Physeter macrocephalus*	E	Oregon Coast	None Designated	Yes	NLAA	N/A
North Pacific right whale *Eubalaena japonica*	E-CH	Oregon Coast	Not in Action Area	Yes	NLAA	NE
Gray whale (Western North Pacific Stock) *Eschrichtius robustus*	E	Oregon Coast	None Designated	No	NLAA	N/A
Gray wolf *Canis lupus*	E-CH	Coos County Douglas County Jackson County Klamath County	Not in Action Area	None Applicable	NLAA	NE
Pacific marten (Coastal DPS c/) *Martes caurina*	PT	Coos County	None Designated	No	NJ/LAA d/	N/A
Pacific fisher (West Coast DPS c/) *Pekania pennanti*	PT	Douglas County Jackson County Klamath County	None Designated	No	NJ/LAA d/	N/A
Birds						
Short-tailed albatross *Phoebastria albatraus*	E	Oregon Coast	None Designated	Yes	NLAA	N/A
Western snowy plover (Pacific Coast Population) *Charadrius alexandrinus nivosus*	T-CH	Coos County	Yes – Unit OR-10, Coos Bay North Spit	Yes	NLAA	NLAA
Marbled murrelet *Brachyramphus marmoratus*	T-CH	Coos County Douglas County	Yes – CHU OR-06-d	Yes	LAA	LAA
Northern spotted owl *Strix occidentalis caurina*	T-CH	Coos County Douglas County Jackson County Klamath County	Yes – CHU OCR-6 (in Unit 2 Oregon Coast Range), KLW-1 (in Unit 9 Klamath West), KLE-1, KLE-2, KLE-3, KLE-4, KLE-5 (in Unit 10 Klamath East), ECS-1 (in Unit 8 East Cascades)	Yes	LAA	LAA

TABLE 1.4.1-1 (continued)

Listed and Proposed Species that May Be Present within the Project Area

Listed Species	Federal Status a/	General Area of Potential Occurrence	Critical Habitat within the Project Area	Recovery Plan Drafted	Effects Determination Species b/	Effects Determination Critical Habitat b/
Herpetofauna						
Green turtle *Chelonia mydas*	T-CH	Oregon Coast	Not in Action Area	Yes	NLAA	NE
Leatherback turtle *Dermochelys coriacea*	E-CH	Oregon Coast	Yes-Pacific Ocean north of Cape Blanco, south of Cape Flattery	Yes	NLAA	NLAA
Olive Ridley turtle *Lepidochelys olivacea*	T	Oregon Coast	None Designated	Yes	NLAA	N/A
Loggerhead turtle *Caretta caretta*	E	Oregon Coast	None Designated	Yes	NLAA	N/A
Oregon spotted frog *Rana pretiosa*	T -CH	Buck Lake, Klamath County	Yes - Buck Lake, Klamath County	No	NLAA	NLAA
Fish						
Green sturgeon (Southern Distinct Population Segment) *Acipenser medirostris*	T-CH	Oregon Coast Coos Bay estuary and tributary rivers to Head of Tide	Yes - Coos Bay estuary, tributary rivers to Head of Tide, and Pacific Ocean to 60 fathoms	No	LAA	LAA
Eulachon (Southern Distinct Population Segment) *Thaleichthys pacificus*	T-CH	Coos Bay, Oregon Coast	Not in Action Area	Yes	LAA	NE
Coho salmon (Southern Oregon/Northern California Coast Evolutionarily Significant Unit) *Oncorhynchus kisutch*	T-CH	Rogue River	Yes – Upper Rogue HU (17100307)	Yes	LAA	LAA
Coho salmon (Oregon Coast Evolutionarily Significant Unit) *Oncorhynchus kisutch*	T-CH	Coos Bay, and the Coos, Coquille, and South Umpqua, Rivers	Yes – South Umpqua Subbasin (HU 17100302), Coquille Subbasin (HU 17100305), – Coos Subbasin including the Coos Bay Estuary (HU 17100304)	Yes	LAA	LAA
Lost River sucker *Deltistes luxatus*	E-CH	Klamath River Lost River	Yes – Unit 1, Klamath County	Yes	LAA	NLAA
Shortnose sucker *Chasmistes brevirostris*	E-CH	Klamath River Lost River	Yes – Unit 1, Klamath County	Yes	LAA	NLAA
Invertebrates						
Vernal pool fairy shrimp *Branchinecta lynchi*	T-CH	Jackson County	Yes – Eagle Point and Sams Valley quadrangles – CHUs VERFS 3A and 3B	Yes	LAA	NLAA
Plants						
Applegate's milk-vetch *Astragalus applegatei*	E	Klamath County	None Designated	Yes	LAA	N/A
Gentner's fritillary *Fritillaria gentneri*	E	Jackson County	None Designated	Yes	LAA	N/A
Large-flowered woolly meadowfoam *Limnanthes pumila ssp. grandiflora*	E-CH	Jackson County	Yes- Units Rogue Valley-6 and Rogue Valley-8	Yes	NLAA	NLAA

TABLE 1.4.1-1 (continued)

Listed and Proposed Species that May Be Present within the Project Area

Listed Species	**Federal Status a/**	**General Area of Potential Occurrence**	**Critical Habitat within the Project Area**	**Recovery Plan Drafted**	**Effects Determination Species b/**	**Effects Determination Critical Habitat b/**
Cook's lomatium *Lomatium cookii*	E-CH	Jackson County	Not in Action Area	Yes	NLAA	NLAA
Kincaid's lupine *Lupinus sulphureus var. kincaidii*	T-CH	Douglas County	Not in Action Area	Yes	LAA	NE
Western lily *Lillium occidentale*	E	Coos County	None Designated	Yes	NLAA	N/A
Rough popcornflower *Plagiobothrys hirtus*	E	Douglas County	None Designated	Yes	NLAA	N/A

a/ Status Key: E = Endangered, T = Threatened, PT = Proposed Threatened, CH = Critical Habitat.
b/ Effects Determination: N/A – Not applicable (critical habitat has not been designated or proposed); NE = No Effect, NLAA= Not Likely to Adversely Affect, LAA = Likely to Adversely Affect, NJ = not likely to jeopardize the continued existence for proposed species
c/ DPS = Distinct Population Segment
d/ This represents a provisional effect determination for this ESA proposed species. This provisional effect determination would apply if the species becomes listed prior to the completion of consultation on the Project.

1.4.2 Information Sources

Information concerning listed and proposed species' distributions, habitat requirements, and occurrence in the action area as set forth in section 1.3 was gathered from numerous sources, including: 1) published scientific literature; 2) agencies' published reports; 3) agencies' unpublished raw and/or compiled data[2]; 4) agencies' geo-spatial databases, which document species observations; 5) field surveys for species and habitats ; and 6) personal communications with agency personnel knowledgeable about species' ecological status in the Project area and vicinity. FERC representatives also met regularly with FWS and NMFS throughout the development of this BA, including ongoing biweekly conference calls with federal cooperating agencies starting on November 2, 2017, ongoing weekly conference calls with FWS and NMFS starting on April 9, 2019, and various other meetings and calls since 2017 to discuss ESA-related topics. FERC provided preliminary drafts of select sections of the BA to FWS and NMFS on May and June of 2019.

Existing vegetation within the Pipeline Project area was classified using several reference/data sources, including: 1) wetland delineation surveys conducted between 2006 and 2017; 2) county-based 2016 aerial photography; 3) BLM Forest Operations Inventory (FOI) digital geographic information system (GIS) coverage (BLM 2016c); 4) digital GIS data coverage and vegetation categories described by the Oregon Gap Analysis Project (Kagan et al. 1999); and 5) current wildlife-habitat types described and delineated by the Northwest Habitat Institute in 1999 (Kiilsgaard and Garrett 1999). Vegetation cover types within at least 100 meters of the Pipeline Project were digitized with GIS from 2016 aerial photography and delineated based on the predominant vegetation physiognomy (e.g., trees, shrubs, herbaceous vegetation) and the dominant species present. Existing vegetation cover types within the LNG Project were determined from field surveys conducted by Jordan Cove, including wetland delineations that were approved by the U.S. Army Corps of Engineers (COE) and Oregon Department of State Lands (ODSL; Stuntzner Engineering and Forestry 2005, SHN Consulting Engineers and Geologists, Inc. [SHN] 2013a), and botanical surveys (SHN 2006, 2013b).

Fisheries (ESA-listed species and species with EFH) information was gathered from many sources, including: 1) NMFS (Wheeler 2006a, 2006b, 2018; NMFS 2017a, 2018a, 2018b, 2018c); 2) FWS (FWS 2018b, 2017a); 3) Oregon Department of Fish and Wildlife (ODFW) Natural Resources Information Management Program (ODFW 2017a), which documents observations of species in the project area; 4) species' population and distribution information available online at StreamNet (StreamNet 2012); and 5) published scientific literature and agency reports. Information on other listed species was gathered from: 1) *Wildlife-Habitat Relationships in Oregon and Washington* (Johnson and O'Neil 2001), which provides relationships between specific habitats and the wildlife species that may occur in the Pipeline Project area; 2) Oregon Biodiversity Information Center (ORBIC; 2017a), GeoBOB (BLM 2017), and Natural Resource Information System (Forest Service 2017) databases; FWS GIS database and NSO demographic database; 3) National Biological Breeding Bird Survey routes and Audubon Christmas Bird Counts; 4) published scientific literature and agency reports; and 5) other state and federal databases and literature available online.

[2] Unpublished data include confidential and privileged information, internal BLM and Forest Service data, and personal communication with FWS and NMFS.

1.4.3 Species Surveys

Jordan Cove conducted botanical, wildlife and fish surveys of the LNG Project in 2005, 2006, and 2012 (LBJ Enterprises 2006; Alice Berg & Associates 2006; SHN 2006, 2013b, 2013c), as well as a biological sampling program in Coos Bay in 2010 (Shanks et al. 2011). Terrestrial wildlife surveys conducted for the Project documented 11 mammal species. The most common marine mammal in Coos Bay near the LNG Project was the harbor seal. Surveys at the LNG Project noted 151 avian species. Sampling by the University of Oregon Institute for Marine Biology for zooplankton in Coos Bay near the LNG Project access channel found sculpin, gunnels, sand lance, English sole, and surf smelt, in addition to ghost shrimp and several crab species. The results of the applicant's biological surveys relevant to federally listed or proposed species are included in section 3 of this BA.

Pacific Connector conducted botanical and biological surveys for the action area for terrestrial sensitive species between 2007 and 2018 where survey access was granted. Based on literature reviews, 108 species of mammals and 281 bird species may be present in habitats that coincide with the action area for the Pipeline. Pacific Connector surveys focused on NSO, MAMU, great gray owl, red tree vole, and northern goshawk, as well as terrestrial and aquatic mollusks. Botanical surveys also focused on ESA-listed and State-listed vascular plant species; Survey and Manage vascular, lichen, bryophyte, and fungi species; vascular, lichen, and bryophyte species on the Oregon BLM Special Status Strategic or Sensitive Plant Lists; and vascular, lichen, and bryophyte species on Forest Service Region 6 Sensitive and Strategic Plant Lists.[3] he results of these surveys relevant to federally listed or proposed species are included in section 3 of this BA.

1.5 MAGNUSON-STEVENS ACT CONSULTATION

The EFH Assessment included in this document provides information on the potential effects to EFH, pursuant to Section 305(b) of the MSA. The MSA describes EFH as those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity (NMFS 1997a). Within the Project action area, EFH has been designated for two salmonids (i.e., Chinook and coho), five pelagic species (i.e., northern anchovy [*Engraulis mordax*], Pacific sardine [*Sardinops sagax*], Pacific mackerel [*Scomber japonicus*], jack mackerel [*Trachurus symmetricus*], and market squid [*Doryteuthis (Loligo) opalescens*]), and 70 groundfish species. All habitat accessible to these managed species, including spawning and incubation, juvenile rearing, juvenile migration corridors, and adult migration corridors, is considered EFH (Pacific Fishery Management Council [PFMC] 1999). Highly migratory species defined by the PFMC include tunas (five species), sharks (five species), billfish/swordfish (two species), and the dorado (also called dolphinfish or mahi-mahi).

[3] BLM and Forest Service no longer track Strategic species (BLM and Forest Service 2019); however, these species were documented if observed during surveys conducted between 2007 and 2018.

2.0 PROPOSED ACTION

As described herein, Jordan Cove proposes to construct and operate an LNG production, storage, and export facility in Coos County, Oregon. Pacific Connector also proposes to construct and operate an interstate natural gas transmission pipeline and associated facilities in Coos, Douglas, Jackson, and Klamath Counties, Oregon. The proposed action also includes amendments to BLM and Forest Service land management plans (LMP). The proposed amendments and associated mitigation actions are described in section 2.8 below.

2.1 PROJECT OPERATIONAL COMPONENTS

2.1.1 Jordan Cove LNG Project

The Jordan Cove LNG export terminal would be located on the bay side of the North Spit of Coos Bay, Oregon. The general location of the terminal and associated temporary construction work areas including marine facilities and mitigation sites is shown on figure 2.1-1. The primary components of the LNG terminal include five liquefaction trains[4], two full-containment LNG storage tanks, vessel loading facilities, a vessel slip, and a marine access channel. The terminal site would also include a connection to the Pipeline Project and a gas conditioning facility. Jordan Cove is proposing five mitigation sites (i.e., the Kentuck project; the Eelgrass Mitigation site; and the Lagoon, Panhandle, and North Bank upland wildlife habitat mitigation sites). As shown on figure 2.1-2, portions of the terminal site are referred to as Ingram Yard which would contain the main terminal facilities; South Dunes, which would contain the Southwest Oregon Regional Safety Center (SORSC), administration building, and temporary workforce housing and laydown areas; and an access and utility corridor between the Ingram Yard and South Dunes. Components that make up the proposed LNG Project are described below, and the location of specific components are shown on figure 2.1-3.

[4] A liquefaction train consists of all components of the liquefaction process arranged in a linear relationship.

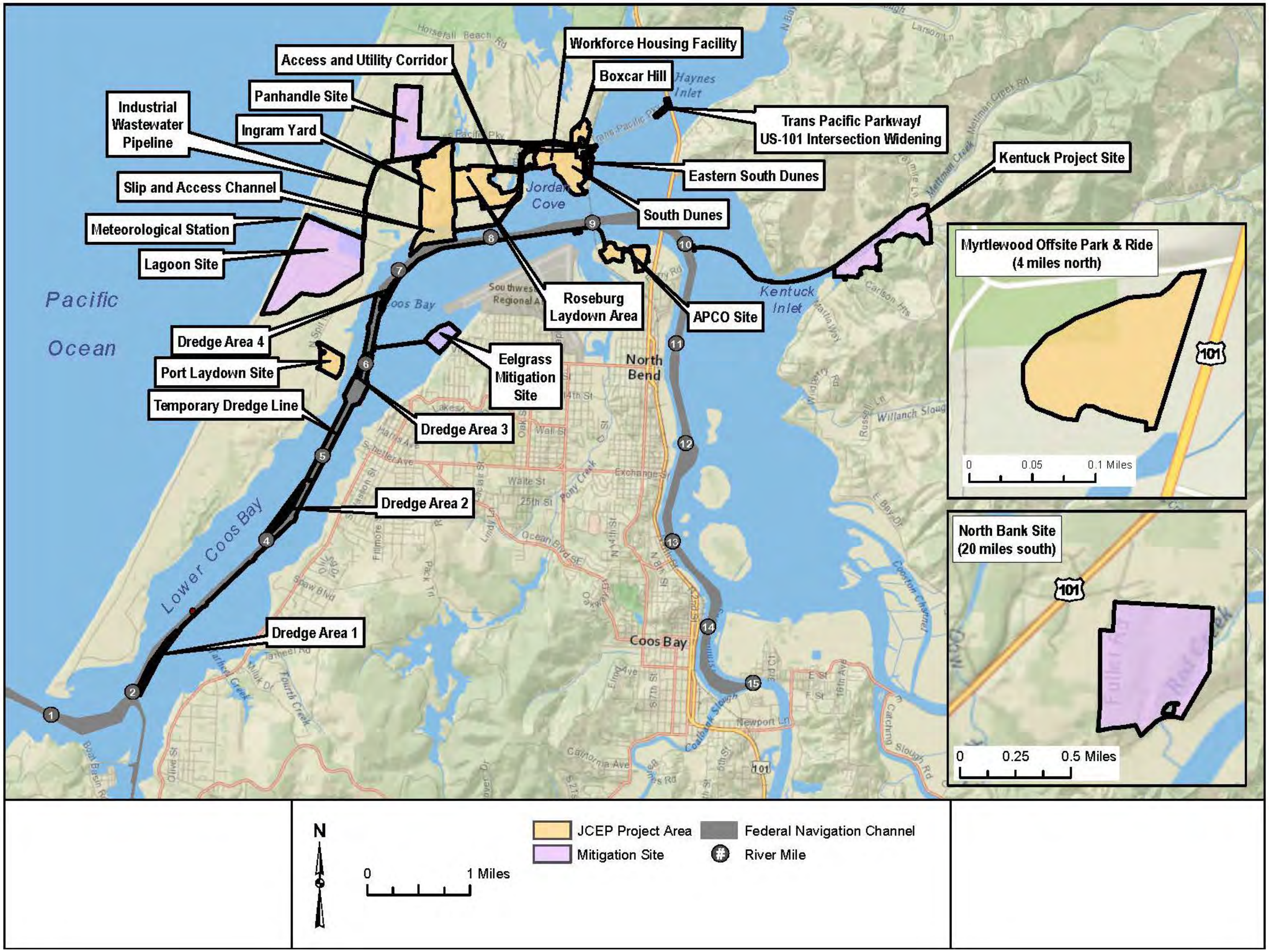

Figure 2.1-1
Jordan Cove LNG Project General Location

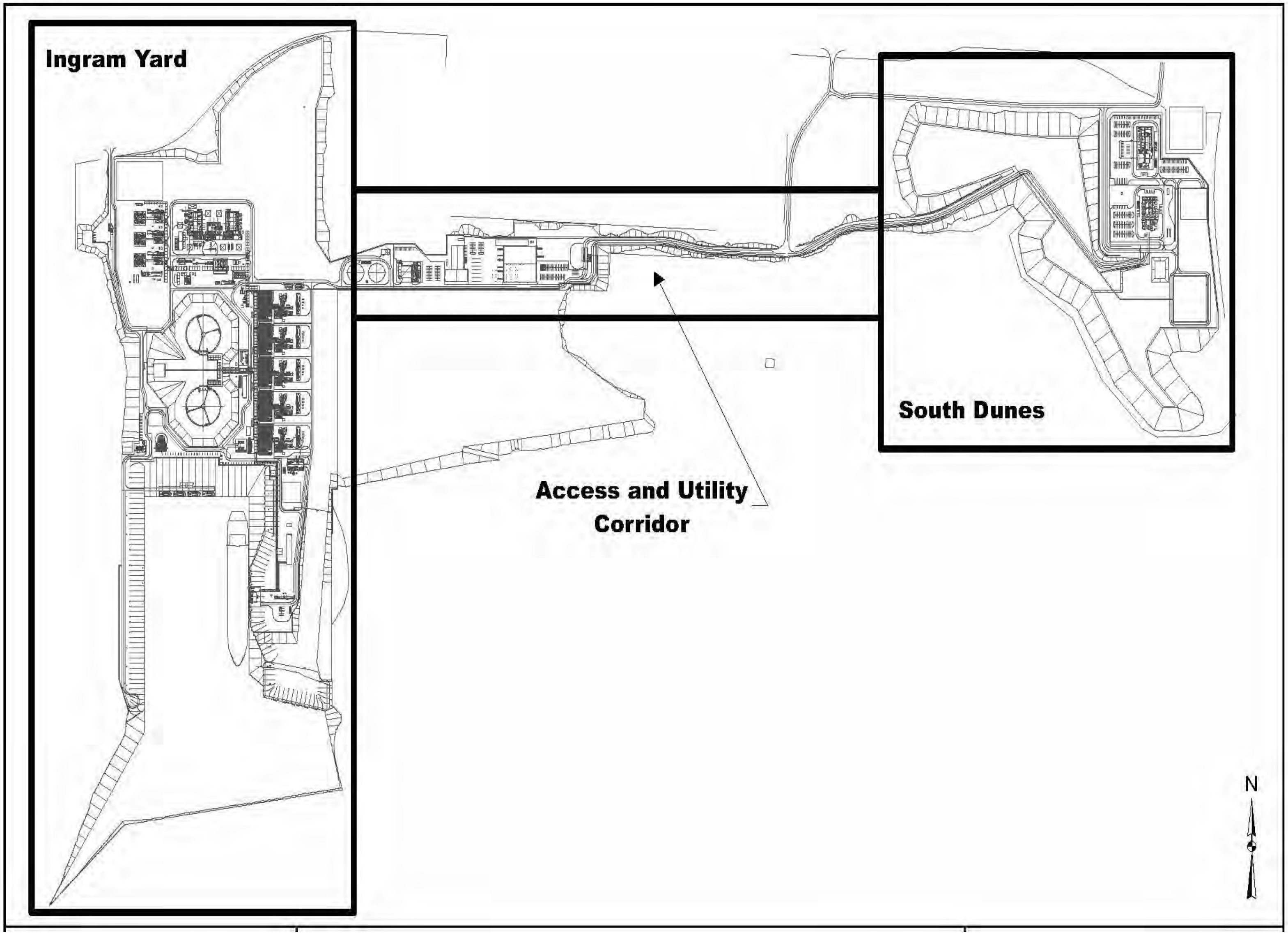

Figure 2.1-2
LNG Terminal Facilities

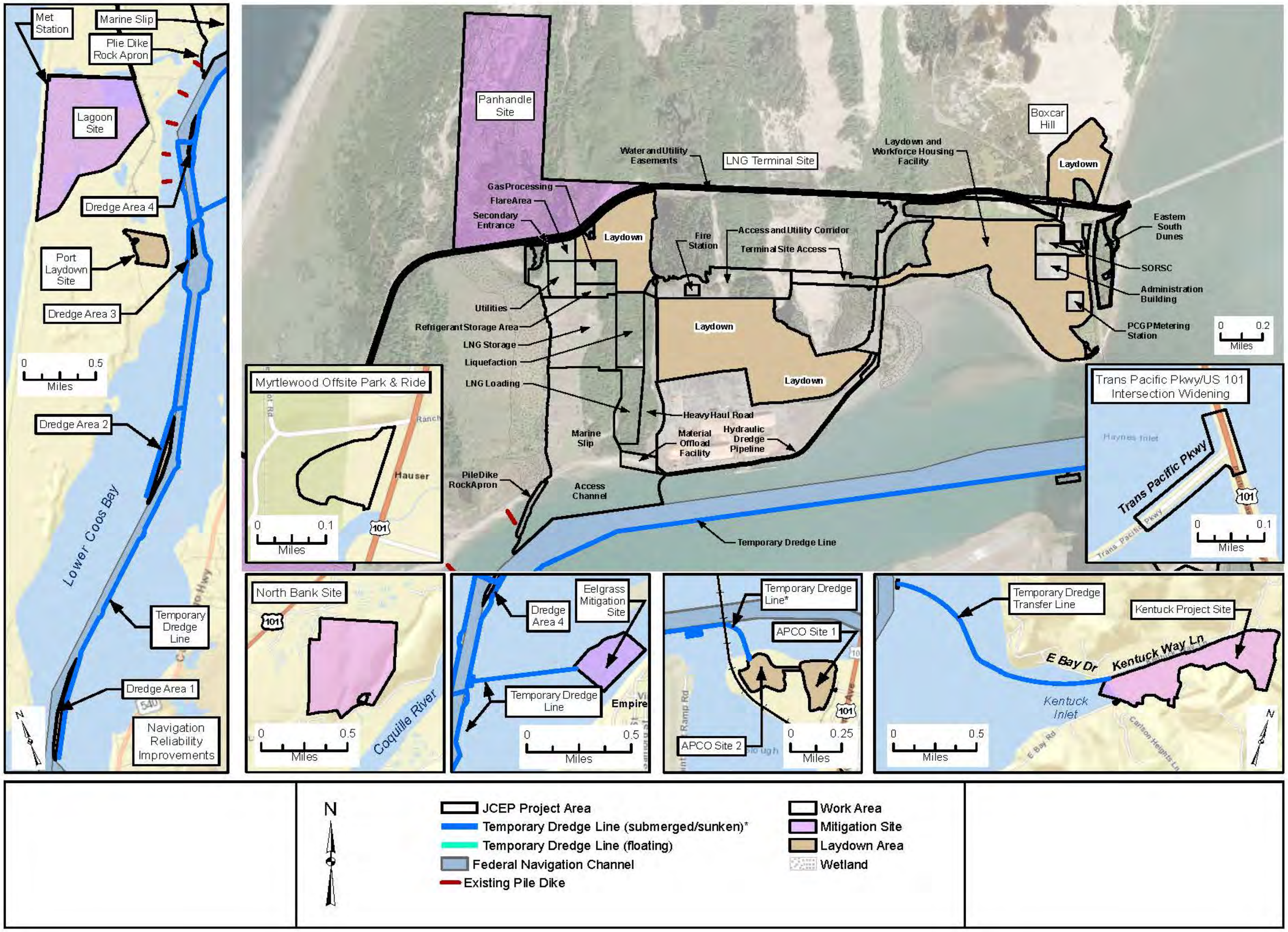

Figure 2.1-3
Jordan Cove LNG Project Detail

2.1.1.1 Lighting System

Twenty-four-hour facility lighting would be required for security and personnel safety during operation of the LNG terminal. A final lighting plan, including lighting of the LNG storage tanks, would be developed during detailed LNG terminal design; however, Jordan Cove states that only lighting required for operation and maintenance, safety, security, and meeting Federal Aviation Administration (FAA) requirements would be used on the LNG storage tanks.

2.1.1.2 Water Systems

Jordan Cove would design and construct a stormwater management system to gather runoff from impervious surfaces within the terminal and direct the flow to designated areas for disposal. Stormwater collected in areas that are potentially contaminated with oil or grease would be pumped or would flow to oily water collection sumps before discharging to the industrial wastewater pipeline. No untreated stormwater would be allowed to enter federal or state waters.

Sanitary waste would either be directed to a holding tank and disposed of by a sanitary waste contractor as necessary or would be treated by a packaged treatment system and directed to an existing industrial wastewater pipeline (IWWP).

During construction of the LNG Project, an existing industrial wastewater pipeline would be abandoned, replaced, and relocated. The new replacement pipeline would consist of 16-inch-diameter slip joint polyvinyl chloride (PVC). It would run for about two miles from the South Dunes portion of the site along the shoulder of the Trans-Pacific Parkway within an easement owned by the Oregon International Port of Coos Bay (Port) to connect with the existing outfall pipe west of the Weyerhaeuser lagoon on the North Spit (see figure 2.1-4).

Jordan Cove proposes to use raw water from the existing Coos Bay North Bend Water Board (CBNBWB) raw water pipeline for construction water needs, including hydrostatic testing of the LNG storage tanks. Following testing and Oregon Department of Environmental Quality (ODEQ) approval, the water would be locally discharged to the stormwater system for infiltration or discharged into the IWWP according to the applicable National Pollutant Discharge Elimination System (NPDES) permit requirements.

An interconnect to the CBNBWB potable water pipeline would be used for all normal operational water needs in the LNG terminal, which includes fire water makeup, utility water used for such items as equipment and area cleaning, and potable water required to supply buildings and eyewash/safety shower stations. In addition, the raw water pipeline tap at the LNG Terminal site would remain connected after construction, but there are no normal operational uses anticipated for this raw water supply. The water pipelines and proposed taps are shown on figure 2.1-5.

During construction of the terminal, Jordan Cove would use approximately 595.5 million gallons of water for various activities, including hydrostatic testing. During terminal operations, about 71.5 million gallons of water would be consumed annually. Water usage and impacts are more fully discussed in section 4.3 of our environmental impact statement (EIS; FERC 2019).

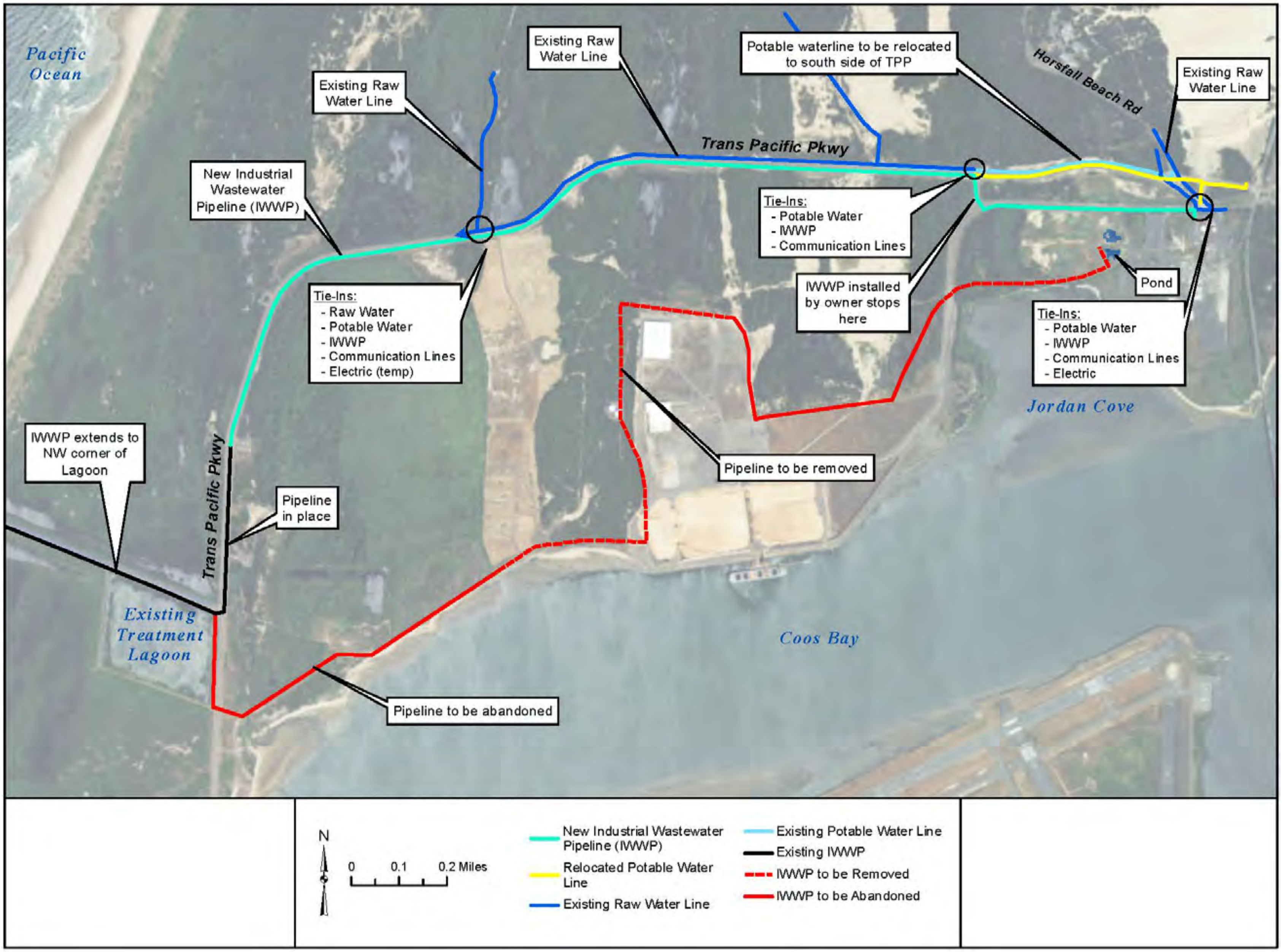

Figure 2.1-4
Industrial Wastewater Pipeline, Water Pipelines Relocation, and Utility Tie-Ins

The LNG terminal would include a fire suppression system with the main fire water supply for the system provided by two aboveground firewater storage tanks located in the access and utility corridor. Water supply for the two tanks would be potable water obtained from CBNBWB. Each tank would hold a minimum usable capacity of 3,240,000 gallons. This would supply approximately 4 hours of firefighting water. The fire water systems would also include stationary fire water pumps, fire hydrant mains, fixed water spray systems, automatic sprinkler extinguishing systems, high expansion foam system, and remotely controlled monitored spray systems. The fire water supply would also be used to provide water for on-site firefighting trucks.

2.1.1.3 Marine Waterway including Proposed Modifications to the Marine Waterway[5]

The U.S. Department of Homeland Security Coast Guard (Coast Guard) defines the waterway for LNG marine traffic for the Project as extending from the outer limits of the United States territorial waters 12 nautical miles (nmi) off the coast of Oregon, and 7.5 nmi up the Federal Navigation Channel to the LNG terminal site (figure 2.1-5). The Federal Navigation Channel extends from the mouth of Coos Bay to the city of Coos Bay Docks at about river mile (RM) 15.1. As part of the Project, Jordan Cove would dredge four areas abutting the current boundary of the navigation channel between RM 2 to RM 7 (figure 2.1-1). Dredging could potentially modify the physical morphology of the channel, by widening four turns along the channel, to allow for more efficient transit of LNG carriers. These proposed dredging actions would not result in a change in the overall depth of the Federal Navigation Channel (only a widening of four turns along the channel). The COE is currently evaluating if the dredging of these four turns would alter the Federal Navigation Channel. The four dredging actions are summarized below.

- **Enhancement #1 – Coos Bay Inside Range channel and right turn to Coos Bay Range:** To reduce constriction to vessel passage at the inbound entrance to Coos Bay Inside Range. Widen channel from the current 300 feet to 450 feet, and lengthen the total corner cutoff on the Coos Bay Range side from the current 850 feet to about 1,400 feet.
- **Enhancement #2 – Turn from Coos Bay Range to Empire Range channels:** Widen the turn area from the Coos Bay Range to the Empire Range from current 400 feet to 600 feet and lengthen the total corner cutoff area from the current 1,000 feet to about 3,500 feet.
- **Enhancement #3 – Turn from the Empire Range to Lower Jarvis Range channels:** Add a corner cut on the west side in this area that would be about 1,150 feet wide to provide additional room for vessels to make this turn.
- **Enhancement #4 – Turn from Lower Jarvis Range to Jarvis Turn Range channels:** Widen turn area from current 500 feet to 600 feet and lengthen total corner cutoff area from the current 1,125 feet to about 1,750 feet, to allow vessels to begin a turn in this area earlier.

In addition, Jordan Cove would install five meteorological ocean data collection buoys to aid navigation within the waterway, by measuring wind speed and direction, current speed and direction, as well as tide height. Jordan Cove intends to replace three existing buoys with the new buoys (one located in the Pacific Ocean near the bay entrance, and one within Coos Bay along the LNG carrier route), and two new buoys located near the access channel.

[5] The proposed modifications to the marine waterway (i.e., dredging at four points along the Federal Navigation Channel) are referred to as “marine waterway modifications” or “navigation channel modifications” in this BA.

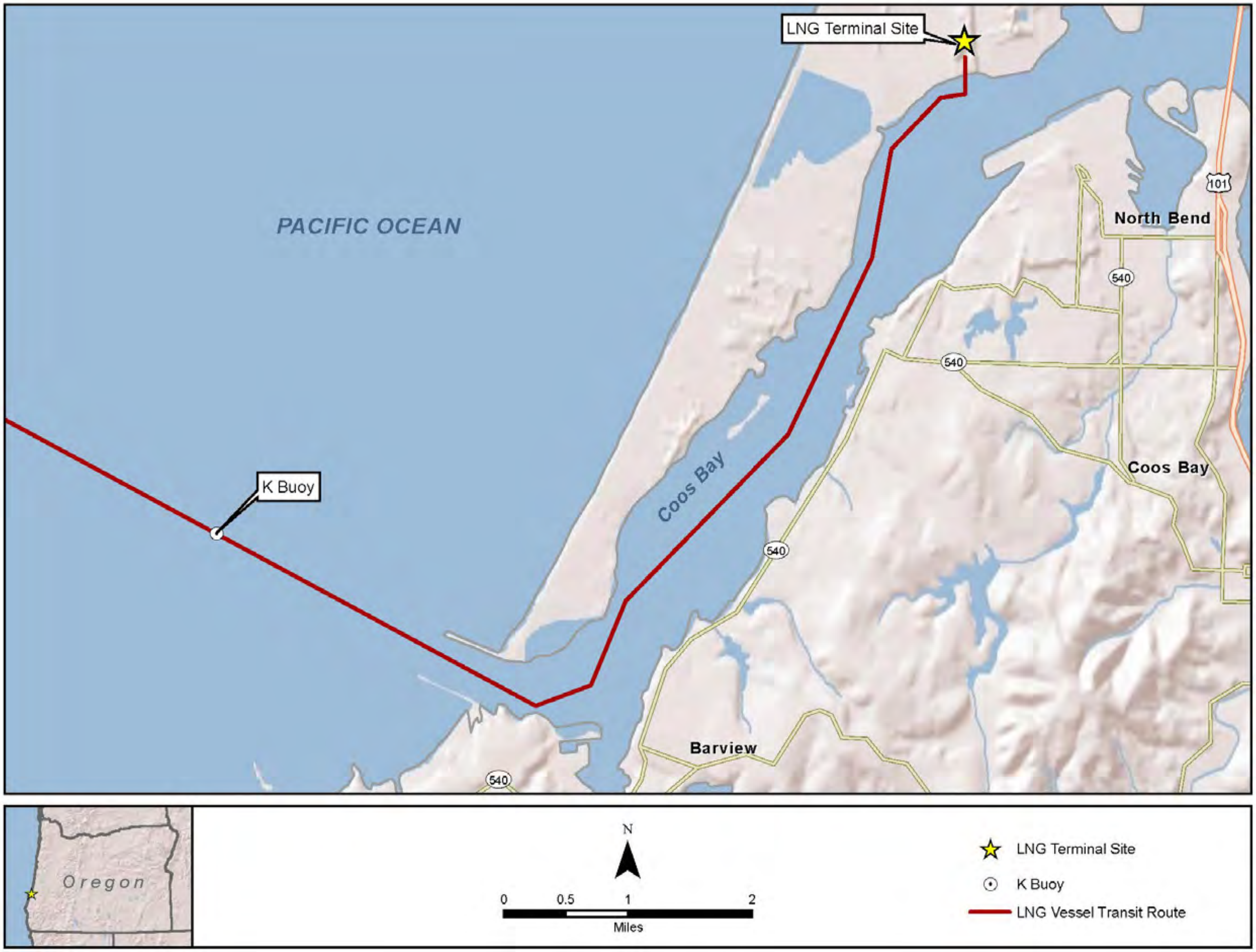

Figure 2.1-5
Proposed LNG Carrier Transit Route

2.1.1.4 Marine Access and Facilities

Access Channel

Jordan Cove would construct an access channel to connect the terminal to the Federal Navigation Channel (figure 2.1-6).[6] The access channel would begin at the confluence between the Jarvis Turn and the Upper Jarvis Range at about navigation channel mile 7.5, and would be about 2,200 feet wide at the navigation channel and about 780 feet wide at the terminal. The distance from the north edge of the navigation channel to the mouth of the terminal would be about 700 feet. The walls of the access channel would be sloped to meet the existing bottom contours at an angle of 3 feet horizontal to one foot vertical (3:1). The access channel would be approximately 45 feet deep and would cover about 22 acres below the highest measured tide elevation of 10.3 feet (North American Vertical Datum of 1988 [NAVD88]).

Terminal Slip

Jordan Cove would construct a marine slip to support vessel operations at the north end of the access channel. This would be a single use slip that would be sized to provide flexibility to safely maneuver an LNG carrier from the access channel into the slip when another LNG carrier is already berthed on the east or west sides. The slip would also be sized to allow for tugs to move a temporarily disabled LNG carrier away from the loading berth on the east side of the slip to the emergency lay berth on the west side of the slip if necessary. The slip would be bounded on the east and west sides by sheet pile walls, creating a vertical face to support mooring structures. The northern side of the slip would be sloped to meet the existing bottom contours at an angle of 3 feet horizontal to one foot vertical (3:1). The minimum water depth within the slip would be -45 feet (NAVD88) in order to maintain at least 10 percent under-keel clearance when the ships are in dock. A berm/tsunami wall would also be constructed between the western edge of the slip and Henderson Marsh to approximate elevation +34.5 feet to increase tsunami resistance (figure 2.1-6).

Material Offloading Facility

The material offloading facility (MOF) would be constructed to receive components of the LNG terminal that are too large or heavy to be delivered by road or rail. The MOF would cover about 3 acres on the southeast side of the slip (see figure 2.1-6). The MOF would be constructed using the same sheet pile wall system as the LNG loading berth to an elevation approximately +13.0 feet (NAVD88). Following construction, the MOF would be retained as a permanent feature of the LNG terminal to support maintenance and replacement of large equipment components.

[6] The access channel and a portion of the marine slip would be within state waters managed by the ODSL. Jordan Cove would construct the access channel and would transfer responsibility for maintenance to the Oregon International Port of Coos Bay (Port) following construction. The Port has already obtained an easement from ODSL for operation and maintenance of the access channel and the in-water portion of the slip. Jordan Cove would reimburse the Port for costs associated with its operation and maintenance of the access channel and slip.

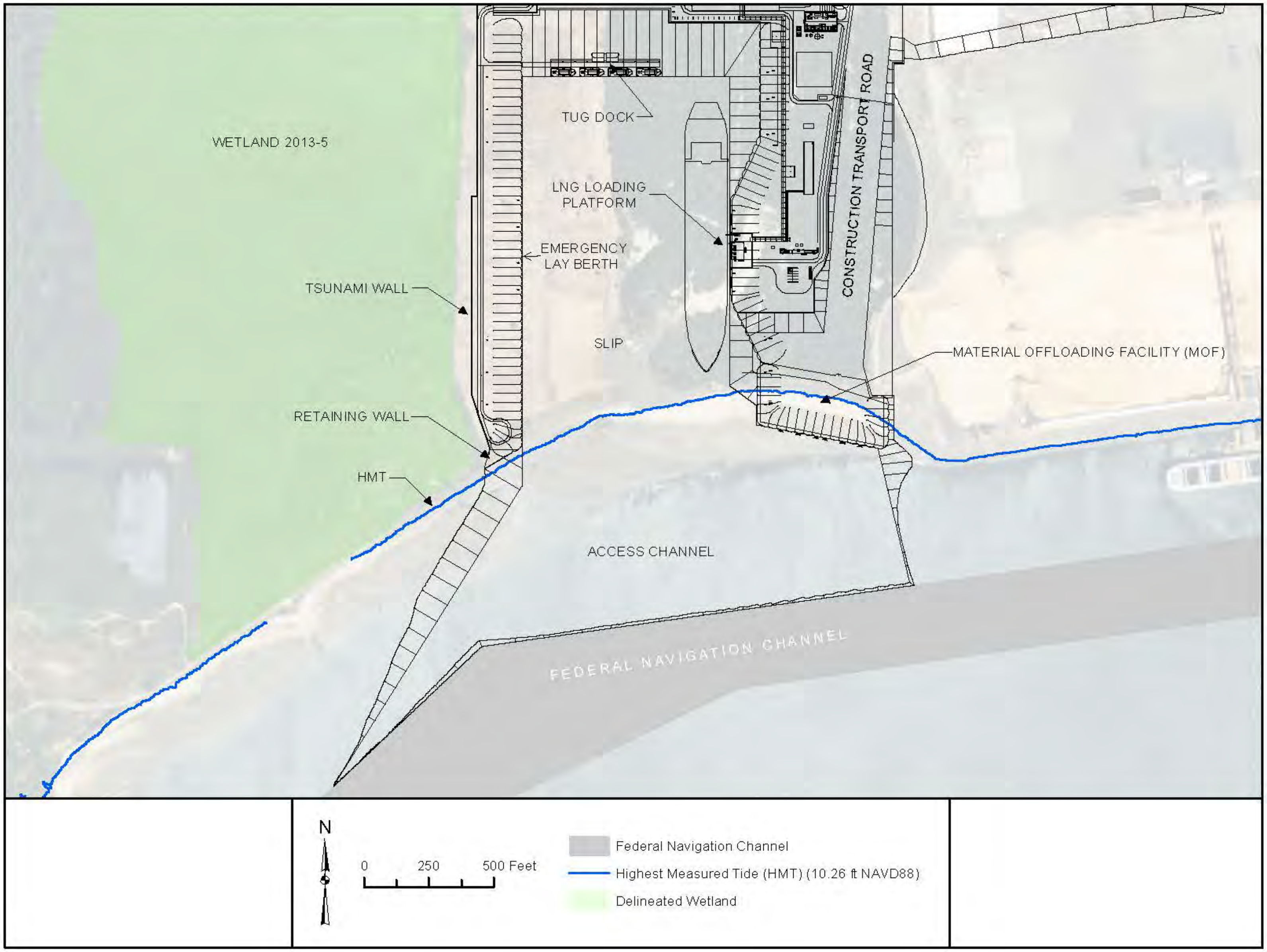

Figure 2.1-6
Plot Plan of the Marine Facilities

LNG Carrier Loading Berth and Product Loading Facility

An LNG carrier loading berth would occupy the eastern side of the slip. A profile of the loading berth is provided in figure 2.1-7. The loading berth would be constructed of steel sheet piles that support surface structures (the loading area) and provide the foundation for the breasting and mooring structures. The berth support wall would extend from the bottom of the slip (elevation approximately -45 feet) to approximate elevation +34.5 feet (NAVD88).[7]

The product loading facility (PLF), or LNG loading platform, would be a pile-supported concrete slab that provides structural support to the marine loading arms, terminal gangway, and other ancillary equipment at the berth. The PLF would be constructed on top of the sheet pile wall at approximate elevation +34.5 feet (NAVD88), with a foundation of reinforced concrete supported by steel pilings.

Emergency Lay Berth

An emergency vessel lay berth on the west side of the slip would be constructed to safely moor a temporarily non-operational LNG carrier (figure 2.1-6). This berthing facility would be supported by the west side sheet pile wall with a top-of-wall elevation of approximately +20 feet (NAVD 88). Support infrastructure would include an access road from the tug berth area, duct bank with cabling for powering the mooring hooks and capstans, and lighting of the ship access area.

Tug and Escort Boat Berth

A berth, also referred to as a tug dock, would be constructed on the north side of the marine slip (figure 2.1-6) to accommodate up to four tugboats, two sheriff's escort boats, and six other visitor boats with similar characteristics as the sheriff's boats. This dock would be about 470 feet long and 18 feet wide and would be precast concrete supported by steel piles. The tug dock would be accessible from land by a pile-founded trestle. Included as part of the dock would be two boat houses. North of the dock would be a tug operator building.

LNG Marine Traffic

Section 2.1.1.6 defines the extent of the marine waterway. For the analysis in this BA and EFH Assessment specific to species covered by the ESA and MSA, as well as in our EIS, we also considered impacts from LNG carrier marine traffic extending out to the edge of the Outer Continental Shelf. Jordan Cove estimated that it would take an LNG carrier between 1.5 hours (at 6 knots) and 2 hours (at 4 knots) to travel through the waterway from Buoy "K" to the terminal (a description of the LNG carriers is provided in section 2.2.1.). An additional 90 minutes would be necessary for the LNG carrier to be turned in the access channel and parked at the terminal berth, with the assistance of tug boats. The entire round-trip transit time for a single LNG carrier to travel from Buoy K through the waterway, turn and dock at the berth, take on a full cargo of LNG, and then exit the terminal slip and travel through the waterway back out to the open ocean past Buoy K would be about 22 hours.

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[7] The slip and berth would be designed to accommodate LNG carriers as large as 217,000 m^3 in capacity.

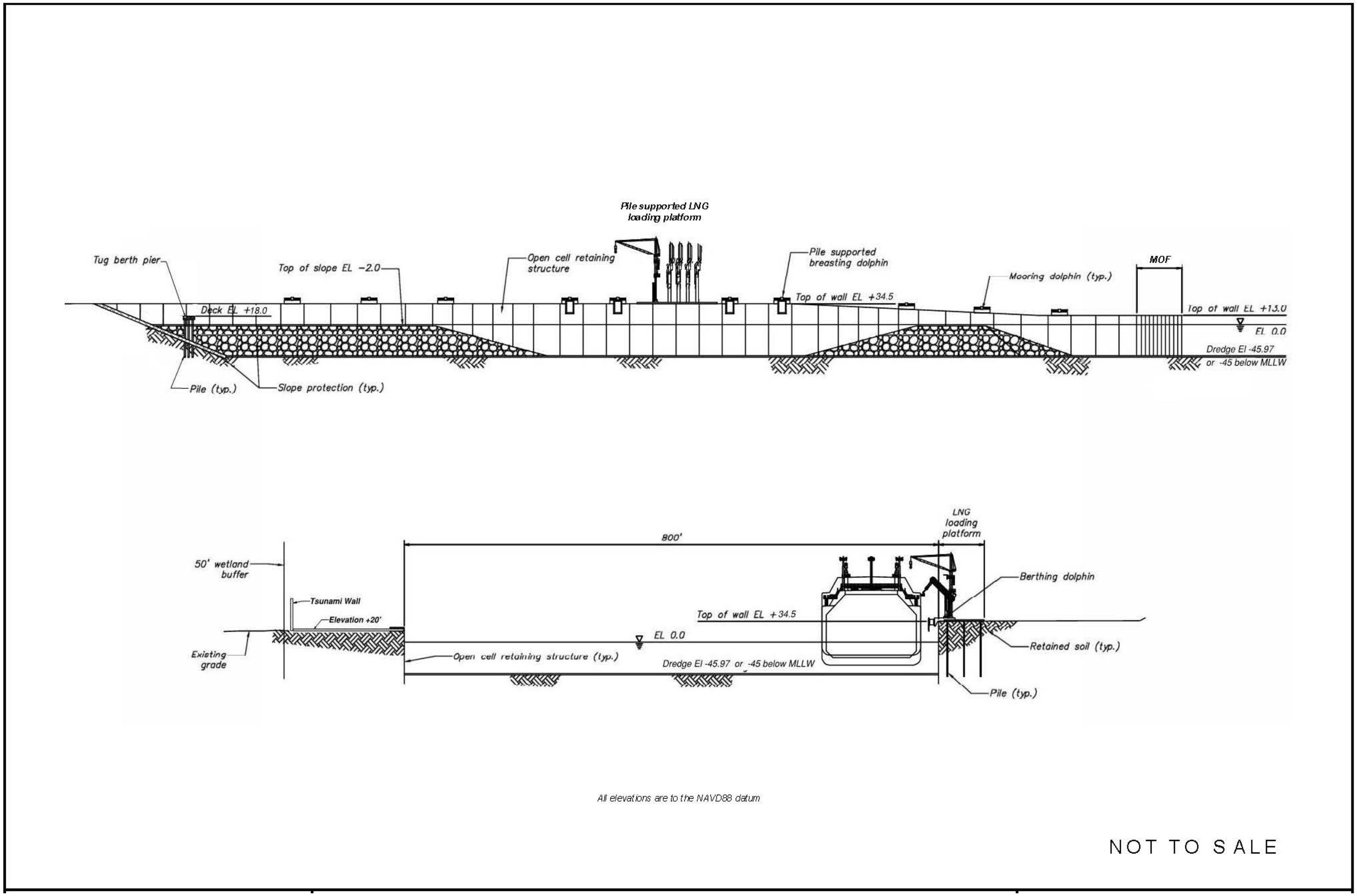


Figure 2.1-7
Profile of Marine Berth

Rock Apron

The COE expressed concern that erosion resulting from the LNG Project's operation could result in impacts on Pile Dike 7.3 (located immediately west of the access channel) as well as the Project's slip. As a result, Jordan Cove would construct a rock apron west of the access channel to arrest slope migration, or equilibration, before it can progress to a condition that could potentially negatively impact Pile Dike 7.3 or the proposed slip. The design involves a 50-foot-wide by 3-foot-thick by approximately 1,100-foot long rock apron set back approximately 20 feet from the top (slope catch point) of the access channel side slope. The size of rock to be used is well graded 6-inch to 22-inch angular stone with a median size of 14 inches. The rock apron design also includes an approximately 100-foot-long extension of the slip's sheetpile bulkhead at the northwest corner of the access channel to minimize slope cut-back at this location. Total required rock volume is approximately 6,500 cubic yards (cy).

2.1.1.5 Dredged and Excavated Material Disposal

Dredging for the Marine Facilities

Dredging for the marine facilities, including the marine waterway modifications, would generate about 6.32 million cubic yards (mcy) of dredged and excavated material (see table 2.1.1-1). Of this, about 3.6 mcy would be dry excavated and then dredged in the fresh water pocket in the slip area and access channel behind an earthen berm that would remain in place to separate work prior to dredging activities in the bay. The remainder of the dredge material would be removed during open water dredging while exposed to the bay and Federal Navigation Channel.

TABLE 2.1.1-1

Materials Excavated and Dredged During Construction of LNG Project Marine Facilities

Area	Construction Phase	Volume (mcy)	Disposal Location
Slip	Excavation and Dredge Behind Berm	3.6	Ingram Yard, Corridor, South Dunes, Roseburg site
Slip	Salt Water Dredge	0.2	Ingram Yard, Corridor, South Dunes, Roseburg site
Protective Berm	Upland Excavation	0.03	Ingram Yard, Corridor, South Dunes
Protective Berm	Salt Water Dredge	0.5	Ingram Yard, Corridor, South Dunes, Kentuck Project
Access Channel	Upland Excavation	0.004	Ingram Yard, Corridor, South Dunes, Roseburg site
Access Channel	Salt Water Dredge	1.4	Ingram Yard, Corridor, South Dunes, Roseburg site
Marine Waterway Modifications	Salt Water Dredge	0.59	APCO Sites 1 and 2
	Total:	**6.32**	

Most of the material excavated and dredged during construction of the marine facilities would be used to raise the elevation of the terminal facilities above the tsunami inundation zone. Ingram Yard, the access and utility corridor, and the South Dunes portions of the site, including temporary use areas (see section 2.1.1.10), would receive material to raise their respective site elevations. Some material would also be deposited at the adjacent Roseburg Forest Products property, and at the Kentuck project mitigation site. Material dredged for the marine waterway modifications would be deposited at APCO Sites 1 and 2.

Dredging for the Marine Waterway Modifications

Approximately 590,000 cy of material would be excavated/dredged to complete the marine waterway modifications. Storage of the dredge material would be distributed between the APCO 1 and APCO 2 upland disposal sites (see figure 2.1-1), or placed entirely at APCO Site 2 if shown to be feasible.

Operational Maintenance Dredging

Jordan Cove proposes to conduct maintenance dredging about every 3 years with about 115,000 cy of material removed per dredging interval for the first 12 years of operation, and after that maintenance dredging could be done about every 5 years with up to 160,000 cy of materials removed during each dredging event.[8] For the marine waterway modification projects within the channel, maintenance dredging would also be conducted about every 3 years with about 27,900 cy of materials removed during each dredging event. Jordan Cove proposes to distribute maintenance dredge material between the upland APCO Sites 1 and 2 (see figure 2.1-3). Jordan Cove would be required to acquire a new permit from the COE if future dredge materials could not be distributed at the upland APCO Sites 1 and 2, due to unforeseen future conditions.

2.1.1.6 Mitigation Areas

Jordan Cove and Pacific Connector have identified several mitigation areas that are directly related to the proposed Project.

Kentuck Project Site

Jordan Cove and Pacific Connector propose to mitigate the loss of wetlands that would result from both the Jordan Cove LNG and Pacific Connector Pipeline Projects through the Kentuck project (i.e., wetland impacts include permanent and temporary impacts and loss of aquatic resource types, functions and values; see section 4.3 of our EIS [FERC 2019]). The Kentuck project would cover about 140 acres on the eastern shore of Coos Bay at the mouth of Kentuck Slough (see figures 2.1-1 and 2.1-3). Formerly, this property was the Kentuck Golf Course, but it is currently owned by Jordan Cove. On August 30, 2016, the Coos County Board of County Commissioners granted Jordan Cove's request for a conditional use permit to allow for mitigation and restoration within this property.

The Kentuck project would also include coho salmon habitat rehabilitation. Construction activities at the Kentuck project include earthwork and civil infrastructure improvements to re-establish a freshwater floodplain reconnection at this former golf course site that more closely approximates conditions at the site prior to the creation of the golf course (see appendix O.1, *Compensatory Wetland Mitigation Plan*).

Kentuck Slough has subsided approximately 2 to 3 feet from its historical profile as a result of diking and drainage; therefore, earthwork activities would include importing of dredge materials from other areas of the LNG Project to raise the subgrade to a profile conducive to establishing appropriate estuarine habitat and some freshwater habitats. Historical drainage patterns would be re-established to the extent practical given the site constraints.

[8] Proposed maintenance dredge frequency and volume is based on a sedimentation study conducted by Jordan Cove and summarized in Moffatt & Nichol (2017a).

Infrastructure improvements would include:

- Constructing a new bridge in East Bay Drive to allow tidal exchange between Kentuck Inlet and the Kentuck project;
- Improving the existing dike separating the site from Kentuck Slough;
- Constructing a new muted tidal regulator (i.e., a "fish-friendly" tidegate) in the upper portion of the Kentuck project to redirect a portion of Kentuck Slough flows into the Kentuck project site;
- Raising the profile of East Bay Drive and approximately 2,100 lineal feet of Golf Course Lane to be above the zone of tidal influence;
- Installing stormwater treatment facilities for new impervious surfaces along East Bay Drive and Golf Course Lane;
- Constructing a fish-friendly culvert or other structure within Golf Course Lane to allow passage into the drainage above the former golf course irrigation sump pond;
- Constructing a temporary unloading facility, including a hydraulic unloader on a deck barge, mooring/fleeting barges, booster pump(s), and a dredge material transport pipeline; and
- Constructing a boardwalk path upland, on the southern boundary of the site.

Jordan Cove has indicated they will continue to coordinate with ODFW and NMFS as the bridge, muted tidal regulator tidegate, and culvert designs progress to review compliance with both agencies' fish passage criteria.

Eelgrass Mitigation Site

Jordan Cove proposes to mitigate for the loss of aquatic vegetation via an eelgrass restoration program in Coos Bay, near the Southwest Oregon Regional Airport in North Bend, including establishing new eelgrass beds (see figures 2.1-1 and 2.1-3). Additional information about wetland impacts and mitigation is presented in section 4.3.3 of our EIS (FERC 2019).

The Eelgrass Mitigation site is approximately 9.3 acres in size and is located approximately 500 feet southeast of the offshore end of the North Bend Municipal Airport runway and about 200 feet off the opposite North Bend shoreline (see appendix O.1 – Compensatory Wetland Mitigation Plan). The area of Coos Bay surrounding the Eelgrass Mitigation site and extending west to the Federal Navigation Channel is composed of lower intertidal mudflat and shallow subtidal habitat(s), including eelgrass beds. Construction of the Eelgrass Mitigation site would involve lowering the bottom grade within an unvegetated sand/mudflat bordered by eelgrass. This elevated area (mound) is currently not supporting eelgrass because of its elevation. Most of this area is currently between elevations +1.0 and +2.5 feet mean lower low water (MLLW; +0.00 and + 1.50 feet NAVD88) and would be lowered to an elevation of approximately -1.5 feet MLLW (-2.5 feet NAVD88).

Upland Wildlife Habitat Mitigation Sites

Jordan Cove developed three upland mitigation sites per recommendations from the ODFW in response to the mitigation policy set forth in Oregon Administrative Rules 635-415-0000 through 0025. The proposed upland habitat mitigation sites include the Panhandle site, the Lagoon site, and the North Bank site. The Panhandle site is approximately 133 acres and is located north of Trans-Pacific Parkway. The Lagoon site is approximately 320 acres and is located adjacent to the meteorological station. The North Bank site is approximately 156 acres and is located on the north bank of the Coquille River adjacent to the Bandon Marsh National Wildlife Refuge (NWR).

Jordan Cove has indicated that the proposed ecological benefit at these sites focuses on improving and preserving current habitat. For example, the proposed ecological benefit at the Lagoon Site would bury overhead powerlines that run from Trans-Pacific Parkway to a small building just behind the foredune, removing potential western snowy plover predatory species perching habitat.

2.1.1.7 Temporary Construction Use Areas

During construction of the LNG terminal, temporary use areas outside of the footprint of the permanent LNG terminal, would be required for equipment and material staging, dredge material disposal and transport, workforce housing, workforce parking, and road improvement. These facilities and their locations are shown on figures 2.1-1 and 2.1-3, and summarized below.

Laydown Yards

Jordan Cove would use several construction laydown areas immediately adjacent to the LNG terminal site, including at the north side of the Ingram Yard, within the Roseburg Forest Products property east of marine terminal facilities, and within the South Dunes portion of the site (figure 2.1-3). Jordan Cove would also use one laydown yard (Boxcar Hill) on the north side of the Trans-Pacific Parkway just north of the South Dunes portion of the site, one laydown yard (Port laydown site) within Port property about 2 miles south of the LNG terminal site, and two laydown yards across Coos Bay on North Point in North Bend (APCO Sites 1 and 2) (figures 2.1-1 and 2.1-3). The laydown yards would be used during construction to house construction offices, workforce lunchrooms, warehousing, equipment maintenance, and laydown of materials after delivery to the site.

Dredge Pipelines

During construction of the marine slip and access channel, a slurry pipeline and return water pipeline would be laid across the Roseburg Forest Products tract to the South Dunes portion of the site. A temporary dredge pipeline would also be laid adjacent to the Federal Navigation Channel (via a floating or submerged pipe) to transport dredge material from the four marine waterway modification sites to the APCO Sites 1 and 2, and a temporary dredge line would be laid between the Federal Navigation Channel and the Kentuck project site to transfer dredge material from marine transport barges to the disposal sites.

Workforce Housing

Jordan Cove proposes to construct a temporary workforce housing facility within the South Dunes portion of the LNG terminal site that could accommodate common facilities and 200 to 700 beds. Parking would be provided on-site, and shuttle buses would be provided to and from local communities to reduce traffic on the road network after working hours. After completion of construction and commissioning activities the entire facility would be decommissioned and removed from the site.

Off-Site Parking

To reduce construction traffic along U.S. Highway 101 (US-101), Jordan Cove would establish a park-and-ride facility at the vacated Myrtlewood RV park near the community of Hauser, north of the US-101 McCullough Bridge (figures 2.1-1 and 2.1-3).[9] Jordan Cove would also provide dedicated buses to and from private RV parks, subject to demand, where those parks could house a large number of construction personnel. After construction of the terminal is completed, the off-site parking lot would be restored to pre-construction condition and use.

2.1.2 Pacific Connector Pipeline and Associated Aboveground Facilities

The 36-inch-diameter, Pacific Connector natural gas pipeline would extend for about 229 miles across Klamath, Jackson, Douglas, and Coos Counties, Oregon and terminate at the proposed LNG export facility in Coos County (figure 2.1-8). The Pipeline would be located adjacent to, but separated from, existing rights-of-way including powerlines, roads, and other pipelines for about 97.7 miles (43 percent).

The Pipeline would have a design capacity of 1.2 billion cubic feet per day of natural gas, with a maximum allowable operating pressure (MAOP) of 1,600 pounds per square inch gauge (psig).[10] The Pipeline (and aboveground facilities) would be designed, constructed, tested, operated, and maintained to conform with USDOT requirements found in 49 CFR Part 192, *Transportation of Natural and Other Gas by Pipeline: Minimum Safety Standards*; the FERC requirements at 18 CFR 380.15, *Site and Maintenance Requirements*; and other applicable federal and state regulations. The location of the Pipeline Project facilities is shown on detailed maps included in appendix C of our EIS (FERC 2019), and described below.

[9] Jordan Cove has indicated that they are working with local developers to identify a second park-and-ride that would be used for the Project. However, at this time the only park-and-ride that has been identified and filed with the FERC is the Myrtlewood RV park-and-ride.

Jordan Cove Meter Station at MP 0.00
Harness Mtn. Comm Tower
Blue Ridge Comm Tower
Signal Tree Comm Tower
Sheep Hill MW
Starveout Creek Comm Tower
Flounce Rock Comm Tower
Robinson Butte Comm Tower
USBR Klamath Basin Project
Stukel Mtn. Comm Tower
Klamath Compressor Station, Klamath-Eagle Meter Station, and Klamath-Beaver Meter Station at MP 228.81
Deschutes National Forest
Willamette National Forest
Winema National Forest
Umpqua National Forest
Roseburg BLM District
Coos Bay BLM District
Rogue River National Forest
Medford BLM District
Siskiyou National Forest
Lakeview BLM District
Figure 2.1-8
General Location
Mileposts
Proposed PCGP Route
USBR Klamath Basin Project
BLM District Boundaries
National Forest Boundaries
Federal Lands
BLM
USFS
N
0 4 8 16
Miles

2.1.2.1 Aboveground Pipeline Facilities

New aboveground facilities would include one compressor station, 3 meter stations, 5 pig launcher/receiver assemblies, 17 mainline valves (MLV), and 15 communication towers (table 2.1.2-1).

TABLE 2.1.2-1

Pacific Connector Aboveground Facilities

Facility	MP	Operational Acres a/	County	Ownership/ Jurisdiction
Jordan Cove Meter Station, MLV #1, Pig Receiver, and Communication Tower	0.0	1.7	Coos	Private
MLV #2 (Boone Creek Road)	15.1	0.1	Coos	Private
MLV #3 (Myrtle Point Stikum Road)	29.5	0.1	Coos	Private
MLV #4 and Communication Tower (Deep Creek Spur)	48.6	0.1	Douglas	BLM
MLV #5 (South of Olalla Creek)	59.6	0.1	Douglas	Private
MLV #6 and Launcher/Receiver (Myrtle Creek)	71.5	0.5	Douglas	Private
MLV #7 (Pack Saddle Road)	80.0	0.1	Douglas	BLM
MLV #8 (Highway 227)	94.7	0.1	Douglas	Private
MLV #9 (BLM Road 33-2-12)	113.7	0.1	Jackson	Private
MLV #10 and Communication Tower (Shady Cove)	122.2	0.1	Jackson	Private
MLV #11, Communication Tower, and Launcher/Receiver (Butte Falls)	132.5	0.3	Jackson	Private
MLV #12 (Heppsie Mountain Quarry Spur)	150.7	0.1	Jackson	BLM
MLV #13 (Clover Creek Road)	169.5	0.1	Klamath	Private
MLV #14 and Launcher/Receiver (Keno)	187.4	0.4	Klamath	Private
MLV #15 and Communication Tower	196.5	0.1	Klamath	Private
MLV #16 and Communication Tower	211.6	0.1	Klamath	Private
Klamath Compressor Station, Klamath-Beaver and Klamath-Eagle Meter Stations, MLV #17, Pig Launcher, and Communications Tower	228.8	21.4	Klamath	Private
Blue Ridge Communication Tower	Approx. 20	0.2	Coos	BLM
Signal Tree Communication Tower	Approx. 45	0.2	Coos	BLM
Sheep Hill Communication Tower	Approx. 70	0.2	Douglas	Private
Harness Mountain Communication Tower	Approx. 75	0.0	Douglas	Private
Starveout Communication Tower	Approx. 115	0.2	Douglas	Private
Flounce Rock Communication Tower	Approx. 123	0.2	Jackson	BLM
Robinson Butte Communication Tower	Approx. 159	0.2	Jackson	Forest Service
Stukel Mountain Communication Tower b/	Approx. 209	0.2	Klamath	BLM

a/ Values are rounded to the nearest tenth of an acre.
b/ Assumes that existing BLM communication Site Plan is sufficient. If not, supplemental environmental compliance may be required.

Meter Stations

The Jordan Cove Meter Station would be located within the South Dunes portion of the terminal. The meter station would be comprised of one building which would house gas chromatographs, moister analyzer, communication equipment, and flow computer. The Klamath-Beaver and the Klamath-Eagle Meter Stations would be co-located within the fenced boundaries of the Klamath Compressor Station at about MP 228.8. The Klamath-Beaver Meter Station would include an interconnection with the existing GTN pipeline system; while the Klamath-Eagle Meter Station would serve as the interconnect with the existing Ruby pipeline system.

Klamath Compressor Station

The Klamath Compressor Station would be located approximately 1.8 miles northeast of the town of Malin, at the eastern terminus of the Pipeline Project, and would be accessible from Malin Loop and Morelock Roads. The station would include the Klamath-Eagle and Klamath-Beaver Meter

Stations and would be located adjacent to the existing GTN Malin/Tuscarora Gas Transmission Company (Tuscarora) Meter Station and the Ruby Turquoise Flats facility. There would also be a small office in one of the buildings and the station would contain aboveground pig launcher/receiver equipment, an MLV, and a 140-foot-high communication tower. The compressor station would be secured by a 7-foot-high chain-link fence.

The Klamath Compressor Station would be utilized as a maintenance base for operation of the Pipeline facilities. The station would not be manned 24 hours per day, but would have emergency pipe, spare parts, and equipment and tools stored on site.

Mainline Block Valves

Pacific Connector would install 17 MLVs along its Pipeline in compliance with USDOT requirements (CFR 192.179) (see table 2.1.2-1). The MLVs would be within the construction and operational right-of-way for the Pipeline, except for the MLVs at meter stations, the compressor station, and that include pig launchers and receivers. Five of the MLVs would be automated to allow remote operation, which would require a 40-foot communication tower to be installed within the facility's fenced footprint.

Pig Launchers/Receivers

Pig launchers and receivers would allow Pacific Connector to maintain the interior of its Pipeline using remotely operated pipe inspection and cleaning tools (known as "pigs"). A pig launcher would be located within the proposed Klamath Compressor Station, and a pig receiver would be installed at the proposed Jordan Cove Meter Station. There would also be pig launcher and receivers at MLVs #6, #11, and #14. The pig launcher and receiver facilities would be fenced at all locations.

Gas Control Communications

The meter stations and compressor station would require a communications link with the gas control monitoring system. New radio towers are proposed at the Jordan Cove Meter Station, the Klamath Falls Compressor Station, and at five MLVs. Pacific Connector has conducted initial communications studies and determined that leased space on eight existing communication towers would also be needed for gas control communications (see table 2.1.2-2 and figure 1.1-1). For the five locations on federal lands, Pacific Connector prepared a *Communication Facilities Plan* (dated January 2013) as part of its Plan of Development (POD; appendix B to this BA).

TABLE 2.1.2-2

Proposed and Existing Gas Control Communication Towers

Facility	County	Landowner	Tower Height (feet)	Operational Acres a/
Proposed New Towers Within Proposed Aboveground Facility Sites				
Jordan Cove Meter Station b/	Coos	Private (Pacific Connector)	140	1.7 c/
MLV #4	Douglas	BLM	40	0.1
MLV #10	Jackson	Private	40	0.1
MLV #11, Launcher/Receiver (Butte Falls)	Jackson	Private	40	0.3
MLV #15 (Klamath River)	Klamath	Private	40	0.1
MLV #16 (Hill Road)	Klamath	Private	40	0.1
Klamath Compressor Station	Klamath	Private (Pacific Connector)	140	17
Existing Communication Tower Sites d/				
Blue Ridge	Coos	BLM (Coos District)	170	0.2
Signal Tree (Kenyon Mt.)	Coos	BLM (Coos District)	120	0.2
Sheep Hill	Douglas	Private	125	0.2
Harness Mountain e/	Douglas	Private (Northwest Pipeline)	150	0.0
Starveout Communication	Jackson	Private	115	0.2
Flounce Rock	Jackson	BLM (Medford District)	120	0.2
Robinson Butte	Jackson	Forest Service (Rogue River National Forest)	125	0.2
Stukel Mountain	Klamath	BLM (Lakeview District)	100	0.2

a/ Acreages are rounded to the nearest 0.1 acre.
b/ A tower at this site would only be necessary if Pacific Connector is unable to mount an antenna on one of the structures within the LNG terminal site.
c/ The towers at meter or compressor stations and MLVs would be within the fenced operational area of the facilities.
d/ Space would be leased on an existing tower, or a new tower and equipment building installed if lease space is not available. Operational acres column assumes worst case.
e/ Communication equipment would be installed on an existing tower.

2.2 NON-JURISDICTIONAL FACILITIES

Under the NGA, the FERC is required to consider, as part of a decision to authorize jurisdictional facilities, all facilities that are directly related to a proposed project where there is sufficient federal control and responsibility to warrant environmental analysis as part of the National Environmental Policy Act (NEPA) environmental review for the Project. Some proposed projects have associated facilities that do not come under the jurisdiction of the Commission. These “non-jurisdictional” facilities may be integral to the need for the proposed facilities, or they may be merely associated as minor components of the jurisdictional facilities that would be constructed and operated as a result of authorization of the proposed facilities. Non-jurisdictional actions associated with the Project were identified in association with both the LNG facility and the Pipeline, as described below.

2.2.1 LNG Carriers

LNG exported from the Jordan Cove terminal to overseas markets would be transported in vessels specially designed and built for that task (i.e., LNG carriers). Jordan Cove expects that its terminal would be visited by about 100 to 120 LNG carriers per year. These carriers would be loaded with LNG at the terminal and deliver the cargo to customers, most likely around the Pacific Rim. LNG carriers would be under the ownership and control of third parties, not Jordan Cove, and would not be regulated by the FERC. The third-party owners and operators of the LNG carriers would have agreements with Jordan Cove for the transportation of the LNG to designated ports or customers. We do not have any information about the exact carriers that would be used to transport the LNG from the terminal; however, the slip and berth would be designed to accommodate LNG carriers as large as 217,000 cubic meters (m^3) in capacity. Neither do we know the exact destinations for the LNG cargo nor the specific routes across the Pacific Ocean to customers that would be taken by LNG carriers, outside of the waterway within 12 miles of the Oregon Coast.

2.2.2 Southwest Oregon Regional Safety Center

Jordan Cove would construct the SORSC, a non-jurisdictional multi-organizational office complex, in the South Dunes area of the LNG terminal site. The SORSC would house the Jordan Cove Security Center, Coos County Dispatch Center, Coos County Emergency Operations Center, and offices for various businesses and agencies.

2.2.3 Fire Department

Jordan Cove would construct a stand-alone fire department building located in the access and utility corridor adjacent to the fire water tanks. This building would house the Jordan Cove Fire Department chief and staff.

2.2.4 Trans-Pacific Parkway/U.S. 101 Intersection Widening

Jordan Cove would add a turning lane to the Trans-Pacific Parkway (approximately 600 feet in length) to manage traffic entering US-101 from the west, and the addition of an automated traffic control signal. Approximately 1,150 wood piles would be installed along the road as part of this road-widening effort. The general location of the intersection is shown on figures 2.1-1 and 2.1-3.

2.2.5 Utility Connections for the Pipeline Facilities

All of the aboveground Pipeline facilities would require either electrical power and/or telephone service. At the Klamath Compressor Station, electricity would be supplied by Pacific Power, which would require upgrades to an existing substation and distribution line immediately adjacent to the compressor station. New disturbance would be limited to the extension of three-phase distribution onto the compressor station property, and Pacific Connector states that Pacific Power does not anticipate disturbance would be required in new areas outside of the existing road right-of-way or existing Pacific Power right-of-way or fenced facilities. Water would be provided from water wells located on property owned by Pacific Connector, immediately adjacent to the compressor station. Telecommunications would be provided by Cal-Ore, which would require a short tie-in from the existing service available immediately adjacent to the compressor station.

For the Jordan Cove Meter Station, Pacific Power would supply electricity through a connection to an existing powerline located adjacent to the Trans Pacific Lane southwest of Ingram Yard. Telecommunications would be supplied from three existing networks, ORCA Communications, LS Networks, and Frontier Communications, through extensions of fiber optic and cable that would be installed to the SORSC proposed by Jordan Cove.

Pacific Connector has located its automated mainline valve facilities near available electrical power facilities such that only short tie-ins would be required. If it were to become necessary, in lieu of purchased power, thermal power generation equipment would be installed to provide electricity for the minimal power requirement at these sites.

2.3 LAND REQUIREMENTS

2.3.1 Jordan Cove LNG Project

The LNG Project would require the use of about 1,355 acres of land. When complete, the LNG Project would occupy about 197 acres. Jordan Cove owns about 295 acres at the terminal site and would acquire the use of the remaining area (e.g., via easements or lease). Table 2.3.1-1 lists the land requirements for the LNG Project.

TABLE 2.3.1-1

Land Requirements for the LNG Project a/

Facilities	Acres Required During Construction b/	Acres Required During Operation b/
JURISDICTIONAL FACILITIES		
Total for Jurisdictional Facilities	202.6	197.1
NON-JURISDICTIONAL FACILITIES		
Southwest Oregon Regional Safety Center	5.4	5.4
Fire Department	0.8	0.8
Total for Non-Jurisdictional Facilities	**6.2**	**6.2**
TEMPORARY CONSTRUCTION AREAS		
Total for Temporary Construction Areas	**368.1**	**0**
MITIGATION SITES		
Eelgrass Mitigation Area and Dredge Line	33.4	0
Kentuck Project and Dredge Line	135.6	0
Panhandle Site	132.6	0
Lagoon Site	320.3	0
North Bank Site	156.1	0
Total for Mitigation Sites	**778.0**	**0.0**
GRAND TOTAL	**1,355.1**	**203.3**

a/ This table lists the acres of land that would be encompassed by Project components or mitigation areas, but may not directly relate to areas that would experience direct effects (e.g., the entire footprint of each of the mitigation areas may not experience direct effects such as clearing, but are included in this table to disclose the scope of the projects footprint). See chapter 4 for the acres of land and resources that would be affected by the Project.

b/ Columns may not sum correctly due to rounding.

2.3.2 Pacific Connector Pipeline and Associated Aboveground Facilities

Constructing and operating the Pipeline Project would require the use of about 4,946 acres of land, and about 1,403 acres of land, respectively. Table 2.3.2-1 lists the land requirements for the Pipeline Project.

TABLE 2.3.2-1

Land Requirements for the Pipeline Project a/

Project Component	Land Required During Construction (acres) b/	Land Required During Operation (acres) b/
Pipeline Right-of-Way	2,582.0	1,373.7 c/
Temporary Extra Work Areas	922.6 d/	0
Uncleared Storage Areas	676.4	0
Rock Source & Disposal Sites e/	41.2 e/	0
Contractor and Pipe Storage Yards	674.2	0
Access Roads	28.5 f/	2.2
Aboveground Facilities	21.4 g/	27.0 g/
Totals	**4,946.4**	**1,402.9**

a/ This table lists the acres of land that would be encompassed by Project components or designations (e.g., permanent easements), but may not directly relate to areas that would experience direct effects (e.g., the entire permanent easement would not be cleared during operation). See chapter 4 for the acres of land and resources that would be affected by the Project.

b/ Columns may not sum correctly due to rounding.

c/ 50-foot-wide permanent Pipeline easement (on federal lands, 30-year maintenance corridor).

d/ Includes TEWAs, existing quarries, rock sources, and disposal areas that may be used as permanent storage areas. These areas would not be used during operation of the Project, and therefore are not included in the operational total.

e/ Includes rock source and disposal sites that would remain disturbed following construction but would not be used during operation of the Project and therefore are not included in the operational total.

f/ Road improvements would remain following construction, but these roads would not be used for operation of the Project and therefore are not included in the operational total.

g/ Construction impacts associated with the aboveground facilities are included in the construction land requirement for the Pipeline right-of-way and TEWAs except the potential off-right-of-way communication tower sites and the Klamath Compressor station, which are included here. Portions of aboveground facilities that fall within the permanent Pipeline easement are included under Pipeline Right-of-Way.

2.3.2.1 Pipeline

Construction Right-of-Way

As illustrated in figure 2.3-1, Pacific Connector would generally construct the Pipeline using a 95-foot-wide right-of-way. Pacific Connector would also use, as necessary, TEWAs to accommodate construction across waterbodies, roads, steep terrain, dense forest, and other areas of concern.[11] Where feasible (i.e., where topographic conditions allow) through forested and scrub-shrub wetlands as well as stream crossings, the construction right-of-way would be narrowed to 75 feet in width to minimize impacts on these resources and be consistent with the FERC's *Wetland and Waterbody Construction and Mitigation Procedures* (FERC's *Procedures*; Section VI.A.3). See additional discussion in section 4.3 of our EIS (FERC 2019).

[11] About 42 acres of the TEWAs would be existing quarries, rock sources, or rock disposal areas that would be permanent storage areas for excess rock, and these areas would remain as exposed rock sites following construction.

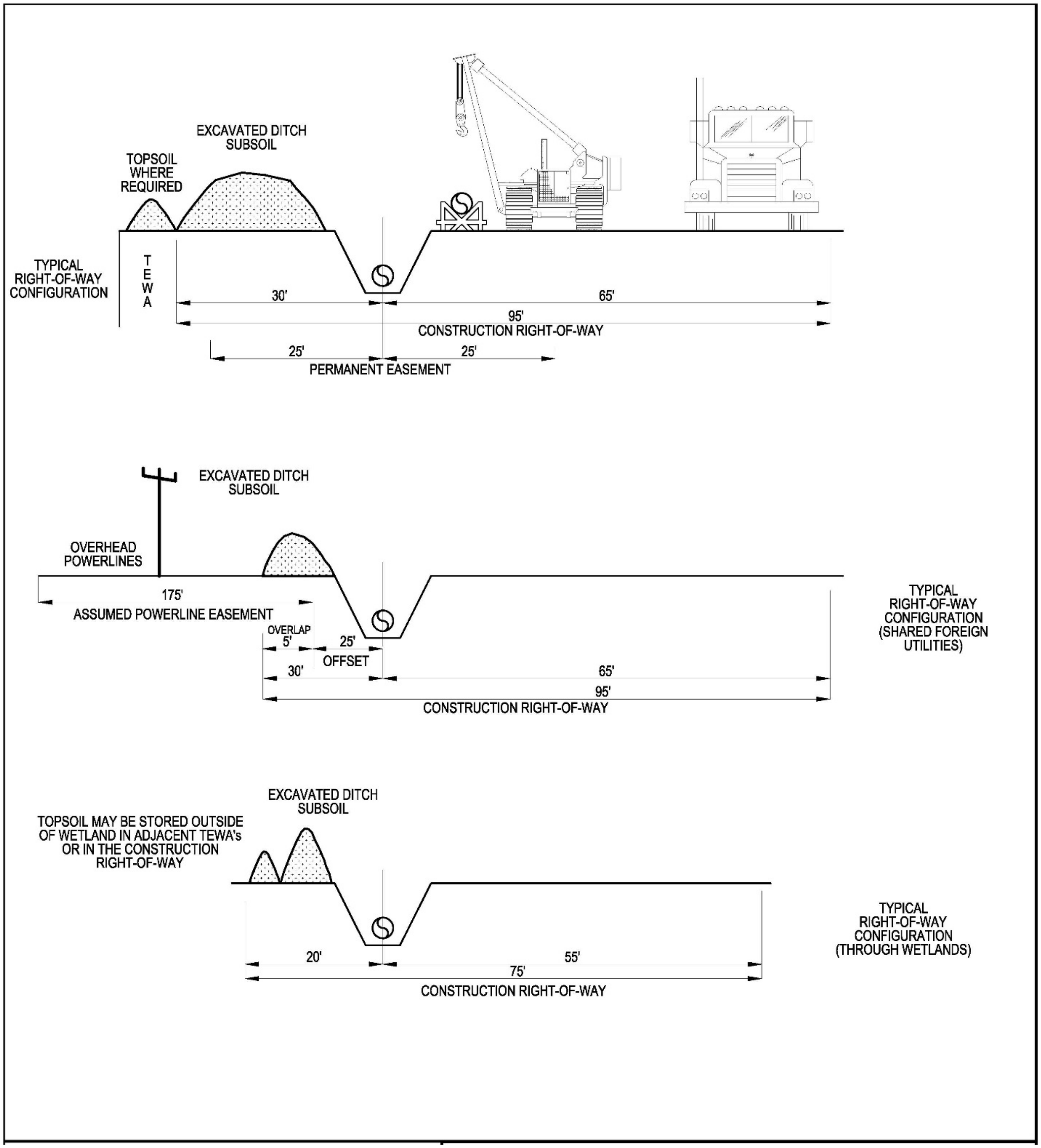


Figure 2.3-1. Typical Pipeline Right-of-Way Cross Sections

Pacific Connector would also use approximately 676 acres of uncleared storage areas (UCSA). UCSAs would not be cleared of trees during construction. UCSAs would be used to store forest slash, stumps, and dead and downed log materials that would be removed from the construction work area before construction and then scattered back across the right-of-way after construction.

In some locations, the UCSAs may be used to store spoil or to temporarily park equipment between the mature trees. However, storage and temporary parking of equipment/vehicles would not occur immediately adjacent to any trees so as to minimize tree damage. In extremely steep and side sloping topography, the UCSAs may be required as a contingency location to contain rock which rolls beyond the construction limits. Along extremely steep and narrow ridgeline areas, logs, slash, and dead and downed material may be used as cribbing to contain materials disturbed or excavated during right-of-way grading and trenching activities. During restoration, some of the materials that are pulled out of the cribbing may roll beyond the construction limits. Where feasible, Pacific Connector would retrieve materials that have rolled downhill using cables and chokers attached to standard on-site restoration equipment (i.e., bulldozers and trackhoes) to winch the material back to the right-of-way. There may be some cases where retrieval of the lost cribbing material may cause more harm to resources than allowing it to remain where it settled. On federal lands, Pacific Connector would protect trees within the UCSAs in accordance with the procedures outlined in its *Leave Tree Protection Plan* (Appendix P of its POD [appendix B to this BA]). After construction, the UCSAs would be restored to their pre-construction condition and use.

Operational Pipeline Right-of-Way

Pacific Connector would retain a 50-foot-wide permanent easement for the long-term operation and maintenance of the Pipeline on non-federal lands. On federal lands, an operational right-of-way may be issued for a specific period of use, with potential for extension. After construction, workspace outside of the maintenance easement would be restored to its original condition and use (although mature forest would take many years to be re-established). The restoration and revegetation of the temporary construction right-of-way would be done in accordance with Pacific Connector's *Erosion Control and Revegetation Plan* (ECRP; appendix F to this BA). On NFS and BLM lands where Riparian Reserves would be affected, up to a 100-foot riparian strip or to the edge of the existing riparian vegetation would be replanted adjacent to stream crossings.

Access Roads

Pacific Connector would primarily use existing roads to access Pipeline workspaces. Existing roads that would be used for construction access are listed in table D-2 in appendix D of our EIS (FERC 2019). Pacific Connector has identified 10 locations where it would be necessary to construct new TARs. Pacific Connector has also identified 27 existing roads that would need to be modified to handle construction traffic. The roads would be stabilized using gravel and appropriate best management practices (BMP), as outlined in the ECRP, to minimize potential surface water runoff and to avoid potential sedimentation impacts. Following construction, new TARs would be removed, and the affected areas restored to pre-construction conditions.

Pacific Connector would construct 15 new PARs to access the Pipeline and aboveground facilities. These roads would provide access during construction as well as during operations and maintenance activities. Most of the new PARs would be within Pacific Connector's operational Pipeline easement.

Contractor and Pipe Storage Yards

Pacific Connector has identified 36 potential sites for yards and rail ports that may be used during construction to off-load and store pipe and stage contractor equipment (see table D-9 in appendix D of our EIS [FERC 2019]). These sites are near the Pipeline but generally not immediately adjacent to it.

Pacific Connector has identified approximately 920 acres of TEWAs that would be disturbed during construction of the Pipeline. All of these areas are considered temporary disturbance and would be restored upon completion of construction. All TEWAs that were forested prior to construction would be replanted with trees.

Rock Source and Permanent Disposal Sites

Pacific Connector has identified 20 potential rock source/disposal sites. These sites are indicated on the Mapping Supplement included as appendix C of our EIS (FERC 2019). Of these locations, 15 sites are existing quarries/gravel pits or abandoned quarries/gravel pits. Although some of the existing/abandoned sites appear to have land use types other than quarries/gravel pits, Pacific Connector would not expand these sites beyond the existing or previously disturbed footprints.

Cathodic Protection System

Pacific Connector would protect the Pipeline from corrosion over time through a cathodic protection (CP) system. The CP system would consist of below ground rectifier/anode beds that input a low voltage electrical charge into the Pipeline. These rectifier/anode beds would be spaced about 30 to 40 miles apart and typically installed within previously disturbed areas near the permanent Pipeline right-of-way. Each CP site would use electric power from a local utility. A typical CP site would include installation by a standard backhoe within an area up to 500 feet long by 15 feet wide and 5 feet deep. In limited locations a deep CP site may be required which would be installed by a truck-mounted drill rig. Identification of the CP sites and installation itself would occur about one year after Pipeline installation to allow the trench to stabilize and for collection of post-construction data on electro-conductivity soil potentials, which is required before the system can be designed and installed. Pacific Connector would consult with appropriate federal, state, and local regulatory agencies after Pipeline construction to determine the level of environmental compliance and agency authorizations necessary for the installation and maintenance of the CP system. On federal lands, any ground-disturbing construction and installation work to install the CP system would require separate authorization and environmental review.

2.3.2.2 Aboveground Facilities

Land required for construction and operation of the proposed aboveground facilities is listed in table 2.3.2-1 above. Operation of the aboveground facilities would require about 27 acres outside of the Pipeline operational right-of-way.

2.3.2.3 Pipeline Facilities on Federal Lands

The Pipeline would cross 46.9 miles of federal land managed by the BLM, 30.6 miles managed by the Forest Service, and 0.31 mile managed by Reclamation (see table 2.3.2.3-1). In addition to the permanent and temporary access roads needed for construction listed in the preceding tables, existing federal roads would also be used. It is estimated that approximately 276 miles of BLM roads, 113 miles of Forest Service roads, and 2 miles of Reclamation roads would be utilized for construction activities.[12] All of the requirements for the use of federal roads are included in Appendix Y of the POD (i.e., the *Transportation Management Plan* [TMP]). This POD attachment outlines the requirements for road use permits, maintenance, modification and reconstruction, road decommissioning, culvert/bridge upgrades, new road construction (PARs and TARs), and traffic management. The federal agencies are continuing to coordinate with the applicant in refining the TMP, and road miles may vary as a result.

2.4 CONSTRUCTION PROCEDURES

Jordan Cove and Pacific Connector would construct the Project in accordance with its project-specific *Erosion and Sediment Control Plan* (ESCP), its *Upland Erosion Control, Revegetation, and Maintenance Plan* (Jordan Cove's *Plan*) and its *Wetland and Waterbody Construction and Mitigation Procedures* (Jordan Cove's *Procedures*).[13] Jordan Cove adopted elements of the FERC's *Plan* and *Procedures* (May 2013 versions) into its *Plan* and *Procedures* as applicable for the Project (see appendix E of our EIS [FERC 2019] for modifications). We have reviewed Jordan Cove's *Plan* and *Procedures* and find them to be consistent with the FERC's *Plan* and *Procedures*. In addition, Jordan Cove has prepared Spill Prevention, Containment, and Countermeasures Plans (SPCCP) for both construction and operations.[14]

2.4.1 Jordan Cove LNG Project

2.4.1.1 Upland Site Preparation

Temporary Concrete Batch Plant

One of the first construction procedures that Jordan Cove would undertake is the installation of a temporary concrete batch plant within the LNG Terminal site or within a construction laydown area. The concrete batch plant would support construction of LNG terminal facilities that include concrete. A washout area would be located adjacent to the batch plant to allow for containment and disposal of waste water related to concrete batching operation.

Demolition and Clearing

Site preparation would include demolition, clearing, and removal and relocation of existing infrastructure to enable earthworks to progress. During this initial phase the IWWP and several existing utilities would be relocated. Other demolition and clearing activities would include:

- Removal and disposal of hydrocarbon contaminated soils – The South Dunes portion of the site contains small areas of hydrocarbon-contaminated soils remaining after the decommissioning of the former Weyerhaeuser paper mill. The contamination is located in the vicinity of the proposed site for the permanent buildings. Jordan Cove plans to conduct additional testing to further characterize the area of potentially contaminated soils and

[12] Estimates derived from Table A.8-1 in Resource Report 8 of Pacific Connector's September 2017 application to the FERC.

[13] Jordan Cove's ESCP including its *Plan* and *Procedures* was attached as Appendix H.7 in Resource Report 7 as part of the Environmental Report included with Jordan Cove's September 2017 application to the FERC.

[14] Jordan Cove's construction and operation SPCCPs were included as Appendices F.2 and G.2 of Resource Report 2, respectively, of its September 2017 application filed with the FERC.

would develop a disposal plan for the approval of ODEQ and would remove and dispose of the contaminated soils in accordance with the approved plan.

- Clearing – The dune areas at the LNG terminal site would be cleared and any merchantable timber would be processed for commercial sale. Scrub and stumps would be processed into mulch for use during construction.

2.4.1.2 Material Deliveries

Transportation of materials, supplies, and staff to the LNG terminal site would be accomplished via a combination of road, marine transport, and rail. The larger and heavier pieces of equipment would be delivered to the site by marine transport in two phases. Initial marine deliveries would be via a temporary material barge berth, constructed in the existing shoreline within the footprint of the eventual marine slip. The temporary material barge berth would allow for material deliveries by barge while the permanent MOF is under construction and would be removed when construction of the MOF is completed.

Jordan Cove anticipates that some bulk materials, such as temporary buildings, construction equipment, steel reinforcement, pipe spools, cable drums, and insulation, would be delivered to the site by road. An existing rail line is located adjacent to the LNG terminal site and would be utilized for deliveries as permitted.

2.4.1.3 Earthworks and Soil Improvement

Earthworks would include removal of topsoil and storage for re-use, cut (excavation and dredging), fill (placement of excavated material), and grading of material to the approximate design elevations. The upland earthworks phase would include work by heavy equipment and require some periods of 24-hour operation. Jordan Cove would construct a temporary traffic overpass to allow separation of the traffic traveling to and from the existing Roseburg Forest Products Company from the large, off-road haul trucks and equipment required for the earthworks phase. During this phase boiler ash previously disposed on the site of the LNG terminal would be relocated to the South Dunes portion of the site where it would be buried within the fill.

The soil conditions at the site require improvement before any aboveground facilities can be constructed. These conditions include peat, clay, buried driftwood, and liquefiable soil, which could cause excessive settlement and stability concerns, or issues associated with liquefiable soils should a seismic event occur. Liquefiable soils within the LNG terminal site have been delineated in distinct soil layers from the groundwater table to various depths down to about 30 feet. A peat layer about 2 to 4 feet thick is present in areas of the site generally from just below the groundwater table to about 7 to 15 feet below grade. A layer of clay up to about 2.5 feet thick has been identified in areas of the South Dunes, and there are several areas in the South Dunes portion of the site where accumulations of buried driftwood are estimated to be present.

Jordan Cove plans to conduct additional site investigations to further characterize the existing subsurface conditions at the site and based on results would develop a plan for soil improvement, however potential soil improvements identified by Jordan Cove are listed below.

- Soil Densification Method 1 – Vibro-compaction could be utilized to condition liquefiable soils. This method consists of driving a vibration device into the sand layers to compact the soils.

- Soil Densification Method 2 – Sand compaction piles could be utilized to compact liquefiable soils, depending on the availability of suitable equipment.
- Organic Material Treatment Method 1 – Excavation and removal would be the preferred method to remove larger peat deposits where dewatering of the excavation pits is possible without affecting adjacent wetlands or waterbodies.
- Organic Material Treatment Method 2 – Excavation and removal of peat without dewatering the excavation pits may be attempted in areas with adjacent off-site wetlands and waterbodies.
- Organic Material Treatment Method 3 – Mixing of the mineral surface soils with peat layers may be attempted where excavation is not feasible.

During the operation of the Weyerhaeuser mill, boiler ash was deposited at Ingram Yard. Jordan Cove would dry excavate this boiler ash and relocate it to South Dunes, where it would be buried with the fill.

2.4.1.4 Subsurface Civil Work

Piling

Construction of the LNG terminal and associated marine facilities would require the installation of temporary and permanent piles. Approximately 1,400 temporary piles and 17,800 permanent piles would be installed. Piles would be installed using vibratory hammering methods for the sheet piles (approximately 60 percent of the total piles), vibratory and drilled methods for the pier piles (15 percent of the total piles) and vibratory and impact methods for the pipe piles (25 percent of the total piles). Jordan Cove states that pile driving would be done over two 10-hour shifts per day, 6 days per week (not on Sundays or major holidays) over a 31-month period.

On-site Underground Utilities

Installation of underground utilities and services would be completed early in the site preparation phase to allow completion of site grading for stormwater control, completion of plant roadways, and installation of foundations and aboveground work. Underground work would be closely coordinated with the site preparation earthwork to install as much of the underground facilities as possible while the site is still being brought to grade.

Foundations

Major foundation work for equipment and structures would generally follow the installation of pilings and underground utilities. Typically, shallow isolated or raft foundations would be used for equipment and structures unless the design requires the use of deep foundations. All foundation loads, analysis, design, and construction would be in accordance with statutory and regulatory requirements. Where required, foundations would be evaluated and designed to mitigate the hazards associated with settlement, bearing capacity, overturning, sliding, buoyancy, erosion, and scour. Formwork for foundations would comprise a mix of metal form systems and job-built wooden forms. Rebar required for foundations would be fabricated off-site, delivered, and tied into place on-site. The temporary on-site batch plant would provide concrete as required for poured foundations.

2.4.1.5 Marine Facilities

Construction of the marine facilities would be done in three phases. The first phase would include upland excavation of the slip. The second phase would include excavation and dredging of the slip area above the natural earthen berm maintained in place to separate the freshwater construction activities from Coos Bay. Maintaining the berm would allow year-round work without being in contact with the waters of Coos Bay. The third phase would require work within Coos Bay and would include excavating the access channel (including area around MOF), removal of the berm and excavation/dredging of the berm area, and installation of MOF fender piles. This third phase would occur during periods when fisheries considerations allow in-water work, between October 1 and February 15. The estimated volume of material removed from each phase and component of excavation and dredging for the marine facilities are listed in table 2.1.1-1. Additional details for construction of the marine facility components are described below.

Construction of Sheetpile Walls

The sheetpile system would serve as a retaining wall for the shoreline on the east and west sides of the slip. It would be designed to support the dead loads of the soils and structures, as well as the live loads of the LNG carrier at berth and LNG transfer equipment; it would also be designed to meet the seismic criteria for the facility and water-imposed loads. The sheetpile wall system would include face sheet piles for retaining the soils as well as tail-walls for anchorage of the retaining wall. Sheet piles and tail-walls would be driven from the land during the first phase of marine facilities construction while the slip construction activities are isolated from Coos Bay.

Dry Excavation

The existing natural ground surface is at an elevation of approximately +20 feet NAVD88. The water table across the slip occurs at an elevation of approximately +10 feet NAVD88. Material above an elevation of approximately +10 feet NAVD88 would be removed by conventional earthmoving equipment such as excavators, scrapers, bulldozers, and front-end loaders. Excavated material would be hauled by trucks to upland disposal within the Ingram Yard, Access/Utility Corridor, South Dunes, and Roseburg site. A berm would be maintained as a barrier to the bay during this construction phase. The north slope of the slip would be finished at 2.5 to 1 horizontal to vertical slope. The same slope would be maintained on the slip side of the temporary berm to preserve the integrity of the berm during excavation and dredging. Contouring of the final slip perimeter above +10 feet NAVD88 would be performed during this step.

Slip Dredging

The material removed from the slip area that is at or below the water table would be removed by means of hydraulic dredging using a barge mounted cutter-suction dredge. The dredge would be delivered by ocean-going barge to the site, partially disassembled, and then pulled over the berm into the slip area. A dredge slurry pipeline would connect the dredge to the South Dunes portion of the site, and a decant water return pipeline would return the water to the slip area or purpose-built decant basin. The hydraulic dredge would be capable of dredging to the final slip depth.

The slurry and decant water pipelines would follow the shoreline and then the route of the future access and utility corridor. The pipes would be made of 18- to 20-inch-diameter seamless polypropylene pipe placed on the ground, braced as necessary, and would span any wetlands or waterbodies along the route. At any point along the Pipeline route where the slurry pipeline could rupture, and the contents could potentially enter the waters of Coos Bay, secondary containment would be provided. When the hydraulic transport has been completed, the pipelines would be drained, flushed with clean water, and cut apart only in those areas where any residual material in the pipeline could not potentially be released into the bay, wetlands, or other waterbodies. The pipeline would be removed and taken off-site for reuse, recycling, or disposal in a permitted landfill.

Dredged material that would be disposed of at the Kentuck project site would be transported along the Federal Navigation Channel via marine transport barge and then deposited on the site using a temporary transfer pipeline. The materials would be dredged "in the dry" (i.e., the material would be dry when dredged), and then re-liquefied and piped through the transfer pipeline to Kentuck.

Access Channel and Proposed Modifications to the Marine Waterway

The access channel would be dredged using a barge mounted crane with clamshell bucket or hydraulic dredge system. The operation would start at the MOF and progress out to the navigation channel. Jordan Cove anticipates that access channel dredging would occur around the clock in order to complete within the available window for in-water work from October 1 to February 15. The channel dredging would occur during the second available in water work window (with the MOF being constructed during the first available in-water window). Dredged material would be loaded into material barges and the barges would be towed to shore and the material transferred to trucks for placement at Ingram Yard, the access and utility corridor, Roseburg Forest Products property, or the South Dunes portion of the site. Material dredged from the along the Federal Navigation Channel (as part of the proposed marine waterway modification) would be transported to APCO Sites 1 and 2 by temporary dredge pipeline laid adjacent to the Coos Bay navigation channel (via a floating or submerged pipe).

Driving of Piling for Marine Structures

Marine piling for the tug dock would be driven "in-the-dry" by land-based mobile cranes, meaning the piles would be installed prior to or concurrent with the freshwater dredging of the slip and while the berm is still in place separating the slip from Coos Bay. All piles required for the LNG loading foundation, and all mooring and berthing structures for the LNG and emergency berths would be located behind the sheetpile walls and would be driven on dry land.

Connection of Slip to the Channel

After completion of the slip excavation and dredging while working behind the berm, the berm would be removed, and the remaining area of the slip would be dredged. This work would be conducted during the allowed in-water work window of October 1 to February 15. Dredging may be conducted from both the Coos Bay side and the slip side to reduce the duration of the activity. Additional dredging to contour the access channel at the connection of the channel and slip would also be conducted at this time. Material would be removed by hydraulic dredge or clam-shell dredge. A portion of the material may be transported to the Kentuck project to be used as fill, and the remainder would be placed at the South Dunes portion of the site. Armoring of the remaining unarmored slip side slopes would then be completed.

Restoration of Marine Facilities

Following the excavation activities, all areas disturbed by marine facilities construction, including exposed slopes, would be protected from erosion and stabilized with an erosion protection system and/or an approved seed mixture specified for the site. The northern slip face would be armored with rip rap to protect the slope from scour. The dredge slurry and decant water return pipelines would be removed, and any areas that are disturbed by the haul truck or pipelines route that do not become part of the access and utility corridor would be restored to pre-construction condition.

2.4.1.6 LNG Loading Platform and Facilities

The LNG carrier loading facilities would be constructed once the eastern sheet pile wall system is complete. All of the loading facilities would be on the shore side of the slip, with no facilities located in the water of the slip. The platform with the loading arms (inclusive of the loading and vapor return arms) would be constructed on a concrete pad at the edge of the slip. The LNG transfer piping would be located over LNG troughs that would contain any spills and divert the LNG to a containment basin. The LNG carrier loading facilities would be constructed using land-based equipment. Installation of berth piping and equipment, and hookup and commissioning of the loading system and utilities would follow.

2.4.1.7 LNG Storage and Support Facilities

LNG Storage Tank Construction

Construction of the LNG storage tanks would be the most time-consuming element in the development of the LNG terminal. General steps would include installation of the foundations and tank bottom slab, construction of the outer concrete container wall, insertion of the bottom carbon steel vapor liner, construction of the steel dome roof and suspended deck, installation of the 9 percent nickel steel inner tank, installation of the internal tank accessories (pump columns, instrumentation, and piping), installation of external tank accessories, installation of insulation, and installation of LNG pumps. Following a successful inner container hydrotest (see below), the tank would be washed down and cleaned. After installation of the LNG pumps, the tank would be closed and purged with nitrogen to a positive gauge pressure. At this point in the construction process, the tank would be ready for cooldown with LNG.

Support Facilities

Construction of buildings and installation of major mechanical equipment would occur once LNG storage tank construction is underway. Installation of mechanical equipment would be followed by electrical and instrumentation installation. As the construction of the process portion of the LNG terminal progresses, work would commence on the pre-commissioning activities, so that these activities would be completed concurrently with the completion of the LNG storage tanks.

2.4.1.8 Testing

Jordan Cove would conduct testing of the LNG storage tanks in accordance with API 620, while piping would be tested in accordance with the American Society of Mechanical Engineers B31.3. Some of the tests are described below.

Testing of the LNG Storage Tanks

Jordan Cove proposes to use raw water from the existing CBNBWB raw water pipeline for hydrostatic testing of the LNG storage tanks. The inner container of each LNG storage tank would be hydraulically tested by filling the tank with water, and then pressurizing the tank. To minimize water usage, the two tanks would be hydrotested with the same water by transferring the water at the conclusion of the hydrotesting of one tank to the other tank. For both tanks combined, about 60 million gallons would be used during hydrostatic testing. Following testing, the water would be locally discharged, following ODEQ approval, to the stormwater system for infiltration or discharged into the IWWP according to applicable NPDES permit requirements. If the hydrostatic test water is discharged to the IWWP, it has the capacity to handle the anticipated discharge of 2.9 mgd. Jordan Cove would use a pneumatic test on the outer container for each LNG storage tank. The pneumatic test would be completed in accordance with API 620 Section R.7.

Testing of Pipework

Piping within the LNG terminal facility would be tested using hydrostatic or pneumatic methods. In general, cryogenic piping (piping that would transfer LNG) would be pneumatically tested with dry air or nitrogen. Non-cryogenic piping (piping that would transfer natural gas) would be hydrotested using clean water. Water used for testing of pipeworks would be discharged in the same manner as water used for hydrostatic testing of the LNG storage tanks, as described above.

2.4.2 Pacific Connector Pipeline and Associated Aboveground Facilities

Construction of the Pipeline would primarily involve standard cross-country pipeline construction as described in section 2.4.2.1. Special construction techniques would also be used when constructing across wetlands; waterbodies; roads, railroads, and other utilities; agricultural and residential areas; and rugged terrain. These special construction techniques are described in section 2.4.2.2. Construction of the aboveground facilities is discussed in section 2.4.2.3.

Minor alignment shifts or additional temporary workspace may be required prior to and during construction to accommodate currently unforeseeable site-specific constraints related to construction, safety, engineering, landowner, and/or environmental concerns. All such alignment shifts or workspace needs would be subject to review and approval by the FERC and the other permitting agencies prior to construction, as appropriate.

2.4.2.1 General Pipeline Construction Techniques

Figure 2.4-1 shows the typical steps of cross-country pipeline construction, which proceeds in the manner of an outdoor assembly line of specific activities that make a linear construction sequence. Typical steps include survey and staking of the right-of-way, clearing and grading, trenching, pipe stringing and bending, welding and coating pipe, lowering-in pipe and backfilling, hydrostatic testing, right-of-way cleanup, and restoration. Pacific Connector anticipates construction would be divided into eight separate construction spreads, with each spread consisting of all construction activities necessary to construct the Pipeline along that spread, as follows:

- Early Works MPs 0.00-7.34R;
- Spread 1 MPs 7.34R-29.54;
- Spread 2 MPs 29.54-51.58;

- Spread 3 MPs 51.58-71.37;
- Spread 4 MPs 71.37-94.75;
- Spread 5 MPs 94.75-132.52;
- Spread 6 MPs 132.52-162.40; and
- Spread 7 MPs 162.40-228.81.

Surveying and Staking

Prior to the start of construction, the exterior limits of the approved construction right-of-way and boundaries of TEWAs would be civil surveyed and clearly staked and signed. Professional land surveyors licensed in the state of Oregon would perform all work and would hold a valid and current Certified Federal Surveyor certificate for federal land surveying and setting of monuments. All surveys would be performed in accordance with procedures found in the *Manual of Surveying Instructions* (U.S. Department of the Interior 2009), and all applicable state or county statutes, codes and regulations, and specifications of the County Surveyor. Pacific Connector's environmental inspectors (EIs)[15] would verify the limits of the staked right-of-way and TEWAs, and would monitor the stakes throughout construction. Any pre-existing property line or survey monuments that occur within the construction right-of-way would be protected where possible, and if damage occurs during construction, these monuments would be replaced according to state and federal standards. Approved access roads would be signed. Also signed would be sensitive environmental areas that would be off-limits to construction crews.

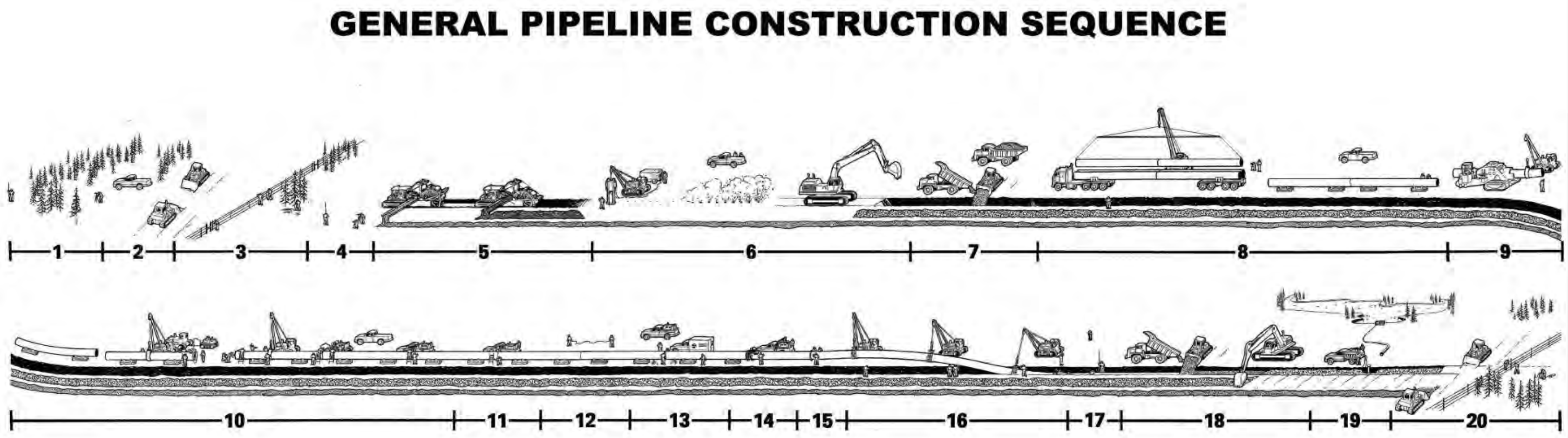
Property line monuments or survey corners on BLM-managed and NFS lands would be reestablished according to federal standards if damaged during construction. Civil surveys on federal lands would adhere to guidelines established by the BLM, Forest Service, and Reclamation. Pacific Connector developed a *Right-of-Way Marking Plan* in consultation with the BLM and Forest Service as part of the POD (see Appendix T to the POD, included as appendix B to this BA). This plan identifies the survey standards and types of survey markings that would be used on federally-managed lands.

Access to the Construction Right-of-Way

Equipment involved in Pipeline construction would be moved onto the right-of-way using approved access roads and would then generally proceed down the right-of-way. The standard 95-foot-wide construction right-of-way would include a travel lane for construction equipment and vehicles. Pacific Connector would place mats over wetlands and bridges over waterbodies along the travel lane, in accordance with its *Plan* and *Procedures*, and install temporary erosion control devices in accordance with its ERCP. Pacific Connector has produced a TMP for federal lands as Appendix Y of its POD (appendix B to this BA) and also a TMP for non-federal lands.[16]

[15] Site individuals who ensure procedures are followed to comply with environmental issues during construction.

[16] Appendix F.8 in Resource Report 8 included as part of Pacific Connector's September 2017 application to the FERC.



1. Right-of-Way Survey
2. Clearing, Erosion Control Installation and Grading
3. Fencing
4. Centerline Survey of Ditch
5. Ditching (Rock-Free)
6. Ditching (Rock)
7. Padding Ditch Bottom
8. Stringing
9. Bending
10. Line Up, Stringer Bead and Hot Pass
11. Fill and Cap Weld
12. As-Built Footage
13. X-Ray and Weld Repair
14. Coating Field and Factory Welds
15. Inspection (Jeeping) and Repair of Coatings
16. Lowering and Tie-Ins
17. As-Built Survey
18. Pad and Backfill
19. Test and Final Tie-In
20. Replace Topsoil, Clean-Up and Revegetation

Figure 2.4-1

Typical Pipeline Construction Sequence

Clearing and Grading

The construction right-of-way and TEWAs would be cleared of brush and trees. Pacific Connector has produced a *Right-of-Way Clearing Plan for Federal Lands* as Appendix U of its POD (appendix B to this BA). The general clearing procedures outlined in that plan would also apply to non-federal lands. During clearing, existing fences crossed by the Pipeline would be cut and braced, and temporary gates installed to control livestock and limit public access to the right-of-way. Temporary erosion control devices would be installed at the end of clearing activities.

Hayfields, pastures, and grassy areas would not be cleared except in areas directly over the trench or where grading would be required to create a level working surface. Tall shrubs, such as sagebrush, would be mowed or scalped off with a motor-grader or a bulldozer. Cleared grasses and brush would be stockpiled along the edge of the right-of-way or within TEWAs or UCSAs, then mulched and spread back over disturbed areas during final cleanup and restoration.

In forested areas, timber would be cut and cleared from the right-of-way and TEWAs. Clearing would follow seasonal timing restrictions as discussed in section 4.5 of our EIS (FERC 2019). Merchantable timber would be removed and/or sold according to landowner stipulations. In general, ground-based skidding and cable (where feasible) logging methods would likely be the standard method; however, in some isolated rugged topographic areas with poor access, helicopter logging may be used. See additional discussion in section 4.4 of our EIS (FERC 2019).

Following clearing, the right-of-way would be graded where necessary to create a reasonably level working surface to allow safe passage and operation of construction equipment. During grading, topsoil would be separated from subsoils in certain areas, and each would be stored in segregated piles within the construction right-of-way and TEWAs. Where topsoil would be segregated on non-federal lands,[17] Pacific Connector has requested 10 additional feet of TEWA for topsoil storage in addition to its nominal 95-foot-wide construction right-of-way in uplands. On BLM-managed and Forest Service lands, Pacific Connector would segregate topsoil in all wetlands according to its *Procedures*. Pacific Connector may segregate topsoil in other areas as determined from the results of biological surveys for federal Survey and Manage species and Region 6 sensitive species including moss, lichen and fungi. Where these species are identified within the construction right-of-way, Pacific Connector would consult with the BLM and Forest Service to determine if topsoil segregation in these areas is a feasible and appropriate mitigation or management measure to minimize impacts on these species.

Trenching

A rotary trenching machine, rock trencher, track-mounted backhoe, or similar equipment would be used to excavate a trench for the Pipeline. Spoil excavated during trenching would be temporarily stockpiled to one side of the right-of-way adjacent to the trench. The depth of the trench would vary according to site-specific conditions and USDOT requirements in 49 CFR 192.327, which specifies that the minimum depth of cover must be:

- 30 inches in normal soil and 18 inches in consolidated (solid) rock for Class 1 locations; and

[17] For example, topsoil salvaging would occur in areas occupied by Applegate's milkvetch, Kincaid's lupine, and Gentner's fritillary, per the *Federally-listed Plant Conservation Plan*.

- 36 inches in normal soil and 24 inches in consolidated rock for Class 2, 3, and 4 locations, and under drainage ditches, public roads, and railroad crossings.

Pacific Connector states that it would strive to exceed USDOT depth requirements where possible and bury its Pipeline up to 36 inches deep in Class 1 areas with normal soils and 24 inches deep in Class 1 areas with consolidated rock. The trench may be deeper at stream crossings with scour concerns based on Pacific Connector's study of channel migration and scour analysis.

In areas where bedrock is found within the Pipeline trench depth, Pacific Connector would first attempt to dig the trench with specialized equipment, such as rock saws, or ripping using hydraulic hammers. If these methods are ineffective, blasting may be necessary to achieve the required trench depth. Pacific Connector has identified a high potential for blasting for about 100 miles of the Pipeline route. All blasting would be done by licensed contractors under the terms of applicable regulatory requirements. Pacific Connector produced a *Blasting Plan* as Appendix C of its POD (appendix B to this BA). Blasting is further discussed in section 4.1 of our EIS (FERC 2019).

Stringing, Bending, and Welding

After trenching, pipe sections would be trucked to the right-of-way and strung along the route, using side-boom tractors to unload the pipe from the flatbed trucks. A hydraulic bending machine would bend some pipe sections to fit the contour of the trench bottom, and in some locations pipe sections would be factory bent, or special pre-fabricated pieces would be used. A separate, trained crew of welders would weld the pipe sections together and place them on wooden skids adjacent to the trench. All welds would be visually inspected, nondestructively tested (using radiographic or equivalent methods), and repaired, if necessary. Line pipe, normally mill-coated prior to stringing, would require field applied coating at the welded joints prior to final inspection and the entire pipeline coating would then be inspected and repaired as needed.

Lowering-in and Backfilling

After welding and coating, the pipe would be lowered into the trench by side-boom tractors and excavators, after first inspecting the trench to ensure it is free of rocks or debris that could damage the pipe or the coating, and after adding padding such as sandbags at the bottom of the trench. To prevent water from the trench from entering wetlands or waterbodies, Pacific Connector would install permanent trench plugs, consisting of sandbags, foam, or bentonite, at the base of slopes adjacent to wetlands and waterbodies. Drain tiles crossed by the Pipeline would be checked, and if damaged, they would be repaired before backfilling. Segregated topsoil, where applicable, would be replaced after backfilling the trench with subsoil. Following backfilling, a small crown of material would be left over the trench line to account for any future soil settling that might occur.

Hydrostatic Testing

After backfilling, the Pipeline would be hydrostatically tested in accordance with USDOT regulations to ensure that is capable of operating at the MAOP. During the test, sections of the Pipeline would be filled with water and pressurized. Should a leak or break occur during testing, the line would be repaired and retested until the specifications are achieved. Pacific Connector produced a *Hydrostatic Test Plan* (see appendix U to this BA), which provides the location of the proposed hydrostatic test water withdrawal locations.

The Pipeline would be tested in approximately 35 sections, each with varying lengths and water volume requirements. Pacific Connector would reuse test water from one section to the next as much as practical and minimize release between test sections (called cascading). The required volume of test water would range between approximately 16 to 60 million gallons depending on how much water would be reused by cascading. Water for hydrostatic testing would be obtained from commercial or municipal sources or from surface water right owners. If water for hydrostatic testing is acquired from surface water sources, Pacific Connector would obtain all necessary appropriations and withdrawal permits prior to construction, including permits through the Oregon Water Resources Department (OWRD). As part of this process, ODEQ and ODFW would review OWRD applications reviewed to evaluate potential impact on water quality and fish and wildlife and their habitats. Pacific Connector would negotiate water appropriations with private owners in the year prior to construction.

Pumps used to withdraw surface water would be screened according to ODFW and NMFS standards to prevent entrainment of aquatic species. In addition, Pacific Connector included BMPs in its *Hydrostatic Test Plan* to avoid the potential spread of aquatic invasive species and pathogens of concern. BMPs were developed in consultation with the BLM, Forest Service, the Center for Lakes and Reservoirs and Aquatic Bioinvasion Research and Policy Institute, and ODEQ.

Following testing, the hydrostatic test water would be released from the Pipeline test sections, potentially at each of the 35 test section breaks, or at fewer sites if cascading of water between test sections is used. Hydrostatic test water would be discharged in upland areas into erosion control devises typically constructed of hale bales and silt fence, in accordance with Pacific Connector's ECRP (appendix F to this BA) and the POD (appendix B to this BA). Water discharged during testing would not be used to fill existing or proposed fire suppression sources (e.g., heli-ponds). Pacific Connector would apply for permission from the ODEQ prior to discharge of hydrostatic test water. Additional discussion of hydrostatic testing discharges can be found in section 4.3 of our EIS (FERC 2019).

Dust Control

Fugitive dust[18] may be created by Pipeline construction activities. To control dust, Pacific Connector would use water trucks to spray the right-of-way. Water for dust control would be obtained from commercial or municipal sources, and all appropriate approvals and/or permits would need to be obtained prior to withdrawal. Pacific Connector produced an *Air, Noise, and Fugitive Dust Control Plan* as Appendix B to its POD (appendix B to this BA). See additional discussion of dust control measures in sections 4.3 and 4.12 of our EIS (FERC 2019).

Cleanup and Permanent Erosion Control

After the Pipeline is installed and the trench is backfilled, Pacific Connector would complete final grading, returning the right-of-way to its approximate original contours or to a stable contour in areas of steep slope. Fences, gates, drainage ditches, culverts, and other structures that may have been temporarily removed or damaged during construction would be permanently repaired, returned to their pre-construction condition, or replaced. All construction debris, including excess rock, would be removed from the right-of-way and placed in authorized disposal locations. On

[18] Fugitive dust consists of small particles of dust suspended in the air, which are an inadvertent by-product of construction or other project-related activities.

federal lands, site-specific crossing restoration plans would be implemented for perennial stream crossings. The right-of-way would be mulched, seeded, and revegetated in accordance with Pacific Connector's ECRP (see appendix F to this BA). Erosion control fabric would be used on streambanks.

Pacific Connector would install permanent erosion control devices consistent with the requirements of Section V.B. of FERC's *Plan* and as described in its ECRP. The permanent erosion control measures include trench breakers, slope breakers, and revegetation to stabilize disturbed areas. Pacific Connector would consult with the BLM, Forest Service, and Reclamation regarding the installation of permanent erosion control structures on federal lands, and with the NRCS regarding such structures on non-federal lands. Table 2.4.2-1 lists specifics from Pacific Connector's ECRP for the installation of slope breakers.

TABLE 2.4.2-1

Permanent Slope Breaker Spacing from Pacific Connector's ECRP a/

Slope	Highly Erosive Granitic Soils b/	Soils with Moderate or Low Potential for Erosion
0 to 5 percent	None required	None required
5 to 15 percent	100 feet	200 to 300 feet
15 to 30 percent	50 to 75 feet	75 to 100 feet
Greater than 30 percent	50 feet	50 feet

a/ Actual spacing would be determined at the time of installation based on site-specific topographic conditions on the right-of-way to ensure proper slope breaker construction and proper drainage to stable off-site areas. On the Umpqua National Forest between about MPs 109 and 110, where the alignment would cross the historic Thomason cinnabar claim group, waterbars would be installed at 50-foot intervals as recommended by the Forest Service.

b/ Granitic formations would be crossed by the Pipeline between: MPs 79.1 to 80.5; MPs 81.6 to 82.2; MPs 87 to 88.8; MPs 97.0 to 101.2; MPs 103.0 to 105.4; and MPs 114.8 to 115.0.

Revegetation

All areas disturbed by construction, including the construction right-of-way, TEWAs, UCSAs, and contractor yards as necessary, would be restored and revegetated in accordance with Pacific Connector's ECRP (see appendix F). A seedbed would be established to a depth of up to four inches where necessary. Consistent with the FERC's *Plan*, if final grading occurs more than 20 days after pipe installation and backfilling, Pacific Connector would apply mulch on all disturbed areas prior to seeding. Based on recommendations provided to Pacific Connector by the Oregon State University Extension Service related to the fertilization rates for nitrogen fertilizer on new pasture seedlings, Pacific Connector would use a standard fertilization rate of 200 pounds per acre bulk triple-16 fertilizer on disturbed areas to be seeded. The Natural Resources Conservation Service (NRCS) did not recommend the addition of lime or other soil pH modifiers. Fertilizer would not be used in wetlands unless required by the land-managing agencies and would not be applied within at least 100 feet of flowing streams that have domestic use or support fisheries and would not be applied during heavy rains or high wind conditions.

It is expected that seeding would be timed to begin in August and could extend into the winter months at lower elevations. Disturbed areas would be seeded within six working days of final grading, weather and soil conditions permitting. Seeding may be done by broadcast methods, drilling, or hydroseeding. Broadcast seeding, using a mechanical broadcaster seeder, is the preferred method of seeding on steep slopes. After broadcast, the seedbed would be lightly dragged by chains or other appropriate harrows to cover the seeds thinly with soil. A drill seeder pulled by a plow may be used as an alternative to broadcast seeding in gently sloping areas. Hydroseeding would be done in accessible upland areas. Seed mixtures were determined in consultations with land-managing agencies and the NRCS. The seed mixtures are listed in Pacific Connector's ECRP (appendix F) and are further discussed in section 4.4 of our EIS (FERC 2019). During right-of-way easement negotiations, private landowners may select their own seed mixtures other than those proposed for elsewhere along the Pipeline route. The seed mixtures on BLM land were developed based on BLM Instruction Memo-2001-014, which specifies the use of native species, if possible. The POD has additional requirements for revegetation on federal lands.

Mulch would be applied on slopes were necessary to stabilize the right-of-way after seeding. Mulch would consist of native wood, certified weed-free straw, or hydromulch. The BLM and Forest Service have established ground cover standards and fuel loading requirements that are further discussed in section 4.4 of our EIS (FERC 2019).

In forested lands, Pacific Connector would replant vegetation according to state and federal reforestation requirements. Reforestation efforts would occur in any given area the first winter/spring (between December and April) after the Pipeline is installed in that area. On all forest lands crossed by the Pipeline, trees would be replanted across the construction right-of-way up to 15 feet from either side of the Pipeline centerline. In riparian areas, shrubs and trees would be replanted across the right-of-way for a width of 25 feet from the waterbody bank. Within Riparian Reserves, Pacific Connector would replant shrubs and trees to within 100 feet of the ordinary high-water mark (OHWM). A list of species to be replanted is included in Pacific Connector's ECRP (appendix F to this BA), and revegetation is further discussed in section 4.4 of our EIS (FERC 2019).

2.4.2.2 Special Pipeline Construction Techniques

Construction in rugged topography; across wetlands and waterbodies; through agricultural, residential, commercial, and industrial areas; at road and railroad crossings; and across existing buried pipelines and other utilities may require special construction techniques. These techniques are described below.

Rugged Topography

The Pipeline Project route would cross several mountain ranges, with steep and rugged topography (e.g., along the Coast Range and foothills between MPs 6.53R to 69.00, as well as between MPs 70 and 127.00). Through those mountains, the Pipeline route would follow ridgelines, where feasible, to minimize the amount of cut and fill, and to avoid steep slopes, geologic hazards, and waterbody crossings, and to reduce erosion potential. In areas of steep slopes, two-tone construction techniques may be necessary, creating two step-wise level surfaces within the construction right-of-way (see Drawing #3430.34-X-0019 in Attachment C of Pacific Connector's ECRP, included with Resource Report 1 filed with Pacific Connector's application to the FERC). In addition, Pacific Connector's *Geological Hazards and Mineral Resources Report* identified geological hazards along the Pipeline route. Site-specific mitigation measures for the crossing of some of these hazards are discussed in more detail in section 4.1 of our EIS (FERC 2019).

During construction through rugged topography, Pacific Connector would consider the following factors:

- Identify adequate work areas to safely construct the Pipeline.
- Provide a safe working grade.
- Utilize appropriate construction techniques for site-specific situations.
- Construct during the dry season as much as possible.
- Install temporary erosion control devices during construction.
- Install trench breakers, as appropriate, on slopes and near waterbody and road crossings.
- Backfill the trench immediately after pipe installation.
- Install permanent erosion controls soon after completing rough grading.
- Revegetate slopes with quick germinating seed mixtures.
- Mulch or install erosion control fabric on slopes, as necessary.
- Monitor and maintain the right-of-way as necessary to ensure stability.

Additionally, Pacific Connector's ECRP outlines procedures for fill on slopes exceeding a gradient of 3H:1V, including fill materials, slope preparation, and fill placement and compaction. The POD includes additional factors that would be considered on federal lands.

Waterbody Crossings

Construction of the Pipeline Project would affect approximately 352 waterbodies.[19] Waterbodies would be crossed in accordance with the FERC's *Procedures* and applicable permits or approvals from other agencies. Pacific Connector filed a *Wetland and Waterbody Crossing Plan* as Appendix BB of its POD (appendix B to this BA). Crossings of perennial streams on NFS lands would be subject to site-specific plans that include construction restoration and monitoring requirements to ensure consistency with the Aquatic Conservation Strategy (ACS), and on BLM lands would be subject to the requirements of the BLM's 2016 Resource Management Plans (RMP). Appendix M lists the waterbodies affected by the Pipeline Project and provides the proposed crossing method for each, the rationale for the proposed method, whether federally listed species are present, the ODFW-recommended in-water work window, and whether an equipment crossing bridge is required.

TEWAs would be located more than 50 feet away from the edge of waterbodies where possible, and Pacific Connector has identified locations where site-specific conditions or other constraints prevent a 50-foot setback (see appendix E of our EIS [FERC 2019]). Hazardous materials, chemicals, fuels, and oils would be stored at least 100 feet from the edge of waterbodies and wetlands (150 feet on federal lands).

Construction equipment would cross waterbodies on temporary bridges. The bridges would be designed to span the entire OHWM of the waterbody, wherever possible. Soil would not be used to stabilize bridges. In order to construct the temporary bridges, waterbody crossings may require one machinery pass through the waterbody without isolation measures in place to construct

[19] This value does not include the wetlands that would be affected by the Project.

temporary equipment bridges. On BLM and NFS lands, all streams, whether wet or dry, would be crossed with (1) a bridge, (2) a temporary culvert, or (3) a low water ford with a rock mat.

All waterbodies would be crossed during the in-water work window recommended by the ODFW, or within an approved in-water work window developed through consultation with the ODFW, NMFS, COE, and FERC. Pacific Connector would attempt to cross intermittent streams and irrigation canals and ditches when they are dry, using standard upland cross-country construction methods. The standard depth of cover would be five feet below channel bottom of intermittent streams and ditches.

Pacific Connector would use the following methods to cross waterbodies with flowing water at the time of construction: diverted open cut, dry open cut, conventional bore, horizontal directional drill (HDD), or Direct Pipe® (DP) technique. These are briefly described below.

Wet Open-Cut Crossing

No wet open-cut crossings are currently proposed for the Pipeline Project. However, an open-cut crossing method may be required if all other crossing methods are attempted and fail. If an open cut crossing method is required, then additional permitting and impact analysis may be required before the applicable agencies could allow the crossing to occur. A wet open-cut crossing method involves excavation of the pipeline trench across the waterbody with a backhoe-type excavator while water is still present in a waterbody. The excavators operate from one or both banks of the waterbody. Spoil excavated from the trench is placed above the OHWM for use as backfill, with the top 12 inches being segregated for use as the top layer of backfill. The pipe segment needs to be weighted, as necessary, to provide negative buoyancy prior to installation. Once the pipe is installed and the trench backfilled, the banks and stream bottom are restored to pre-construction contours and stabilized. However, as indicated above, this crossing method is not currently proposed, and would only be implemented if all other crossing methods (described below) fail, and may require additional analysis and permitting requirements.

Diverted Open Cut Crossing

Pacific Connector would use a diverted open cut for the eastern (second) crossing of the South Umpqua River at about MP 94.7. The river at this location is too wide for a typical dry crossing using either dam and pump or flume methods, and geotechnical studies indicate that subsurface conditions are not suitable for an HDD or conventional boring. At the proposed crossing location, the South Umpqua River channel is sufficiently flat, wide (175 feet bank to bank), and shallow (varying from a few inches to 15 feet deep), with flow slow enough to allow water to be diverted to one side while work is conducted on the opposite bank. Pacific Connector developed a site-specific plan for the eastern crossing of the South Umpqua River at MP 94.7 (see appendix W).

Dry Open Cut

Flume

The flume method would be used to cross streams less than 100 feet across. Water would be directed across the work area through one or more flume pipes. Sandbag and plastic sheeting would be used to support and seal the ends of the flume and to direct stream flow into the flume and over the construction area. Temporary dams at both the upstream (inlet) and downstream (outlet) sections of the flume would contain stream channel disturbance. After fish are salvaged from the confined area between the dams, water would be pumped out, through an upland dewatering structure, to create a dry work area for Pipeline installation. Spoil from trenching would be stored in TEWAs located at least 10 feet away from the stream banks; with piles surrounded by silt fence. In-stream work (trenching, Pipeline installation, and backfilling) would be conducted while the flume is in place, and the flume would be removed immediately after backfilling and bottom recontouring is completed. Details about stream fluming procedures are provided in appendix W.

Dam-and-Pump

The dam-and-pump method is an alternative dry construction technique that can be used to cross small or intermediate width waterbodies that are classified as coldwater fisheries. This method is preferred where the stream bottom is bedrock, and blasting may be necessary during trench excavation. Two temporary in-stream dams would be installed, with sandbags with plastic liner or other structures such as steel plates or water bladders. Stream flow would be diverted around the work area by pumping water through hoses. Intakes would be screened to prevent the entrainment of aquatic species. An energy-dissipation device would be used to prevent scouring of the streambed at the downstream discharge location. The area between the dams would be dewatered, and the trench then excavated. Spoil would be stored in TEWAs located at least 10 feet from the banks; surrounded by silt fence. After Pipeline installation and backfilling, the dams would be removed and stream banks restored and stabilized. Pacific Connector would cross streams using the dam-and-pump method during the ODFW recommended in-water work windows. Details about dam-and-pump procedures are provided in appendix W.

Conventional Bore

Pacific Connector proposes to use conventional bore methods to cross under the Medford Aqueduct at MP 133.4, and all Reclamation water conveyance facilities (canals, laterals, and drains) associated with the Klamath Project. During a standard boring operation, pits are excavated on both ends of the bore, and the pipe fabricated and installed horizontally from one pit to the other beneath the feature being crossed. The walls of the bore pits may be supported by trench boxes or metal sheet piling. If groundwater seeps in to the bore or bore pits, a dewatering system would need to be used.

When crossing irrigation canals associated with Reclamation's Klamath Project, Pacific Connector committed to complying with Reclamation's Engineering and O&M Guidelines for Crossings – Bureau of Reclamation Water Conveyance Facilities (Canals, Pipelines, and Similar Facilities) unless otherwise described in the *Klamath Project Facilities Crossing Plan* (Appendix O of its POD [appendix B of this BA]). All crossings would require Professional Engineer–stamped design drawings approved by Reclamation prior to installation.

Horizontal Directional Drilling

Pacific Connector proposes to use the HDD method to cross under the Coos Bay Estuary (MPs 0.3–1.0 and 1.5–3.0) and three major waterbodies (Coos River at MP 11.1R; Rogue River at MP 122.7; and Klamath River at MP 199.4). This technique involves drilling a pilot hole under the feature being crossed, then enlarging that hole through successive reaming until large enough to install the Pipeline. High pressure drilling fluids, usually consisting of a slurry made of bentonite clay mixed with water, would be jetted under pressure through the inside of the drill pipe to the drill head to advance the hole, and would then flow back to the drill entry point along annular space between the outside of the drill pipe and the drilled hole. Pipe sections long enough to span the entire crossing would be staged and welded along the construction work area on the opposite side of the waterbody, hydrostatically tested, and then pulled through the drilled hole. Upon completion of HDDs, the drilling mud returns would be hauled off-site and disposed of at an approved disposal facility in accordance with all applicable federal and state regulations. The right-of-way between the entry and exit hole of an HDD would generally not need to be cleared or graded, except for the area of the guide wires, and direct impacts on the waterbody and adjacent riparian vegetation would be avoided.

Pacific Connector prepared an HDD Feasibility Analysis (see appendix E). That study showed that the HDD under the Coos Bay Estuary could be completed in two sections with a total length of about 8,970 feet and a maximum depth of about -190 feet; the HDD under the Coos River would be about 1,602 feet long with a maximum depth of -65 feet; the HDD under the Rogue River would be about 3,050 feet long with a maximum depth of -76 feet; and the HDD under the Klamath River would be about 2,309 feet long with a maximum depth of -71 feet. In case of an HDD failure, or the unanticipated release of drilling mud, Pacific Connector prepared a contingency plan (see appendix D).

Direct Pipe Technology

DP technology is a trenchless construction method that can be used to install pipelines underneath rivers or roads without surface impacts. It is a combination of a micro-tunneling process and HDD. DPs are completed using an articulated, steerable micro-tunnel boring machine (MTBM) mounted on the leading end of the pipe or casing. Bentonite slurry is used to increase lubrication and advance the MTBM. The pipeline is pre-fabricated and welded in sections to the back of subsequent sections as the MTBM advances.

Pacific Connector proposes to use DP technology to install its Pipeline under the western crossing of the South Umpqua River at about MP 71.3 and the associated crossings under Interstate 5 (I-5), Dole Road, and the Central Oregon & Pacific Railroad. This DP crossing would be about 1,680 feet long, with a maximum depth of -90 feet. Further details are available in Pacific Connector's I-5/South Umpqua River Direct Pipe Feasibility Evaluation[20] and a separate site-specific crossing plan (see appendix W).

Wetland Crossings

Pacific Connector would construct the Pipeline across wetlands in accordance with the FERC's *Procedures*. The construction right-of-way through wetlands would be limited to a 75-foot width or less, where possible, and TEWAs would be located at least 50 feet away from wetlands, except where topographic constraints prevent this. Grading and stump removal in wetlands would only occur over the trench. Silt fence and straw bales would be installed at the edges of the construction right-of-way through wetlands. Trench plugs would be put in where the Pipeline enters and exits wetlands. In saturated wetlands, Pacific Connector may use low ground weight equipment operating off pre-fabricated wooden mats. Pipe stringing in saturated wetlands may be done next to the trench or in adjacent TEWAs. If the wetland is flooded, Pacific Connector may use "push-pull" or "float" techniques. Pipeline installation through wetlands is further discussed in section 4.3 of our EIS (FERC 2019).

[20] Attached as Appendix J.2 as part of Pacific Connector's 2017 application to the FERC.

Agricultural and Residential Areas

The FERC's *Plan* requires topsoil segregation in all residential areas, cultivated or rotated agricultural lands, pasture, and hayfields, or where requested by landowners. In these areas, topsoil would be stripped and segregated from either the full construction right-of-way, or over the trench line and subsoil storage area. Pacific Connector identified areas, in addition to most wetlands, where it intends to salvage and segregate topsoil along the Pipeline route (see table D-4 in appendix D of our EIS [FERC 2019]). Where topsoil segregation is proposed, Pacific Connector has requested 10 feet of TEWA in addition to the 95-foot construction right-of-way to stockpile segregated soils. Agricultural lands are further discussed in section 4.2 of our EIS and residential lands in section 4.7 of our EIS (FERC 2019).

Road, Railroad, and Utility Crossings

The Pipeline Project would include multiple road and railroad crossings. Conventional bores are typically used to cross under railroads, with DP and HDD technology proposed for one crossing each (see table D-2 in appendix D of our EIS [FERC 2019]). Roads would either be bored or open cut. At least five feet of cover would be maintained over Pipeline crossings of paved county, city, and state roads, as well as railroad crossings.

2.4.2.3 Aboveground Facility Construction

Aboveground sites would be cleared and graded as applicable to accommodate the planned facilities. Excavation would be performed as necessary to accommodate the new reinforced concrete foundations for meter and compressor station equipment. The meter and compressor station equipment would be shipped to the site by truck. All components in high-pressure natural gas service would be strength tested prior to placing in service. Before being placed in service, all controls and safety equipment and systems would be checked and tested. MLVs would be installed within Pacific Connector's operational easement. The installation of the MLVs would meet the same standards and requirements established for Pipeline construction.

2.5 CONSTRUCTION SCHEDULE AND WORKFORCE

The date for the start of construction would depend on completion of all required environmental and safety reviews and receipt of all necessary permits, approvals, and Commission authorization. Jordan Cove states that construction of the LNG terminal and slip would be expected to take five years. All in-water work for the terminal, including placement of material for the MOF, dredging, and work required to remove the berm separating the slip and the access channel would occur during an in-water work window between October 1 and February 15. Jordan Cove estimates that the construction workforce would average about 1,020 workers with a peak of about 2,000 workers occurring in year 3 of construction.

Pacific Connector states that construction and restoration of the Pipeline and associated facilities would take place over the course of five years. Early works, including the two HDD crossings of Coos Bay, would begin in year one. Some forest clearing along the Pipeline would begin during year 2. Mainline Pipeline and aboveground facility construction would take place during years 3 and 4, with the Pipeline being placed into service by about the middle of year 4. Right-of-way restoration would begin during year 4 and continue into year 5. The total workforce during construction of the Pipeline and associated facilities is estimated to range between about 88 and

4,242 workers, with an average of about 886 workers, with the peak occurring during summer and fall of year 1 of mainline construction (see section 4.9 of our EIS [FERC 2019]).

Figure 2.5-1 provides a general schedule for the Pipeline Project. Timber clearing in areas of NSO and MAMU would be conducted outside the critical breeding seasons (see table 2.5-1). Construction activities are scheduled to take advantage of the drier periods of the year to minimize winter construction, to reduce potential environmental impacts and construction safety risks. Construction across waterbodies would occur within the ODFW-recommended in-stream construction timing windows, although the majority of bridges, where required, would be installed prior to and removed after the in-stream timing window. General timing of activities is shown schematically in figure 2.5-1.

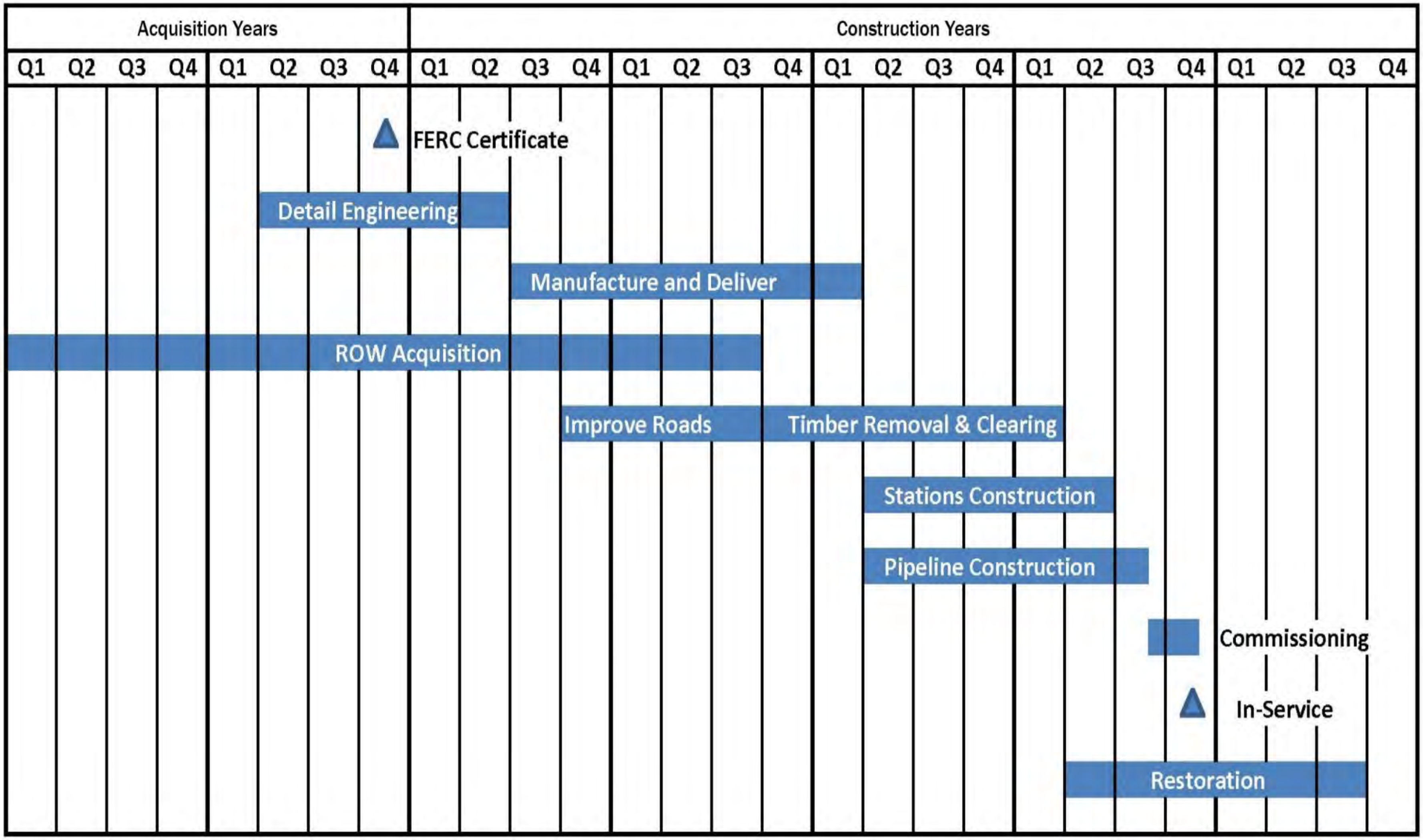


Figure 2.5-1
General Construction Schedule for the Pacific Connector Pipeline Project

TABLE 2.5-1

Summary of Seasonal Timing Restrictions for Migratory Birds, Endangered Species and Raptors Based on Pacific Connector Pipeline Activities

	Seasonal Timing Restrictions for Timber Felling, Logging, Clearing and Construction Activities						
Pipeline Activity	**Migratory Birds (wooded habitat) a/**	**Northern Spotted Owl b/**	**Marbled Murrelet b/**	**Great Grey Owl b/**	**Bald Eagle c/**	**Golden Eagle c/**	**Peregrine Falcon d/**
Felling and Brush Mowing e/	NO WORK Apr 1–Jul 15	NO WORK Mar 1–Sept 30	NO WORK Apr 1–Sep 15 within 300-ft buffer from stand	NO WORK Mar 1–Jul 31	NO WORK Jan 1–Aug 31	NO WORK Jan 1–Aug 31	NO WORK Jan 1–Jul 31
Logging, Skidding and Processing	NO RESTRICTION f/	NO WORK f/ Mar 1–Jul 15	DTR f/, g/ Apr 1–Aug 5; Apr 1–Sep 15 w/ helicopters h/	NO WORK Mar 1–Jul 31	NO WORK Jan 1–Aug 31	NO WORK Jan 1–Aug 31	NO WORK Jan 1–Jul 31
Clearing, Grubbing, and Stump Removal	NO RESTRICTION f/	NO WORK f/ Mar 1–Jul 15	DTR f/, g/ Apr 1–Aug 5	NO WORK Mar 1–Jul 31	NO WORK Jan 1–Aug 31	NO WORK Jan 1–Aug 31	NO WORK Jan 1–Jul 31
Driving Through Restricted Area on Right-of-Way	NO RESTRICTION f/	NO RESTRICTION f/	DTR f/, g/ Apr 1–Aug 5	NO RESTRICTION	NO RESTRICTION	NO RESTRICTION	NO RESTRICTION
Driving Through Restricted Area on Existing Access Road	NO RESTRICTION	NO RESTRICTION	NO RESTRICTION	NO RESTRICTION	NO RESTRICTION	NO RESTRICTION	NO RESTRICTION
Pipeline Construction	NO RESTRICTION f/	NO WORK f/ Mar 1–Jul 15	DTR f/, g/ Apr 1–Aug 5; Apr 1–Sep 15 w/ helicopters [8]	NO WORK Mar 1–Jul 31	NO WORK Jan 1–Aug 31	NO WORK Jan 1–Aug 31	NO WORK Jan 1–Jul 31
Maintenance on Existing Access Roads	NO RESTRICTION f/	NO WORK f/ Mar 1–Jul 15	DTR f/, g/ Apr 1–Aug 5	NO WORK Mar 1–Jul 31	NO WORK Jan 1–Aug 31	NO WORK Jan 1–Aug 31	NO WORK Jan 1–Jul 31
Access Road Improvement and New Road Construction	NO RESTRICTION f/	NO WORK f/ Mar 1–Jul 15	DTR f/, g/ Apr 1–Aug 5	NO WORK Mar 1–Jul 31	NO WORK Jan 1–Aug 31	NO WORK Jan 1–Aug 31	NO WORK Jan 1–Jul 31

a/ Only considers migratory bird "wooded" habitat (meaning all forest regenerating areas [not including recent clear-cuts], deciduous tree groves, shrub/brush thickets, etc.). Note: understory and residual slash in felled timbered areas would not be considered migratory bird habitat.
b/ Applies to areas within 0.25 mile of nest site (northern spotted owl, great gray owl) or marbled murrelet stand (presumed occupied, occupied), unless otherwise noted.
c/ Applies to areas within 0.5 mile of nest site (bald eagle, golden eagle).
d/ Applies to areas within 1.5 miles of peregrine falcon eyrie as delineated by Umpqua National Forest.
e/ Includes all forested areas (not including recent clear-cuts), deciduous tree groves, shrub/brush thickets (i.e., oak).
f/ Applies if trees and brush are previously felled. Otherwise, see restriction for "felling and brush mowing."
g/ DTRs (Daily Timing Restrictions) stipulate no work until two hours after sunrise and work must stop two hours before sunset.
h/ Where large transport helicopter use is necessary to remove logs or supply pipe.

2.6 ENVIRONMENTAL INSPECTION, AND COMPLIANCE MONITORING

2.6.1 Jordan Cove Environmental Inspection Program

During construction, Jordan Cove and Pacific Connector would provide contractors with all Project design documents, including environmental alignment sheets, and copies of all applicable federal, state, and local permits. Jordan Cove would provide environmental training before a contractor or Jordan Cove employee steps out to a work area, and training records would be kept to demonstrate training activities. Numerous individuals, including company Chief Construction Inspectors, would supervise construction activities. EIs would be hired to ensure compliance with approved construction methods and all applicable permit and consultation requirements and conditions.

EIs would have peer status with all other activity inspectors along with the authority to stop activities that violate the environmental conditions of the FERC authorization, other permits, or landowner/land managing agency requirements, and to order appropriate corrective actions. The EIs would also be responsible for advising the chief construction inspector when conditions (such as wet weather) make it advisable to restrict construction activities. EI duties would include maintaining status reports and training records.

The EI's responsibilities would include:

- ensuring compliance with the requirements of the Jordan Cove and Pacific Connector's *Plan* and *Procedures* (including modifications), the environmental conditions of the section 3 and Certificate authorization, the mitigation measures proposed by the applicant (as approved and/or modified by FERC's authorization), other environmental permits and approvals, and environmental requirements in landowner easement agreements;
- verifying that the limits of authorized construction work areas and locations of access roads are properly marked before clearing;
- verifying the location of signs and highly visible flagging marking the boundaries of sensitive resource areas, waterbodies, wetlands, or areas with special requirements along the construction work area;
- identifying erosion/sediment control and soil stabilization needs in all areas;
- ensuring that the location of dewatering structures and slope breakers would not direct water into known cultural resources sites or locations of sensitive species;
- verifying that trench dewatering activities do not result in the deposition of sand, silt, and/or sediment near the point of discharge into a wetland or waterbody. If such deposition is occurring, the dewatering activity would be stopped and the design of the discharge would be changed to prevent reoccurrence;
- identifying, documenting, and overseeing corrective actions, as necessary to bring an activity back into compliance; and
- keeping records of compliance with the environmental conditions of the FERC Certificate, and the mitigation measures proposed by the Project sponsor in the application submitted to the FERC, and other federal or state environmental permits during active construction and restoration.

2.6.2 FERC Environmental Compliance Monitoring

During construction of the Project, third-party Compliance Monitors representing the FERC would be present on a full-time basis to inspect construction procedures and mitigation measures and provide regular feedback on compliance issues to the FERC and Jordan Cove and Pacific Connector's environmental inspection team. Construction progress and environmental compliance would be tracked and documented by the Compliance Monitors. The Compliance Monitors would report directly to a Compliance Manager who would report directly to the FERC Project Manager. Other objectives of the third-party Compliance Monitoring program would be to facilitate the timely resolution of compliance issues in the field; provide continuous information to FERC regarding noncompliance issues and their resolution; and review, process, and track construction-related variance requests. Changes to previously approved mitigation measures, construction procedures, and construction work areas due to unforeseen or unavoidable site conditions would require various levels of regulatory approval, with the delegation of some authority to the third-party Compliance Monitors. FERC would also receive regular construction status reports filed by Jordan Cove and conduct periodic field inspections during construction and restoration of the Project. FERC would have the authority to stop any activity that violates an environmental condition of the FERC authorization issued to Jordan Cove. Other federal, state, and local agencies could also monitor the Project to the extent determined necessary by the agency.

2.6.3 Monitoring by Land Managing Agencies on Federal Lands

Monitoring is an essential element of project implementation (CEQ 2011). If the BLM issues a Temporary Use Permit and a Right-of-Way Grant for the Pacific Connector Pipeline Project, those authorizations would provide the terms and conditions for construction, operation, maintenance, and eventual termination of the facility on federal public lands. As cooperating agencies with jurisdiction by law for activities that occur on lands they administer, the BLM, Forest Service, and Reclamation have a responsibility to monitor implementation of the Pacific Connector Pipeline Project to assure that the terms and conditions of the Right-of-Way Grant are carried out (43 CFR 2885.24). This monitoring would be in addition to the Environmental Compliance Monitoring carried out by third-party Compliance Monitors representing the FERC.

Council on Environmental Quality (CEQ) regulations for NEPA (40 CFR 1505.3) also provide that a monitoring and enforcement program should be adopted as part of the decision to implement the Project. Many of the requirements of the POD that are a part of the BLM Right-of-Way Grant on federal lands are project design measures that reduce the environmental consequences of the Project on-site. The Forest Service has also proposed off-site compensatory mitigation plans (see section 2.8). In addition to monitoring implementation of the Temporary Use Permit and the Right-of-Way Grant, the BLM, Forest Service, and Reclamation also have a responsibility to monitor authorized actions, whether they are project design features described in the POD or off-site mitigation measures included in Forest Service mitigation plans. As needed, agency representatives of the BLM, Forest Service, and Reclamation would participate in the monitoring process to assure that agency priorities are accomplished and agency obligations are fulfilled. Reclamation agency representatives would be on-site during all crossings of Reclamation facilities. Reclamation would require a minimum 48-hour notice for each crossing to ensure that Reclamation agency representatives are able to be on-site during the crossing installations.

Pacific Connector worked closely with the BLM and Forest Service to minimize impacts on federal lands during the Pipeline route selection and construction footprint design process. In developing the POD (included as appendix B to this BA), interdisciplinary teams of the BLM and Forest Service worked with Pacific Connector to implement project design features that would reduce impacts on LSR, Riparian Reserves, soil resources, water quality, recreation, and other resources as described in the POD attachments below. Additional discussion on the steps taken to avoid or reduce impacts on LSR and Riparian Reserves is included in appendix F of our EIS (FERC 2019). The POD developed by Pacific Connector is part of the Right-of-Way Grant application and includes monitoring requirements to ensure that impacts from construction and operation of the Project are minimized and that objectives of the respective land management plans are accomplished. The POD includes 28 attachments, 27 of which were developed in cooperation with the BLM, Forest Service, and Reclamation (the remaining attachment is the Environmental Alignment Sheets for the Project). These attachments are individual plans detailing Pacific Connector's proposed method for construction and operation of the Pipeline on federal lands. A description of the POD is summarized in table 2.6.3-1. Ongoing discussion between the applicant and agencies may result in refinements to the POD. Because the proposed actions specific to federal lands include amendments to LMPs, the regular monitoring and reporting programs of the respective BLM RMPs and Forest Service Land and Resource Management Plans (LRMP) would be used in addition to those identified in the POD.

TABLE 2.6.3-1

Pacific Connector's Plan of Development

Appendix	Appendix Title	Description
A	Aesthetics Management Plan for Federal Lands	The purpose of this Plan is to outline methods that Pacific Connector would implement to ensure compliance with agency land and resource management plans pertaining to visual and aesthetic resources within the Pipeline Project area. This Plan establishes goals for managing visual resources as they relate to construction, reclamation and management of the Pacific Connector Pipeline Project and describes actions to be taken by Pacific Connector to minimize impacts on visual resources.
B	Air, Noise and Fugitive Dust Control Plan	This Plan describes the practices that would be implemented during construction of the Pacific Connector Pipeline Project to minimize or control the potential impacts on air quality or the impacts caused by noise or fugitive dust on federal lands crossed by the Pipeline Project. The minimization and control measures described in this plan are also important to protecting the safety of construction workers, visiting agency personnel, and the general public that may use the public roads during the construction activities or reside near the construction right-of-way.
C	Blasting Plan	The purpose of this Blasting Plan is to provide guidelines for the safe use and storage of blasting materials proposed for use during construction of the Pacific Connector Pipeline Project. This Blasting Plan is intended to help ensure the safety of construction personnel, the public, nearby facilities and sensitive resources.
D	Communication Facilities Plan	The purpose of this plan is to describe the construction, modification, operation and maintenance of communication facilities necessary for the operation of the Pacific Connector Pipeline Project on federal lands managed by the BLM and the Forest Service. The communication facilities are necessary to enable communications between facilities constructed in conjunction with the Pipeline Project and the Pacific Connector gas control center.
E	Contaminated Substances Discovery Plan	The purpose of the Contaminated Substances Discovery Plan is to outline practices to protect human health and worker safety and to prevent further contamination in the event of an unanticipated discovery of contaminated soil, water, or groundwater during construction of the Pacific Connector Pipeline Project.

TABLE 2.6.3-1 (continued)		
Pacific Connector's Plan of Development		
Appendix	**Appendix Title**	**Description**
F	Corrosion Control Plan	Pacific Connector would implement methods to protect the Pipeline system from external, internal, and atmospheric corrosion in accordance with USDOT 49 CFR 192. Corrosion Control is critical to public safety and the safe/reliable operation of the Pipeline. This plan will illustrate methods used to identify the corrosion control needs for the Pipeline Project, as well as methods to provide the required protection and mitigation.
G	Environmental Briefings Plan	The purpose of this Plan is to outline the environmental reporting procedures, briefings, or notifications that Pacific Connector would provide to the federal land-managing agencies prior to construction, during construction, post construction, and during operations of the Pacific Connector Pipeline. Detailed compliance management documents would be developed based on the conditions in the permits/authorizations issued for the project and would be provided to the federal land-managing agencies prior to construction.
H	Emergency Response Plan	The purpose of this Emergency Response Plan is to identify the standards and criteria that Pacific Connector would follow to minimize the hazards during Pipeline operation resulting from a gas pipeline emergency in accordance with the Pipeline and Hazardous Materials Safety Administration's regulations in 49 CFR 192.615 and 192.617.
I	Erosion Control and Revegetation Plan	The Erosion Control and Revegetation Plan outlines the erosion control and revegetation procedures that Pacific Connector would utilize during construction of the Pipeline to minimize erosion, sedimentation and enhance revegetation success on all lands crossed by the Pipeline.
J	Plant Conservation Plan	The purpose of this plan is to describe the conservation measures that Pacific Connector would implement to minimize the potential effects on federally-listed plants, including one plant identified as a species of concern, that have been documented during Pipeline Project survey efforts to-date, or that may be documented during subsequent survey efforts prior to ground-disturbing activities. The plan outlines avoidance, minimization, propagation, restoration and other mitigation measures for federally-listed plant species.
K	Fire Prevention and Suppression Plan	The Fire Prevention and Suppression Plan describes the measures to be used by Pacific Connector and its contractors (Contractor) to ensure that fire prevention and suppression techniques are carried out in accordance with federal, state and local regulations.
L	Fish Salvage Plan	The fish salvage plan has been developed to minimize adverse effects on Endangered Species Act (ESA) listed salmonids (Southern Oregon/Northern California Coast coho salmon and Oregon Coast coho salmon), non-listed salmonids (Chinook, steelhead, cutthroat trout) and ESA-listed catostomids (Lost River sucker and shortnose sucker) during construction of the Pacific Connector Pipeline Project as well as other aquatic organisms.
M	Hydrostatic Test Plan	In accordance with USDOT 49 CFR Part 192, Pacific Connector would strength test (or hydrostatic test) the Pipeline system (in sections) after it has been lowered into the pipe trench and backfilled. The purpose of the hydrostatic test is to verify the manufacturing and construction integrity of the Pipeline before placing it in service to flow natural gas.
N	Integrated Pest Management Plan	This plan would provide Pacific Connector's management and staff with the necessary BMPs to address the control of noxious weeds, invasive plants, forest pathogens, and soil pests across the route of the Pipeline. The BMPs have been created to minimize the potential spread of invasive species and minimize the potential adverse effects of control treatments.
O	Klamath Project Facilities Crossing Plan	The Plan identifies the locations within Klamath County, Oregon where the Pacific Connector alignment crosses facilities within the Klamath Project that are administered by the Klamath Basin Area Office of Reclamation and the methods proposed to construct the Pipeline Project across Reclamation facilities.
P	Leave Tree Protection Plan	The purpose of this plan is to describe the measures that would be implemented during construction of the Pacific Connector to identify, conserve and protect selected trees (living and snags) within or along the edges of the Pipeline Project's certificated work limits.
Q	Overburden and Excess Material Disposal Plan	The purpose of this Plan is to identify the proposed locations on federal lands that may be used for the permanent and temporary storage of excess rock, timber, and spoil generated during timber removal and Pipeline construction of the Pipeline Project.

TABLE 2.6.3-1 (continued)

Pacific Connector's Plan of Development

Appendix	Appendix Title	Description
R	Prescribed Burning Plan	The Prescribed Burning Plan describes the protocols that Pacific Connector would follow to obtain appropriate agency authorization on all lands (federal, state and private) crossed by the Pipeline, where it is necessary to dispose of forest slash by burning. This plan also outlines the appropriate BMPs that would be utilized to safely conduct slash burning operations.
S	Recreation Management Plan	The purpose of the Plan is to assist in the management of existing recreation resources on lands within the Pipeline Project area or impacted by the Pipeline. This Plan establishes goals for managing recreation in the vicinity of the Pipeline and describes actions to provide continued safe access, prevent resource damage, and to avoid potential user conflict.
T	Right-of-Way Marking Plan	The purpose of this Plan is to identify the survey standards and types of survey markings that would be used by Pacific Connector on federal lands during the pre-construction, construction, and operational phases of the Pipeline Project.
U	Right-of-Way Clearing Plan	The purpose of this Right-of-Way Clearing Plan (Plan) is to outline the methods that Pacific Connector would implement during timber (and other vegetation) removal within the construction right-of-way and TEWAs. This Plan was developed utilizing applicable BMP compliance protocols outlined in the Erosion Control and Revegetation Plan for the Pipeline Project.
V	Safety and Security Plan	The purpose of this plan is to describe safety standards and practices that would be implemented to minimize health and safety concerns related to the construction of the Pipeline Project.
W	Sanitation and Waste Management Plan	The purpose of the Plan is to outline the procedures that would be implemented by Pacific Connector and its contractors to manage sanitation and waste materials during construction and operations of the Pipeline Project.
X	Spill Prevention, Containment, and Countermeasures Plan	The Plan identifies measures to be taken by Pacific Connector and its contractors to prevent, contain and respond to spills during the construction of the Pipeline Project.
Y	Transportation Management Plan	The purpose of the plan is to cover all Pipeline Project transportation-related activities involving Agency-jurisdiction roads or rights-of-way and identifies ongoing cooperative procedures.
Z	Unanticipated Discovery Plan	This plan provides the procedures Jordan Cove, Pacific Connector, its personnel, and consultants would follow in the event that unanticipated discoveries of historic properties, archaeological objects, archaeological sites, or human remains are made during the construction and operation of the Project.
AA	Environmental Alignment Sheets	A set of photo-based maps depicting the centerline and construction right-of-way at a scale of 1":200' and the associated environmental features and requirements.
BB	Wetland and Waterbody Crossing Plan	The Plan outlines the construction methods, restoration procedures, and BMPs that Pacific Connector would utilize during construction of its Pipeline. The measures set out in this plan would be employed to avoid, minimize, and restore potential impacts associated with wetland and waterbody crossings, as well as to minimize potential effects on aquatic resources.

2.7 OPERATION AND MAINTENANCE PROCEDURES

2.7.1 LNG Project Facilities

Jordan Cove would operate and maintain its facilities in compliance with 49 CFR 193, 33 CFR 127, National Fire Protection Association (NFPA) 59A, and other applicable federal and state regulations. Before commencing operation of the LNG terminal, Jordan Cove would prepare and submit for approval operation and maintenance manuals that address specific procedures for the safe operation and maintenance of the LNG storage and processing facilities. Jordan Cove would also prepare an operations manual that addresses specific procedures for the safe operation of the ship unloading facilities in accordance with 33 CFR 127.305. Operating procedures would address normal operations as well as safe startup, shutdown, and emergency conditions.

All operations and maintenance personnel at the terminal would be trained to properly and safely perform their jobs. Jordan Cove states that operators would meet all the training requirements of the Coast Guard, USDOT, ODOE, Oregon State Fire Marshall, Coos Bay, Coos County Fire Department, and other regulatory entities. The SORSC would provide on-site resources and assets, including a Sherriff's office and fire department.

The LNG terminal and related facilities would be staffed with about 180 full-time equivalent employees working three shifts, so there would be coverage 24 hours a day, 365 days a year. The terminal's full-time staff would conduct routine maintenance and minor overhauls. Major overhauls and other major maintenance would be handled by bringing in maintenance personnel specifically trained to perform the maintenance. All scheduled and unscheduled maintenance would be entered into a computerized maintenance management system.

2.7.2 Pipeline and Associated Aboveground Facilities

Pacific Connector would test, operate, and maintain the proposed facilities in accordance with USDOT regulations provided in 49 CFR Part 192; the FERC's guidance at 18 CFR 380.15; rules and regulations promulgated by the Pipeline and Hazardous Materials Safety Administration (PHMSA); and maintenance provisions of its ECRP. The Pipeline right-of-way would be clearly marked where it crosses public roads, waterbodies, fenced property lines, and other locations as necessary. All Pipeline facilities would be marked and identified in accordance with applicable regulations.

The aboveground facilities would be inspected for the life of the Pipeline at intervals that meet USDOT requirements. Pipeline personnel would perform routine checks of the facilities, including calibration of equipment and instrumentation, inspection of critical components, and scheduled and routine maintenance of equipment. Safety equipment, such as pressure-relief devices, fire detection and suppression systems, and gas detection systems, would be tested for proper operation. Corrective actions would be taken for any identified problem. Vegetation at aboveground facilities would be periodically maintained using mowing, cutting, trimming and the selective use of herbicides.

To facilitate periodic Pipeline corrosion/leak surveys, a corridor centered on the Pipeline and up to 10 feet wide would be maintained in an herbaceous state, with no vegetation greater than 6 feet in height. Trees that are located within 15 feet of the Pipeline and that are greater than 15 feet in height would be cut and removed from the right-of-way. Vegetation within the permanent easement would be periodically maintained by mowing, cutting, and trimming (either by mechanical or hand methods). Maintenance activities are expected to occur approximately every three to five years depending on the growth rate. During maintenance, trimmed or cut vegetation would be scattered across the operational easement to naturally decompose and to discourage off-highway vehicle (OHV) traffic. Occasionally, where site conditions allow, chipping of this material may also occur. Herbicides would not be used for brush control; however, if noxious weed infestation occurs on the permanent easement, selective use of herbicides would be used to control these species. Herbicides would not be used in or within 100 feet of a waterbody's mean high-water mark.

Pacific Connector would employ a permanent staff of 15 employees, including six operations technicians in the Coos Bay pipeline office in Coos County, five employees in the Medford pipeline office in Jackson County, and four employees at the compressor station near Malin in Klamath County. In addition, the Pipeline and aboveground facilities would be monitored all the time using Pacific Connector's gas control communication system and radio towers reporting back to a command center at the Williams' office in Salt Lake City, Utah.

2.8 ESA CONSULTATION ON PROPOSED LAND MANAGEMENT PLAN AMENDMENTS

Amendments of BLM and Forest Service LMPs are part of the proposed action and the environmental impacts may be considered the same as those of construction and operation of the Pipeline Project. This is because the plan amendments are required to make provision for the proposed right-of-way where it does not conform to the existing applicable land and resource management plans. Therefore, consultation under Section 7 of the ESA on the proposed plan amendments is properly and most efficiently conducted as part of the consultation on the proposed Project.

A description of the BLM plan amendment is provided in the EIS (FERC 2019). No additional impacts to listed species are anticipated as a result of the plan amendments beyond what was described in the EIS.

Forest Service plan amendments and Forest Service compensatory mitigation are described in our EIS (FERC 2019), as well as in appendix O.4. The impacts to habitat and occupied sites as a result of the plan amendments are one-time impacts specific to this Project. With these amendments, the Forest Service would not be opening the door for impacts from other projects. Measures such as the reallocation of Matrix to LSR, while not a direct compensation for the impacts to habitat on NFS lands, ensure other areas would develop into LSOG habitat, and benefit the long-term conservation of the species as was intended under the Northwest Forest Plan (NWFP). Table 2.8-1 below identifies ESA listed and proposed species that could be affected by the Project on NFS lands, and which of the Forest Service actions would affect these species.

TABLE 2.8-1

ESA Listed and Proposed Species That Could Be Affected by the Project on NFS Lands

Admin. Unit	Watershed	Project Type	Project Name	Project Rationale	Quantity
Fisher					
RRNF	Little Butte Creek	Road Decommissioning	Little Butte Cr. Road Decommissioning	A construction corridor 75-95 feet wide with additional work areas would be cleared. Of this, a 30-foot-wide route along the pipeline route would be maintained in early successional habitat. This strip of land, in a forested ecosystem, provides a barrier for movement of small animals between the remaining forest blocks and degrades neighboring habitat through edge effects and fragmentation. This is of special concern in riparian ecosystems where movement of wildlife species is concentrated. Fishers use mature forests with low levels of fragmentation, including riparian corridors with continuous canopies. Decommissioning and planting selected roads in conjunction with precommercial thinning treatments (see other mitigations) would block up forested habitat and reduce edge effects and fragmentation in a period of about 40 years. Little Butte Creek is a key watershed and road reduction is a major objective (NWFP ROD C-7). Note that this would be most effective if done in conjunction with the thinning proposed.	57.5 Miles
RRNF	Little Butte Creek	Precommercial Thinning	Little Butte Cr LSR Precommercial Thin	There would be direct impacts to existing interior, developing interior habitat. The project would result in additional fragmentation and preclude the recovery of fragmented habitat for those stands adjacent to the pipeline corridor. Maintenance of pipeline corridor would provide a continued vector for predators, early-seral species and non-native species. Also the project would result in a direct loss in biological services provided by mature forest characteristics for many decades past the life of this project. Both mature stands and developing stands would be removed during pipeline construction. Density management of forested stands would assist in the recovery of late-seral habitat, impact from fragmentation, reduction in edge effects and enhance resilience of mature stands. Accelerating development of mature forest characteristics would shorten the impacts of pipeline construction on fishers, who require mature forests with low levels of fragmentation. Thinning of young stands is a recognized treatment within LSRs if designed to accelerate development of late-successional habitat characteristics (NWFP ROD C-12). ROD Pages B-11 ACS Objectives , C-11 and C-17.	618 Acres

TABLE 2.8-1 (continued) **ESA Listed and Proposed Species That Could Be Affected by the Project on NFS Lands**					
Admin. Unit	**Watershed**	**Project Type**	**Project Name**	**Project Rationale**	**Quantity**
Fisher (cont.)					
RRNF	Little Butte Creek	LW Upland Placement a/	Little Butte Cr. LSR LW Placement	Mitigate for the loss of recruitment of large down wood to adjacent stands and within the construction clearing zone. The project would forgo the development of large down wood for the life of the project and for decades after. Downed wood is a critical component of Mature Forest ecosystems. Large wood replacement would partially mitigate for the barrier effect of the corridor by creating structure across the corridor for use by small wildlife species. Placement in wood deficient areas adjacent to the corridor allows for scattering of stockpiled wood, reducing localized fuel loads while improving habitat in deficient stands. Larger logs maintain moisture longer and are less likely to be fully consumed by fire. Fishers prefer mature forests with low levels of fragmentation and downed timber, and placement of large downed wood may minimize the barrier effect of the corridor and reduce potential fire impacts on mature forests they prefer. Acres that can be treated are necessarily limited by material available from the corridor.	511 acres
RRNF	Little Butte Creek	Snag Creation	Little Butte Cr. LSR Snag Creation	Mitigate immediate and future impacts to snag habitat from the clearing of the pipeline right-of-way. The project prevents development of large snags during the life of the project and for decades after. Corridor construction would result in loss of snag habitat on approximately 775 acres of corridor construction (includes safety zone buffer). This project would add to those cumulative impacts. While spotted owls are the intended beneficiary of this mitigation projects, fishers would also benefit as they require mature forests with a high percentage of dead timber. Snag requirements are specifically outlined in the Forests' LRMPs and NWFP. Forests require analysis and mitigation under most management activities. There would be a 10 year delay as snag decay develops. Snag management is required in the RRNF LRMP (4-20), with levels set under the various management directions. Snag Management is discussed in the NWFP for LSRs on C-14 and 15 of the ROD (items 4 and 7). Snag management levels are based on the Forest's Plant Association Guidelines. Snags are also discussed in the South Cascades LSR Assessment (Chap. 3).	622 acres
RRNF	Little Butte Creek	Reallocation of Matrix to LSR	LSR 227 Addition	This action contributes to the "neutral to beneficial" standard for new developments in LSRs by adding acres to the LSR land allocation to offset the long-term loss of acres of acres and habitat from the construction and operation of the Pipeline Project. Fishers require mature forests and would benefit from additional acres to the LSR land allocation.	25 acres
RRNF	Big Butte Creek	Reallocation of Matrix to LSR	LSR 227 Addition	This action contributes to the "neutral to beneficial" standard for new developments in LSRs by adding acres to the LSR land allocation to offset the long-term loss of acres of acres and habitat from the construction and operation of the Pipeline Project. Fishers require mature forests and would benefit from additional acres to the LSR land allocation.	497 acres

TABLE 2.8-1 (continued)

ESA Listed and Proposed Species That Could Be Affected by the Project on NFS Lands

Admin. Unit	Watershed	Project Type	Project Name	Project Rationale	Quantity
Fisher (cont.)					
UNF	Upper Cow Creek	Road Closure	Upper Cow Cr. Road Closure	Close roads, remove culverts, and treat weeds. Mowing and maintenance of pipeline corridor, temporary road construction, and road use are direct disturbance impacts to wildlife. Road closure would mitigate some of those impacts, improve interior stand connectivity for wildlife, including fishers.	1.2 miles
UNF	Elk Creek South Umpqua	Road Decommissioning	Elk Cr. Road Decommissioning	A construction corridor 75-95 feet wide with additional work areas would be cleared. Of this, a 30-foot-wide route along the pipeline route would be maintained in early successional habitat. This strip of land, in a forested ecosystem, provides a barrier for movement of small animals between the remaining forest blocks and degrades neighboring habitat through edge effects and fragmentation. This is of special concern in riparian ecosystems where movement of wildlife species is concentrated. Fishers use mature forests with low levels of fragmentation, including riparian corridors with continuous canopies. Decommissioning and planting selected roads in conjunction with precommercial thinning treatments (see other mitigations) would block up forested habitat and reduce edge effects and fragmentation in a period of about 40 years. This mitigation meets ACS objectives 2, 4, 5, 8 & 9. Elk Creek South Umpqua is a key watershed and road reduction is a major objective (NWFP ROD C-7). Note that this would be most effective if done in conjunction with the thinning proposed.	5.9 miles
UNF	Trail Creek	Road Decommissioning	Trail Cr. Road Decommissioning	A construction corridor 75-95 feet wide with additional work areas would be cleared. Of this, a 30-foot-wide route along the pipeline route would be maintained in early successional habitat. This strip of land, in a forested ecosystem, provides a barrier for movement of small animals between the remaining forest blocks and degrades neighboring habitat through edge effects and fragmentation. This is of special concern in riparian ecosystems where movement of wildlife species is concentrated. Fishers use mature forests with low levels of fragmentation, including riparian corridors with continuous canopies. Decommissioning and planting selected roads in conjunction with precommercial thinning treatments (see other mitigations) would block up forested habitat and reduce edge effects and fragmentation in a period of about 40 years. This mitigation meets ACS objectives 2, 4, 5, 8 & 9. Trail Creek is a key watershed and road reduction is a major objective (NWFP ROD C-7). Note that this would be most effective if done in conjunction with the thinning proposed.	0.3 mile

TABLE 2.8-1 (continued)

ESA Listed and Proposed Species That Could Be Affected by the Project on NFS Lands

Admin. Unit	Watershed	Project Type	Project Name	Project Rationale	Quantity
Fisher (cont.)					
UNF	Upper Cow Creek	Road Decommissioning	Upper Cow Cr. Road Decommissioning	A construction corridor 75-95 feet wide with additional work areas would be cleared. Of this, a 30-foot-wide route along the pipeline route would be maintained in early successional habitat. This strip of land, in a forested ecosystem, provides a barrier for movement of small animals between the remaining forest blocks and degrades neighboring habitat through edge effects and fragmentation. This is of special concern in riparian ecosystems where movement of wildlife species is concentrated. Fishers use mature forests with low levels of fragmentation, including riparian corridors with continuous canopies. Decommissioning and planting selected roads in conjunction with precommercial thinning treatments (see other mitigations) would block up forested habitat and reduce edge effects and fragmentation in a period of about 40 years. This mitigation meets ACS objectives 2, 4, 5, 8 & 9. Upper Cow Creek is a key watershed and road reduction is a major objective (NWFP ROD C-7). Note that this would be most effective if done in conjunction with the thinning proposed.	1.0 mile
UNF	Elk Creek South Umpqua	LW Upland Placement	Elk Cr. LSR LW Placement	Mitigate for the loss of recruitment of large down wood to adjacent stands and within the construction clearing zone. The project would forgo the development of large down wood for the life of the project and for decades after. Downed wood is a critical component of Mature Forest ecosystems. Large wood replacement would partially mitigate for the barrier effect of the corridor by creating structure across the corridor for use by small wildlife species. Placement in wood deficient areas adjacent to the corridor allows for scattering of stockpiled wood, reducing localized fuel loads while improving habitat in deficient stands. Larger logs maintain moisture longer and are less likely to be fully consumed by fire. Fishers prefer mature forests with low levels of fragmentation and downed timber, and placement of large downed wood may minimize the barrier effect of the corridor and reduce potential fire impacts on mature forests they prefer. Acres that can be treated are necessarily limited by material available from the corridor.	99 acres
UNF	Upper Cow Creek	LW Upland Placement	Upper Cow Cr. LSR LW Placement	Mitigate for the loss of recruitment of large down wood to adjacent stands and within the construction clearing zone. The project would forgo the development of large down wood for the life of the project and for decades after. Downed wood is a critical component of Mature Forest ecosystems. Large wood replacement would partially mitigate for the barrier effect of the corridor by creating structure across the corridor for use by small wildlife species. Placement in wood deficient areas adjacent to the corridor allows for scattering of stockpiled wood, reducing localized fuel loads while improving habitat in deficient stands. Larger logs maintain moisture longer and are less likely to be fully consumed by fire. Fishers prefer mature forests with low levels of fragmentation and downed timber, and placement of large downed wood may minimize the barrier effect of the corridor and reduce potential fire impacts on mature forests they prefer. Acres that can be treated are necessarily limited by material available from the corridor.	65 acres

TABLE 2.8-1 (continued)

ESA Listed and Proposed Species That Could Be Affected by the Project on NFS Lands

Admin. Unit	Watershed	Project Type	Project Name	Project Rationale	Quantity
Fisher (cont.)					
UNF	Days Creek South Umpqua	Snag Creation	Days Cr. South Umpqua Matrix Snag Creation	Mitigate immediate and future impacts to snag habitat from the clearing of the pipeline right-of-way. The project prevents development of large snags during the life of the project and for decades after. Corridor construction would result in loss of snag habitat on approximately 775 acres of corridor construction (includes safety zone buffer). This project would add to those cumulative impacts. While spotted owls are the intended beneficiary of this mitigation projects, fishers would also benefit as they require mature forests with a high percentage of dead timber. Snag requirements are specifically outlined in the Forests' LRMPs and NWFP. Forests require analysis and mitigation under most management activities. There would be a 10 year delay as snag decay develops. Snag management is required in the RRNF LRMP (4-20), with levels set under the various management directions. Snag Management is discussed in the NWFP for LSRs on C-14 and 15 of the ROD (items 4 and 7). Snag management levels are based on the Forest's Plant Association Guidelines. Snags are also discussed in the South Cascades LSR Assessment (Chap. 3).	14 acres
UNF	Trail Creek	Snag Creation	Trail Cr. Matrix Snag Creation	Mitigate immediate and future impacts to snag habitat from the clearing of the pipeline right-of-way. The project prevents development of large snags during the life of the project and for decades after. Corridor construction would result in loss of snag habitat on approximately 775 acres of corridor construction (includes safety zone buffer). This project would add to those cumulative impacts. While spotted owls are the intended beneficiary of this mitigation projects, fishers would also benefit as they require mature forests with a high percentage of dead timber. Snag requirements are specifically outlined in the Forests' LRMPs and NWFP. Forests require analysis and mitigation under most management activities. There would be a 10 year delay as snag decay develops. Snag management is required in the RRNF LRMP (4-20), with levels set under the various management directions. Snag Management is discussed in the NWFP for LSRs on C-14 and 15 of the ROD (items 4 and 7). Snag management levels are based on the Forest's Plant Association Guidelines. Snags are also discussed in the South Cascades LSR Assessment (Chap. 3).	109 acres

TABLE 2.8-1 (continued)

ESA Listed and Proposed Species That Could Be Affected by the Project on NFS Lands

Admin. Unit	Watershed	Project Type	Project Name	Project Rationale	Quantity
Fisher (cont.)					
UNF	Upper Cow Creek	Snag Creation	Upper Cow Cr. Matrix Snag Creation	Mitigate immediate and future impacts to snag habitat from the clearing of the pipeline right-of-way. The project prevents development of large snags during the life of the project and for decades after. Corridor construction would result in loss of snag habitat on approximately 775 acres of corridor construction (includes safety zone buffer). Data relies on the Cow Creek Watershed Analysis which suggests the watershed is far below historic levels of snag habitat due of past management actions. This project would add to those cumulative impacts. While spotted owls are the intended beneficiary of this mitigation projects, fishers would also benefit as they require mature forests with a high percentage of dead timber. Snag requirements are specifically outlined in the Forests' LRMPs and NWFP. Forests require analysis and mitigation under most management activities. There would be a 10 year delay as snag decay develops. Snag management is required in the RRNF LRMP (4-20), with levels set under the various management directions. Snag Management is discussed in the NWFP for LSRs on C-14 and 15 of the ROD (items 4 and 7). Snag management levels are based on the Forest's Plant Association Guidelines. Snags are also discussed in the South Cascades LSR Assessment (Chap. 3).	11 acres
UNF	Days Creek South Umpqua	Snag Creation	Days Cr. South Umpqua LSR Snag Creation	Mitigate immediate and future impacts to snag habitat from the clearing of the pipeline right-of-way. The project prevents development of large snags during the life of the project and for decades after. Corridor construction would result in loss of snag habitat on approximately 775 acres of corridor construction (includes safety zone buffer). This project would add to those cumulative impacts. While spotted owls are the intended beneficiary of this mitigation projects, fishers would also benefit as they require mature forests with a high percentage of dead timber. Snag requirements are specifically outlined in the Forests' LRMPs and NWFP. Forests require analysis and mitigation under most management activities. There would be a 10 year delay as snag decay develops. Snag management is required in the RRNF LRMP (4-20), with levels set under the various management directions. Snag Management is discussed in the NWFP for LSRs on C-14 and 15 of the ROD (items 4 and 7). Snag management levels are based on the Forest's Plant Association Guidelines. Snags are also discussed in the South Cascades LSR Assessment (Chap. 3).	32 acres

TABLE 2.8-1 (continued)

ESA Listed and Proposed Species That Could Be Affected by the Project on NFS Lands

Admin. Unit	Watershed	Project Type	Project Name	Project Rationale	Quantity
Fisher (cont.)					
UNF	Elk Creek South Umpqua	Snag Creation	Elk Cr. LSR Snag Creation	Mitigate immediate and future impacts to snag habitat from the clearing of the pipeline right-of-way. The project prevents development of large snags during the life of the project and for decades after. Corridor construction would result in loss of snag habitat on approximately 775 acres of corridor construction (includes safety zone buffer). This project would add to those cumulative impacts. While spotted owls are the intended beneficiary of this mitigation projects, fishers would also benefit as they require mature forests with a high percentage of dead timber. Snag requirements are specifically outlined in the Forests' LRMPs and NWFP. Forests require analysis and mitigation under most management activities. There would be a 10 year delay as snag decay develops. Snag management is required in the RRNF LRMP (4-20), with levels set under the various management directions. Snag Management is discussed in the NWFP for LSRs on C-14 and 15 of the ROD (items 4 and 7). Snag management levels are based on the Forest's Plant Association Guidelines. Snags are also discussed in the South Cascades LSR Assessment (Chap. 3).	68 acres
UNF	Upper Cow Creek	Snag Creation	Upper Cow Cr. LSR Snag Creation	Mitigate immediate and future impacts to snag habitat from the clearing of the pipeline right-of-way. The project prevents development of large snags during the life of the project and for decades after. Corridor construction would result in loss of snag habitat on approximately 775 acres of corridor construction (includes safety zone buffer). This project would add to those cumulative impacts. While spotted owls are the intended beneficiary of this mitigation projects, fishers would also benefit as they require mature forests with a high percentage of dead timber. Snag requirements are specifically outlined in the Forests' LRMPs and NWFP. Forests require analysis and mitigation under most management activities. There would be a 10 year delay as snag decay develops. Snag management is required in the RRNF LRMP (4-20), with levels set under the various management directions. Snag Management is discussed in the NWFP for LSRs on C-14 and 15 of the ROD (items 4 and 7). Snag management levels are based on the Forest's Plant Association Guidelines. Snags are also discussed in the South Cascades LSR Assessment (Chap. 3).	90 acres
UNF	Days Creek South Umpqua	Fuels Reduction	Days Cr. South Umpqua Matrix Integrated Fuels Reduction	High intensity fire has been identified as the single factor most impacting late successional and old growth forest habitats on federal lands in the area of the NWFP. Construction of the pipeline and associated activities removes both mature and developing stands and would increase fire suppression complexity, however the corridor also provides a fuel break. Fuels reduction adjacent to the corridor would increase the effectiveness of the corridor as a fuel break. Fuels reduction would lower the risk of loss of developing and existing mature stands and other valuable habitats to high-intensity fire, and would benefit wildlife such as fishers.	194 acres

TABLE 2.8-1 (continued)

ESA Listed and Proposed Species That Could Be Affected by the Project on NFS Lands

Admin. Unit	Watershed	Project Type	Project Name	Project Rationale	Quantity
Fisher (cont.)					
UNF	Elk Creek South Umpqua	Fuels Reduction	Elk Cr. Matrix Integrated Fuels Reduction	Both mature stands and developing stands would be removed during pipeline construction. Impacts to mature and developing stands would exceed the life of this project by many decades. Density management would increase longevity of existing mature stands by reducing losses from disease, insects, and fire. Density management in younger stands would accelerate development of LSOG. Associated fuel reductions reduce risk of loss to fire and reduce potential fire size and intensity. Biological resources are not compensated by land allocation change. Removal of LSOG is essentially a permanent loss that cannot be replaced. Young stands would take 70 years to develop into LSOG so this is not a 1-1 replacement. LSR Assessments have identified the importance of density management to control losses to stand replacing fire. In order to effectively offset permanent loss, entire stands need to treated so habitat over time becomes contiguous and is in proximity of the project. The proposed ridge line pipeline route intersects an area that has had reoccurring lighting strikes and has potential for stand replacement fires. This mitigation would assist in protection and restoration of the late-seral forest values, which would benefit wildlife such as fishers that rely on mature forests.	176 acres
UNF	Trail Creek	Fuels Reduction	Trail Cr. Matrix Integrated Fuels Reduction	High intensity fire has been identified as the single factor most impacting late successional and old growth forest habitats on federal lands in the area of the NWFP. Construction of the pipeline and associated activities removes both mature and developing stands and would increase fire suppression complexity, however the corridor also provides a fuel break. Fuels reduction adjacent to the corridor would increase the effectiveness of the corridor as a fuel break. Fuels reduction would lower the risk of loss of developing and existing mature stands and other valuable habitats to high-intensity fire, and would benefit wildlife such as fishers.	500 acres
UNF	Upper Cow Creek	Fuels Reduction	Upper Cow Cr. Matrix Integrated Fuels Reduction	High intensity fire has been identified as the single factor most impacting late successional and old growth forest habitats on federal lands in the area of the NWFP. Construction of the pipeline and associated activities removes both mature and developing stands and would increase fire suppression complexity, however the corridor also provides a fuel break. Fuels reduction adjacent to the corridor would increase the effectiveness of the corridor as a fuel break. Fuels reduction would lower the risk of loss of developing and existing mature stands and other valuable habitats to high-intensity fire, and would benefit wildlife such as fishers.	730 acres
UNF	Days Creek South Umpqua	Fuels Reduction	Days Cr. South Umpqua LSR Integrated Fuels Reduction	High intensity fire has been identified as the single factor most impacting late successional and old growth forest habitats on federal lands in the area of the NWFP. Construction of the pipeline and associated activities removes both mature and developing stands and would increase fire suppression complexity, however the corridor also provides a fuel break. Fuels reduction adjacent to the corridor would increase the effectiveness of the corridor as a fuel break. Fuels reduction would lower the risk of loss of developing and existing mature stands and other valuable habitats to high-intensity fire, and would benefit wildlife such as fishers.	254 acres

TABLE 2.8-1 (continued)

ESA Listed and Proposed Species That Could Be Affected by the Project on NFS Lands

Admin. Unit	Watershed	Project Type	Project Name	Project Rationale	Quantity
Fisher (cont.)					
UNF	Upper Cow Creek	Reallocation of Matrix to LSR	LSR 223 Addition	This action contributes to the "neutral to beneficial" standard for new developments in LSRs by adding acres to the LSR land allocation to offset the long-term loss of acres of acres and habitat from the construction and operation of the Pipeline Project. Fishers require mature forests and would benefit from additional acres to the LSR land allocation.	585 acres
UNF	Upper Cow Creek	Fuels Reduction	Upper Cow Cr. LSR Integrated Fuels Reduction	High intensity fire has been identified as the single factor most impacting late successional and old growth forest habitats on federal lands in the area of the NWFP. Construction of the pipeline and associated activities removes both mature and developing stands and would increase fire suppression complexity, however the corridor also provides a fuel break. Fuels reduction adjacent to the corridor would increase the effectiveness of the corridor as a fuel break. Fuels reduction would lower the risk of loss of developing and existing mature stands and other valuable habitats to high-intensity fire, and would benefit wildlife such as fishers.	635 acres
UNF	Trail Creek	Precommercial Thinning	Trail Cr. LSR PCT Enhancement	There would be direct impacts to existing interior, developing interior habitat. The project would result in additional fragmentation and preclude the recovery of fragmented habitat for those stands adjacent to the pipeline corridor. Maintenance of pipeline corridor would provide a continued vector for predators, early-seral species and non-native species. Also the project would result in a direct loss in biological services provided by mature forest characteristics for many decades past the life of this project. Both mature stands and developing stands would be removed during pipeline construction. Density management of forested stands would assist in the recovery of late-seral habitat, impact from fragmentation, reduction in edge effects and enhance resilience of mature stands. Accelerating development of mature forest characteristics would shorten the impacts of pipeline construction on fishers, who require mature forests with low levels of fragmentation. Thinning of young stands is a recognized treatment within LSRs if designed to accelerate development of late-successional habitat characteristics (NWFP ROD C-12). ROD Pages B-11 ACS Objectives , C-11 and C-17.	112 acres
UNF	Upper Cow Creek	Commercial Thin	Upper Cow Cr. LSR Enhancement	This prescription is intended to enhance LSOG habitat by increasing the growth, health, and vigor of the trees remaining in the stands; restoring stand density, species diversity, and structural diversity to those considered characteristic under a natural disturbance regime. While spotted owls are the primary intended beneficiary, fishers would also benefit from improving the health of mature forests.	197 acres
UNF	Elk Creek South Umpqua	Commercial Thin	Elk Cr. LSR Enhancement	This prescription is intended to enhance LSOG habitat by increasing the growth, health, and vigor of the trees remaining in the stands; restoring stand density, species diversity, and structural diversity to those considered characteristic under a natural disturbance regime. While spotted owls are the primary intended beneficiary, fishers would also benefit from improving the health of mature forests.	91 acres

TABLE 2.8-1 (continued)

ESA Listed and Proposed Species That Could Be Affected by the Project on NFS Lands

Admin. Unit	Watershed	Project Type	Project Name	Project Rationale	Quantity
Fisher (cont.)					
UNF	Elk Creek South Umpqua	Off-site Pine Removal	Elk Cr LSR Off-site Pine Removal	Stand-density management is proposed in pine plantations that were planted with off-site seedlings. The purpose of this mitigation action is to restore stand density, species diversity, and structural diversity to those considered characteristic under a natural disturbance regime by enhancing and accelerating the physical and biological services for associated flora and fauna within LSR 223. Fishers would benefit from improving forest health within LSRs.	300 acres
UNF	Upper Cow Creek	Precommercial Thinning	Elk Cr LSR PCT Enhancement	There would be direct impacts to existing interior, developing interior habitat. The project would result in additional fragmentation and preclude the recovery of fragmented habitat for those stands adjacent to the pipeline corridor. Maintenance of pipeline corridor would provide a continued vector for predators, early-seral species and non-native species. Also the project would result in a direct loss in biological services provided by mature forest characteristics for many decades past the life of this project. Both mature stands and developing stands would be removed during pipeline construction. Density management of forested stands would assist in the recovery of late-seral habitat, impact from fragmentation, reduction in edge effects and enhance resilience of mature stands. Accelerating development of mature forest characteristics would shorten the impacts of pipeline construction on fishers, who require mature forests with low levels of fragmentation. Thinning of young stands is a recognized treatment within LSRs if designed to accelerate development of late-successional habitat characteristics (NWFP ROD C-12). ROD Pages B-11 ACS Objectives , C-11 and C-17.	116 acres
UNF	Upper Cow Creek	Water Source Improvement	Upper Cow Cr Pump Chance	Construction of the pipeline and associated activities would increase fire suppression complexity. Pump chances increase capacity for agency response and help reduce potential fire losses to valuable habitats, including mature forests preferred by fishers, by providing readily available water sources.	1 site
UNF	Elk Creek South Umpqua	Water Source Improvement	Elk Cr Pump Chance	Construction of the pipeline and associated activities would increase fire suppression complexity. Pump chances increase capacity for agency response and help reduce potential fire losses to valuable habitats, including mature forests preferred by fishers, by providing readily available water sources.	2 sites
WNF	Spencer Creek	Road Decommissioning	Spencer Cr. Road Decommissioning	A construction corridor 75-95 feet wide with additional work areas would be cleared. Of this, a 30-foot-wide route along the pipeline route would be maintained in early successional habitat. This strip of land, in a forested ecosystem, provides a barrier for movement of small animals between the remaining forest blocks and degrades neighboring habitat through edge effects and fragmentation. This is of special concern in riparian ecosystems where movement of wildlife species is concentrated. Fishers use mature forests with low levels of fragmentation, including riparian corridors with continuous canopies. Decommissioning and planting selected roads in conjunction with precommercial thinning treatments (see other mitigations) would block up forested habitat and reduce edge effects and fragmentation in a period of about 40 years. This mitigation addresses ACS objectives 2, 4, 5, 8, & 9.	29.2 miles

TABLE 2.8-1 (continued)

ESA Listed and Proposed Species That Could Be Affected by the Project on NFS Lands

Admin. Unit	Watershed	Project Type	Project Name	Project Rationale	Quantity
Northern Spotted Owl					
RRNF	Little Butte Creek	Precommercial Thinning	Little Butte Cr LSR Precommercial Thin	There would be direct impacts to existing interior, developing interior habitat. The project would result in additional fragmentation and preclude the recovery of fragmented habitat for those stands adjacent to the pipeline corridor. Maintenance of pipeline corridor would provide a continued vector for predators, early-seral species and non-native species. Also the project would result in a direct loss in biological services provided by mature forest characteristics for many decades past the life of this project. Both mature stands and developing stands would be removed during pipeline construction. Density management of forested stands would assist in the recovery of late-seral habitat, impact from fragmentation, reduction in edge effects and enhance resilience of mature stands. Accelerating development of mature forest characteristics would shorten the impacts of those biological services loss due to pipeline construction. Thinning of young stands is a recognized treatment within LSRs if designed to accelerate development of late-successional habitat characteristics (NWFP ROD C-12). ROD Pages B-11 ACS Objectives , C-11 and C-17. Northern spotted owls would benefit from mitigation measures designed to improve health and accelerate development of mature forests within LSRs.	618 acres
RRNF	Little Butte Creek	Snag Creation	Little Butte Cr. LSR Snag Creation	Mitigate immediate and future impacts to snag habitat from the clearing of the pipeline right-of-way. The project prevents development of large snags during the life of the project and for decades after. Corridor construction would result in loss of snag habitat on approximately 775 acres of corridor construction (includes safety zone buffer). This project would add to those cumulative impacts. As snags are a critical component of LSR northern spotted owl habitat, replacement is needed. Snag requirements are specifically outlined in the Forests' LRMPs and NWFP. Forests require analysis and mitigation under most management activities. There would be a 10 year delay as snag decay develops. Snag management is required in the RRNF LRMP (4-20), with levels set under the various management directions. Snag Management is discussed in the NWFP for LSRs on C-14 and 15 of the ROD (items 4 and 7). Snag management levels are based on the Forest's Plant Association Guidelines. Snags are also discussed in the South Cascades LSR Assessment (Chap. 3).	622 acres
RRNF	Little Butte Creek	Reallocation of Matrix to LSR	LSR 227 Addition	This action contributes to the "neutral to beneficial" standard for new developments in LSRs by adding acres to the LSR land allocation to offset the long-term loss of acres of acres and habitat from the construction and operation of the Pipeline Project. Northern spotted owls would benefit from additional acreage to the LSR land allocation.	25 acres
RRNF	Big Butte Creek	Reallocation of Matrix to LSR	LSR 227 Addition	This action contributes to the "neutral to beneficial" standard for new developments in LSRs by adding acres to the LSR land allocation to offset the long-term loss of acres of acres and habitat from the construction and operation of the Pipeline Project. Northern spotted owls would benefit from additional acreage to the LSR land allocation.	497 acres

TABLE 2.8-1 (continued)

ESA Listed and Proposed Species That Could Be Affected by the Project on NFS Lands

Admin. Unit	Watershed	Project Type	Project Name	Project Rationale	Quantity
Northern Spotted Owl (cont.)					
UNF	Days Creek South Umpqua	Snag Creation	Days Cr. South Umpqua Matrix Snag Creation	Mitigate immediate and future impacts to snag habitat from the clearing of the pipeline right-of-way. The project prevents development of large snags during the life of the project and for decades after. Corridor construction would result in loss of snag habitat on approximately 775 acres of corridor construction (includes safety zone buffer). This project would add to those cumulative impacts. As snags are a critical component of northern spotted owl habitat, replacement is needed. Snag requirements are specifically outlined in the Forests' LRMPs and NWFP. Forests require analysis and mitigation under most management activities. There would be a 10 year delay as snag decay develops. Snag management is required in the RRNF LRMP (4-20), with levels set under the various management directions. Snag Management is discussed in the NWFP for LSRs on C-14 and 15 of the ROD (items 4 and 7). Snag management levels are based on the Forest's Plant Association Guidelines. Snags are also discussed in the South Cascades LSR Assessment (Chap. 3).	14 acres
UNF	Trail Creek	Snag Creation	Trail Cr. Matrix Snag Creation	Mitigate immediate and future impacts to snag habitat from the clearing of the pipeline right-of-way. The project prevents development of large snags during the life of the project and for decades after. Corridor construction would result in loss of snag habitat on approximately 775 acres of corridor construction (includes safety zone buffer). This project would add to those cumulative impacts. As snags are a critical component of LSR northern spotted owl habitat, replacement is needed. Snag requirements are specifically outlined in the Forests' LRMPs and NWFP. Forests require analysis and mitigation under most management activities. There would be a 10 year delay as snag decay develops. Snag management is required in the RRNF LRMP (4-20), with levels set under the various management directions. Snag Management is discussed in the NWFP for LSRs on C-14 and 15 of the ROD (items 4 and 7). Snag management levels are based on the Forest's Plant Association Guidelines. Snags are also discussed in the South Cascades LSR Assessment (Chap. 3).	109 acres
UNF	Upper Cow Creek	Snag Creation	Upper Cow Cr. Matrix Snag Creation	Mitigate immediate and future impacts to snag habitat from the clearing of the pipeline right-of-way. The project prevents development of large snags during the life of the project and for decades after. Corridor construction would result in loss of snag habitat on approximately 775 acres of corridor construction (includes safety zone buffer). Data relies on the Cow Creek Watershed Analysis which suggests the watershed is far below historic levels of snag habitat due of past management actions. This project would add to those cumulative impacts. As snags are a critical component of northern spotted owl habitat, replacement is needed. Snag requirements are specifically outlined in the Forests' LRMPs and NWFP. Forests require analysis and mitigation under most management activities. Replacement would be immediate though there would be a 10 year delay as snag decay develops. Snag management levels are based on the Forest's Plant Association Guidelines. Snags are also discussed in the South Cascades LSR Assessment (Chap. 3).	11 acres

TABLE 2.8-1 (continued)

ESA Listed and Proposed Species That Could Be Affected by the Project on NFS Lands

Admin. Unit	Watershed	Project Type	Project Name	Project Rationale	Quantity
Northern Spotted Owl (cont.)					
UNF	Days Creek South Umpqua	Snag Creation	Days Cr. South Umpqua LSR Snag Creation	Mitigate immediate and future impacts to snag habitat from the clearing of the pipeline right-of-way. The project prevents development of large snags during the life of the project and for decades after. Corridor construction would result in loss of snag habitat on approximately 775 acres of corridor construction (includes safety zone buffer). This project would add to those cumulative impacts. As snags are a critical component of LSR northern spotted owl habitat, replacement is needed. Snag requirements are specifically outlined in the Forests' LRMPs and NWFP. Forests require analysis and mitigation under most management activities. There would be a 10 year delay as snag decay develops. Snag management is required in the RRNF LRMP (4-20), with levels set under the various management directions. Snag Management is discussed in the NWFP for LSRs on C-14 and 15 of the ROD (items 4 and 7). Snag management levels are based on the Forest's Plant Association Guidelines. Snags are also discussed in the South Cascades LSR Assessment (Chap. 3).	32 acres
UNF	Elk Creek South Umpqua	Snag Creation	Elk Cr. LSR Snag Creation	Mitigate immediate and future impacts to snag habitat from the clearing of the pipeline right-of-way. The project prevents development of large snags during the life of the project and for decades after. Corridor construction would result in loss of snag habitat on approximately 775 acres of corridor construction (includes safety zone buffer). This project would add to those cumulative impacts. As snags are a critical component of LSR northern spotted owl habitat, replacement is needed. Snag requirements are specifically outlined in the Forests' LRMPs and NWFP. Forests require analysis and mitigation under most management activities. There would be a 10 year delay as snag decay develops. Snag management is required in the RRNF LRMP (4-20), with levels set under the various management directions. Snag Management is discussed in the NWFP for LSRs on C-14 and 15 of the ROD (items 4 and 7). Snag management levels are based on the Forest's Plant Association Guidelines. Snags are also discussed in the South Cascades LSR Assessment (Chap. 3).	68 acres

TABLE 2.8-1 (continued)

ESA Listed and Proposed Species That Could Be Affected by the Project on NFS Lands

Admin. Unit	Watershed	Project Type	Project Name	Project Rationale	Quantity
Northern Spotted Owl (cont.)					
UNF	Upper Cow Creek	Snag Creation	Upper Cow Cr. LSR Snag Creation	Mitigate immediate and future impacts to snag habitat from the clearing of the pipeline right-of-way. The project prevents development of large snags during the life of the project and for decades after. Corridor construction would result in loss of snag habitat on approximately 775 acres of corridor construction (includes safety zone buffer). Data relies on the Cow Creek Watershed Analysis which suggests the watershed is far below historic levels of snag habitat due of past management actions. This project would add to those cumulative impacts. As snags are a critical component of LSR northern spotted owl habitat, replacement is needed. Snag requirements are specifically outlined in the Forests' LRMPs and NWFP. Forests require analysis and mitigation under most management activities. Replacement would be immediate though there would be a 10 year delay as snag decay develops. Snag Management is discussed in the NWFP for LSRs on C-14 and 15 of the ROD (items 4 and 7). Snag management levels are based on the Forest's Plant Association Guidelines. Snags are also discussed in the South Cascades LSR Assessment (Chap. 3).	90 acres
UNF	Days Creek South Umpqua	Fuels Reduction	Days Cr. South Umpqua Matrix Integrated Fuels Reduction	High intensity fire has been identified as the single factor most impacting late successional and old growth forest habitats on federal lands in the area of the NWFP. Construction of the pipeline and associated activities removes both mature and developing stands and would increase fire suppression complexity, however the corridor also provides a fuel break. Fuels reduction adjacent to the corridor would increase the effectiveness of the corridor as a fuel break. Fuels reduction would lower the risk of loss of developing and existing mature stands to high-intensity fire, which would benefit forested habitats used by northern spotted owls.	194 acres
UNF	Elk Creek South Umpqua	Fuels Reduction	Elk Cr. Matrix Integrated Fuels Reduction	Both mature stands and developing stands would be removed during pipeline construction. Impacts to mature and developing stands would exceed the life of this project by many decades. Density management would increase longevity of existing mature stands by reducing losses from disease, insects and fire. Density management in younger stands would accelerate development of LSOG. Associated fuel reductions reduce risk of loss to fire and reduce potential fire size and intensity. Biological resources are not compensated by land allocation change. Removal of LSOG is essentially a permanent loss that cannot be replaced. Young stands would take 70 years to develop into LSOG so this is not a 1-1 replacement. LSR Assessments have identified the importance of density management to control losses to stand replacing fire. In order to effectively offset permanent loss, entire stands need to be treated so habitat over time becomes contiguous and is in proximity of the project. The proposed ridge line pipeline route intersects and area that has had reoccurring lighting strikes and has potential for stand replacement fires. This mitigation would assist in protection and restoration of the late-seral forest values, which would benefit northern spotted owls.	176 acres

TABLE 2.8-1 (continued)

ESA Listed and Proposed Species That Could Be Affected by the Project on NFS Lands

Admin. Unit	Watershed	Project Type	Project Name	Project Rationale	Quantity
Northern Spotted Owl (cont.)					
UNF	Trail Creek	Fuels Reduction	Trail Cr. Matrix Integrated Fuels Reduction	High intensity fire has been identified as the single factor most impacting late successional and old growth forest habitats on federal lands in the area of the NWFP. Construction of the pipeline and associated activities removes both mature and developing stands and would increase fire suppression complexity, however the corridor also provides a fuel break. Fuels reduction adjacent to the corridor would increase the effectiveness of the corridor as a fuel break. Fuels reduction would lower the risk of loss of developing and existing mature stands to high-intensity fire, which would benefit forested habitats used by northern spotted owls.	500 acres
UNF	Upper Cow Creek	Fuels Reduction	Upper Cow Cr. Matrix Integrated Fuels Reduction	High intensity fire has been identified as the single factor most impacting late successional and old growth forest habitats on federal lands in the area of the NWFP. Construction of the pipeline and associated activities removes both mature and developing stands and would increase fire suppression complexity, however the corridor also provides a fuel break. Fuels reduction adjacent to the corridor would increase the effectiveness of the corridor as a fuel break. Fuels reduction would lower the risk of loss of developing and existing mature stands to high-intensity fire, which would benefit forested habitats used by northern spotted owls.	730 acres
UNF	Days Creek South Umpqua	Fuels Reduction	Days Cr. South Umpqua LSR Integrated Fuels Reduction	High intensity fire has been identified as the single factor most impacting late successional and old growth forest habitats on federal lands in the area of the NWFP. Construction of the pipeline and associated activities removes both mature and developing stands and would increase fire suppression complexity, however the corridor also provides a fuel break. Fuels reduction adjacent to the corridor would increase the effectiveness of the corridor as a fuel break. Fuels reduction would lower the risk of loss of developing and existing mature stands to high-intensity fire, which would benefit forested habitats used by northern spotted owls.	254 acres
UNF	Upper Cow Creek	Reallocation of Matrix to LSR	LSR 223 Addition	This action contributes to the "neutral to beneficial" standard for new developments in LSRs by adding acres to the LSR land allocation to offset the long-term loss of acres of acres and habitat from the construction and operation of the Pipeline Project. Northern spotted owls would benefit from additional acreage to the LSR land allocation.	585 acres
UNF	Upper Cow Creek	Fuels Reduction	Upper Cow Cr. LSR Integrated Fuels Reduction	High intensity fire has been identified as the single factor most impacting late successional and old growth forest habitats on federal lands in the area of the NWFP. Construction of the pipeline and associated activities removes both mature and developing stands and would increase fire suppression complexity, however the corridor also provides a fuel break. Fuels reduction adjacent to the corridor would increase the effectiveness of the corridor as a fuel break. Fuels reduction would lower the risk of loss of developing and existing mature stands to high-intensity fire, which would benefit forested habitats used by northern spotted owls.	635 acres

TABLE 2.8-1 (continued)

ESA Listed and Proposed Species That Could Be Affected by the Project on NFS Lands

Admin. Unit	Watershed	Project Type	Project Name	Project Rationale	Quantity
Northern Spotted Owl (cont.)					
UNF	Trail Creek	Precommercial Thinning	Trail Cr. LSR PCT Enhancement	There would be direct impacts to existing interior, developing interior habitat. The project would result in additional fragmentation and preclude the recovery of fragmented habitat for those stands adjacent to the pipeline corridor. Maintenance of pipeline corridor would provide a continued vector for predators, early-seral species and non-native species. Also the project would result in a direct loss in biological services provided by mature forest characteristics for many decades past the life of this project. Both mature stands and developing stands would be removed during pipeline construction. Density management of forested stands would assist in the recovery of late-seral habitat, impact from fragmentation, reduction in edge effects and enhance resilience of mature stands. Accelerating development of mature forest characteristics would shorten the impacts of those biological services loss due to pipeline construction. Thinning of young stands is a recognized treatment within LSRs if designed to accelerate development of late-successional habitat characteristics (NWFP ROD C-12). ROD Pages B-11 ACS Objectives , C-11 and C-17. Northern spotted owls would benefit from mitigation measures designed to improve health and accelerate development of mature forests within LSRs.	112 acres
UNF	Upper Cow Creek	Commercial Thin	Upper Cow Cr. LSR Enhancement	This prescription is intended to enhance LSOG habitat, on which northern spotted owls rely, by increasing the growth, health, and vigor of the trees remaining in the stands; restoring stand density, species diversity, and structural diversity to those considered characteristic under a natural disturbance regime.	197 acres
UNF	Elk Creek South Umpqua	Commercial Thin	Elk Cr. LSR Enhancement	This prescription is intended to enhance LSOG habitat, on which northern spotted owls rely, by increasing the growth, health, and vigor of the trees remaining in the stands; restoring stand density, species diversity, and structural diversity to those considered characteristic under a natural disturbance regime.	91 acres
UNF	Elk Creek South Umpqua	Off-site Pine Removal	Elk Cr LSR Off-site Pine Removal	Stand-density management is proposed in pine plantations that were planted with off-site seedlings. The purpose of this mitigation action is to restore stand density, species diversity, and structural diversity to those considered characteristic under a natural disturbance regime by enhancing and accelerating the physical and biological services for associated flora and fauna within LSR 223.	300 acres

TABLE 2.8-1 (continued)

ESA Listed and Proposed Species That Could Be Affected by the Project on NFS Lands

Admin. Unit	Watershed	Project Type	Project Name	Project Rationale	Quantity
Northern Spotted Owl (cont.)					
UNF	Upper Cow Creek	Precommercial Thinning	Elk Cr LSR PCT Enhancement	There would be direct impacts to existing interior, developing interior habitat. The project would result in additional fragmentation and preclude the recovery of fragmented habitat for those stands adjacent to the pipeline corridor. Maintenance of pipeline corridor would provide a continued vector for predators, early-seral species and non-native species. Also the project would result in a direct loss in biological services provided by mature forest characteristics for many decades past the life of this project. Both mature stands and developing stands would be removed during pipeline construction. Density management of forested stands would assist in the recovery of late-seral habitat, impact from fragmentation, reduction in edge effects and enhance resilience of mature stands. Accelerating development of mature forest characteristics would shorten the impacts of those biological services loss due to pipeline construction. Thinning of young stands is a recognized treatment within LSRs if designed to accelerate development of late-successional habitat characteristics (NWFP ROD C-12). ROD Pages B-11 ACS Objectives , C-11 and C-17. Northern spotted owls would benefit from mitigation measures designed to improve health and accelerate development of mature forests within LSRs.	116 acres
UNF	Evans Creek	Road Shaded Fuel Break	Evans Cr LSR Road Shaded Fuel Break	High intensity fire has been identified as the single factor most impacting late successional and old growth forest habitats on federal lands in the area of the NWFP. Construction of the pipeline and associated activities removes both mature and developing stands and would increase fire suppression complexity. Existing forest roads cam provide a fuel break. Fuels reduction along each side of existing roads would increase the effectiveness of the road as a fuel break. Road shaded fuel breaks would lower the risk of loss of developing and existing mature stands, on which northern spotted owls rely, to high-intensity fire.	63 acres
UNF	Trail Creek	Road Shaded Fuel Break	Trail Cr LSR Road Shaded Fuel Break	High intensity fire has been identified as the single factor most impacting late successional and old growth forest habitats on federal lands in the area of the NWFP. Construction of the pipeline and associated activities removes both mature and developing stands and would increase fire suppression complexity. Existing forest roads cam provide a fuel break. Fuels reduction along each side of existing roads would increase the effectiveness of the road as a fuel break. Road shaded fuel breaks would lower the risk of loss of developing and existing mature stands, on which northern spotted owls rely, to high-intensity fire.	175 acres
UNF	Upper Cow Creek	Road Shaded Fuel Break	Upper Cow Cr LSR Road Shaded Fuel Break	High intensity fire has been identified as the single factor most impacting late successional and old-growth forest habitats on federal lands in the area of the NWFP. Construction of the pipeline and associated activities removes both mature and developing stands and would increase fire suppression complexity. Existing forest roads cam provide a fuel break. Fuels reduction along each side of existing roads would increase the effectiveness of the road as a fuel break. Road shaded fuel breaks would lower the risk of loss of developing and existing mature stands, on which northern spotted owls rely, to high-intensity fire.	378 acres

TABLE 2.8-1 (continued)

ESA Listed and Proposed Species That Could Be Affected by the Project on NFS Lands

Admin. Unit	Watershed	Project Type	Project Name	Project Rationale	Quantity
Northern Spotted Owl (cont.)					
UNF	Upper Cow Creek	Water Source Improvement	Upper Cow Cr Pump Chance	Construction of the pipeline and associated activities would increase fire suppression complexity. Pump chances increase capacity for agency response and help reduce potential fire losses to valuable habitats, include old growth forests preferred by northern spotted owls, by providing readily available water sources.	1 site
UNF	Elk Creek South Umpqua	Water Source Improvement	Elk Cr Pump Chance	Construction of the pipeline and associated activities would increase fire suppression complexity. Pump chances increase capacity for agency response and help reduce potential fire losses to valuable habitats, include old growth forests preferred by northern spotted owls, by providing readily available water sources.	2 sites
Oregon Spotted Frog					
WNF	Spencer Creek	Riparian Planting	Spencer Cr. Riparian Planting	Spencer Creek just upstream of Buck Lake. This is a meadow site that has lost streamside vegetation and has compacted soils. There is an overall need to restore health and vigor to riparian stands by maintaining and improving riparian reserve habitat. Shade provided by the plantings would contribute to moderating water temperatures in Spencer Creek. Root strength provided by new vegetation would increase bank stability, decrease erosion and sediment depositions to Spencer Creek and provide habitat for species that use riparian habitats. Oregon spotted frogs occur within Buck Lake but Spencer Creek does not currently provide habitat for the species. Enhancing Spencer Creek habitat would benefit the downstream habitat of the Oregon spotted frog and potentially provide new habitat for the species in which to expand their local range.	0.5 mile
WNF	Spencer Creek	Fencing	Spencer Cr. Fencing	This fence would serve to divide the Buck Indian Allotment into pastures north and south at Clover Creek Road. This fence would keep cattle from grazing newly revegetated areas in the Right of Way corridor, including areas where the corridor crosses Spencer Creek, thus helping to ensure that erosion control and revegetation objectives are met. This fence would require 7-9 cattle guard crossings for Forest Roads intersecting the fence. Oregon spotted frogs occur within Buck Lake but Spencer Creek does not currently provide habitat for the species. Enhancing Spencer Creek habitat would benefit the downstream habitat of the Oregon spotted frog and potentially provide new habitat for the species in which to expand their local range.	6.5 miles

TABLE 2.8-1 (continued)

ESA Listed and Proposed Species That Could Be Affected by the Project on NFS Lands

Admin. Unit	Watershed	Project Type	Project Name	Project Rationale	Quantity
Oregon Spotted Frog (cont.)					
WNF	Spencer Creek	LW Instream	Spencer Cr. Instream LW	Over the last century, many streams with high aquatic habitat potential have become simplified, and therefore, have a reduced capacity to provide quality habitat. Riparian stands have decreased health and vigor, resulting in increased time to develop large tree structure for wildlife, stream shade, and future instream wood. Placement of LW in streams adds structural complexity to aquatic systems, traps fine sediments and can contribute to reductions in stream temperatures over time. The BLM completed placement last year on 3 miles of Spencer Creek below this reach. Addition of this segment would complete the stream rehabilitation on the reach of Spencer Creek where the project occurs. Logs from the Pipeline Project Right of Way would be used for the project. An estimated 75 pieces are needed. A helicopter would be used to place the logs. Oregon spotted frogs occur within Buck Lake but Spencer Creek does not currently provide habitat for the species. Enhancing Spencer Creek habitat would benefit the downstream habitat of the Oregon spotted frog and potentially provide new habitat for the species in which to expand their local range.	1.0 mile
WNF	Spencer Creek	Stream Crossing Repair	Spencer Cr. Ford Hardening and Interpretive Sign	Mitigation-Indirect: The proposed pipeline would cross Spencer Creek upstream of Buck Lake. This ford is at the uppermost reach of the perennial portion of Spencer Creek which is occupied by redband trout. Spencer Creek has been identified by NMFS through the FERC re-licensing process for the Klamath River hydro facilities, as habitat for Federally listed Southern Oregon/Northern California Coast Coho salmon. Additionally, once fish passage is provided through the Klamath River hydro facilities, steelhead would re-colonize Spencer Creek. The pipeline crosses SONC Coho habitats at other locations in other watersheds along the proposed pipeline route, possibly impairing habitat quality or reducing available habitat. Improving habitat quality at Spencer Creek provides the opportunity to be pro-active in providing quality habitat for SONC Coho, mitigating for any detrimental effects to other SONC Coho habitats, while also improving habitat for Oregon spotted frog. Spencer Creek appears on the Oregon DEQ 303(d) list as water quality impaired from increased sedimentation. Improvements at this location would immediately benefit all downstream aquatic habitats and the species associated with those habitats, such as Oregon spotted frogs in Buck Lake. This includes interpretive signage.	1 site
WNF	Spencer Creek	Stream Crossing Repair	Spencer Cr. Stream Crossing Decommissioning	Restoring stream crossings reconnects aquatic habitats by allowing the passage of aquatic biota and restoring riparian vegetation. Over time, these actions reduce sediment and restore shade. Restoration of these crossings includes riparian planting as a mitigation which would help offset the impact of shade removal at pipeline R/W crossings. Oregon spotted frogs occur within Buck Lake, but Spencer Creek does not currently provide habitat for the species. Enhancing Spencer Creek habitat would benefit the downstream habitat of the Oregon spotted frog and potentially provide new habitat for the species in which to expand their local range.	25 sites

TABLE 2.8-1 (continued)

ESA Listed and Proposed Species That Could Be Affected by the Project on NFS Lands

Admin. Unit	Watershed	Project Type	Project Name	Project Rationale	Quantity
Oregon Spotted Frog (cont.)					
WNF	Spencer Creek	Road Decommissioning	Spencer Cr. Road Decommissioning	A construction corridor 75-95 feet wide with additional work areas would be cleared. Of this, a 30-foot-wide route along the pipeline route would be maintained in early successional habitat. Decommissioning and planting selected roads can block up forested habitat in a period of about 40 years. Removal of culverts and roadbeds in riparian reduces sedimentation to the waters. This mitigation addresses ACS objectives 2, 4, 5, 8 & 9. Spencer Creek does not currently provide habitat for Oregon spotted frog; however, the species occupies Buck Lake downstream. Enhancing Spencer Creek habitat would benefit the downstream habitat of the Oregon spotted frog and potentially provide new habitat for the species in which to expand their local range.	29.2 miles
Coho (Southern Oregon/Northern California Coast ESU)					
RRNF	Little Butte Creek	LW Instream	SF Little Butte Cr. LW	Over the last century, many streams with high aquatic habitat potential have become simplified, and therefore, have a reduced capacity to provide quality habitat. Riparian stands have decreased health and vigor, resulting in increased time to develop large tree structure for wildlife, stream shade, and future instream wood. Placement of LW in streams adds structural complexity to aquatic systems, traps fine sediments and can contribute to reductions in stream temperatures over time, all of which improve habitat for Coho.	1.5 miles
RRNF	Little Butte Creek	Stream Crossing Repair	Little Butte Cr. Stream Crossing Decommissioning	Restoring stream crossings reconnects aquatic habitats by allowing the passage of aquatic biota and restoring riparian vegetation. Over time, these actions reduce sediment and restore shade, both of which improve habitat for Coho. Restoration of these crossings includes riparian planting as a mitigation which would help offset the impact of shade removal at pipeline R/W crossings.	32 sites
RRNF	Little Butte Creek	Road Decommissioning	Little Butte Cr. Road Decommissioning	A construction corridor 75-95 feet wide with additional work areas would be cleared. Of this, a 30-foot-wide route along the pipeline route would be maintained in early successional habitat. Decommissioning and planting selected roads in conjunction with precommercial thinning treatments (see other mitigations) would block up forested habitat in a period of about 40 years, and removal of culverts and roadbeds in riparian reduces sedimentation to the waters, all of which would improve habitat for Coho. This mitigation meets ACS objectives 2, 4, 5, 8 & 9. Little Butte Creek is a key watershed and road reduction is a major objective (NWFP ROD C-7). Note that this would be most effective if done in conjunction with the thinning proposed. This mitigation also offsets the impacts of soil compaction and displacement within the construction R/W.	57.5 miles
UNF	Upper Cow Creek	Road Closure	Upper Cow Cr. Road Closure	Close roads, remove culverts, and treat weeds. Mowing and maintenance of pipeline corridor, temporary road construction, and road use are direct disturbance impacts to wildlife. Road closure would mitigate some of those impacts, improve interior stand connectivity and benefit aquatic habitats for Coho over time.	1.2 miles

TABLE 2.8-1 (continued)

ESA Listed and Proposed Species That Could Be Affected by the Project on NFS Lands

Admin. Unit	Watershed	Project Type	Project Name	Project Rationale	Quantity
Coho (Southern Oregon/Northern California Coast ESU) (cont.)					
UNF	Elk Creek South Umpqua	Road Decommissioning	Elk Cr. Road Decommissioning	A construction corridor 75-95 feet wide with additional work areas would be cleared. Of this, a 30-foot-wide route along the pipeline route would be maintained in early successional habitat. Decommissioning and planting selected roads in conjunction with precommercial thinning treatments (see other mitigations) would block up forested habitat in a period of about 40 years, and removal of culverts and roadbeds in riparian reduces sedimentation to the waters, all of which would improve habitat for Coho. This mitigation meets ACS objectives 2, 4, 5, 8 & 9. Note that this would be most effective if done in conjunction with the thinning proposed. This mitigation also offsets the impacts of soil compaction and displacement within the construction R/W.	5.9 miles
UNF	Elk Creek South Umpqua	Road Stormproofing	Elk Cr. Road Stormproofing	Sediment has been identified as a limiting factor for aquatic habitat in Elk Cr. The effects of the Pipeline Project are similar to a road, including possible impacts to flow and sediment regimes. Stormproofing improvement of existing roads restores hydrologic connectivity and reduces sediment by managing drainage and restoring surfacing where needed, all of which would benefit habitat for Coho.	9.2 miles
UNF	Trail Creek	Road Stormproofing	Trail Creek Stormproofing	Sediment has been identified as a limiting factor for aquatic habitat in Elk Cr. The effects of the Pipeline Project are similar to a road, including possible impacts to flow and sediment regimes. Stormproofing improvement of existing roads restores hydrologic connectivity and reduces sediment by managing drainage and restoring surfacing where needed, all of which would benefit habitat for Coho.	2.2 miles
UNF	Trail Creek	Road Decommissioning	Trail Cr. Road Decommissioning	A construction corridor 75-95 feet wide with additional work areas would be cleared. Of this, a 30-foot-wide route along the pipeline route would be maintained in early successional habitat. Decommissioning and planting selected roads in conjunction with precommercial thinning treatments (see other mitigations) would block up forested habitat in a period of about 40 years, and removal of culverts and roadbeds in riparian reduces sedimentation to the waters, all of which would improve habitat for Coho. This mitigation meets ACS objectives 2, 4, 5, 8 & 9. Note that this would be most effective if done in conjunction with the thinning proposed. This mitigation also offsets the impacts of soil compaction and displacement within the construction R/W.	0.3 miles
UNF	Upper Cow Creek	Road Decommissioning	Upper Cow Cr. Road Decommissioning	A construction corridor 75-95 feet wide with additional work areas would be cleared. Of this, a 30-foot-wide route along the pipeline route would be maintained in early successional habitat. Decommissioning and planting selected roads in conjunction with precommercial thinning treatments (see other mitigations) would block up forested habitat in a period of about 40 years, and removal of culverts and roadbeds in riparian reduces sedimentation to the waters, all of which would improve habitat for Coho. This mitigation meets ACS objectives 2, 4, 5, 8 & 9. Note that this would be most effective if done in conjunction with the thinning proposed. This mitigation also offsets the impacts of soil compaction and displacement within the construction R/W.	1.0 mile
UNF	Elk Creek South Umpqua	Fish Passage	Elk Cr. Fish Passage Culverts	Restoring stream crossings reconnects aquatic habitats by allowing the passage of aquatic biota, including Coho, and restoring riparian vegetation. Over time, these actions reduce sediment and restore shade. Restoration of these crossings includes riparian planting as a mitigation which would help offset the impact of shade removal at pipeline R/W crossings.	5 sites

TABLE 2.8-1 (continued)

ESA Listed and Proposed Species That Could Be Affected by the Project on NFS Lands

Admin. Unit	Watershed	Project Type	Project Name	Project Rationale	Quantity
Coho (Southern Oregon/Northern California Coast ESU) (cont.)					
UNF	Upper Cow Creek	Fish Passage	Upper Cow Cr. Fish Passage Culverts	Restoring stream crossings reconnects aquatic habitats by allowing the passage of aquatic biota, including Coho, and restoring riparian vegetation. Over time, these actions reduce sediment and restore shade. Restoration of these crossings includes riparian planting as a mitigation which would help offset the impact of shade removal at pipeline R/W crossings.	6 sites
UNF	Upper Cow Creek	Water Source Improvement	Upper Cow Cr Pump Chance	Construction of the pipeline and associated activities would increase fire suppression complexity. Pump chances increase capacity for agency response and help reduce potential fire losses to valuable habitats, including riparian vegetation that affects stream quality for coho, by providing readily available water sources.	1 site
UNF	Elk Creek South Umpqua	Water Source Improvement	Elk Cr Pump Chance	Construction of the pipeline and associated activities would increase fire suppression complexity. Pump chances increase capacity for agency response and help reduce potential fire losses to valuable habitats, including riparian vegetation that affects stream quality for coho, by providing readily available water sources.	2 sites
Coho (Oregon Coast ESU)					
UNF	Upper Cow Creek	Road Closure	Upper Cow Cr. Road Closure	Close roads, remove culverts, and treat weeds. Mowing and maintenance of pipeline corridor, temporary road construction, and road use are direct disturbance impacts to wildlife. Road closure would mitigate some of those impacts, improve interior stand connectivity and benefit aquatic habitats for coho over time.	1.2 miles
UNF	Elk Creek South Umpqua	Road Decommissioning	Elk Cr. Road Decommissioning	A construction corridor 75-95 feet wide with additional work areas would be cleared. Of this, a 30-foot-wide route along the pipeline route would be maintained in early successional habitat. Decommissioning and planting selected roads in conjunction with precommercial thinning treatments (see other mitigations) would block up forested habitat in a period of about 40 years, and removal of culverts and roadbeds in riparian reduces sedimentation to the waters, all of which would improve habitat for Coho. This mitigation meets ACS objectives 2, 4, 5, 8 & 9. Note that this would be most effective if done in conjunction with the thinning proposed. This mitigation also offsets the impacts of soil compaction and displacement within the construction R/W.	5.9 miles
UNF	Elk Creek South Umpqua	Road Stormproofing	Elk Cr. Road Stormproofing	Sediment has been identified as a limiting factor for aquatic habitat in Elk Cr. The effects of the Pipeline Project are similar to a road, including possible impacts to flow and sediment regimes. Stormproofing improvement of existing roads restores hydrologic connectivity and reduces sediment by managing drainage and restoring surfacing where needed, all of which would benefit habitat for coho.	9.2 miles
UNF	Trail Creek	Road Stormproofing	Trail Creek Stormproofing	Sediment has been identified as a limiting factor for aquatic habitat in Elk Cr. The effects of the Pipeline Project are similar to a road, including possible impacts to flow and sediment regimes. Stormproofing improvement of existing roads restores hydrologic connectivity and reduces sediment by managing drainage and restoring surfacing where needed, all of which would benefit habitat for coho.	2.2 miles

TABLE 2.8-1 (continued) **ESA Listed and Proposed Species That Could Be Affected by the Project on NFS Lands**					
Admin. Unit	**Watershed**	**Project Type**	**Project Name**	**Project Rationale**	**Quantity**
Coho (Oregon Coast ESU) (cont.)					
UNF	Trail Creek	Road Decommissioning	Trail Cr. Road Decommissioning	A construction corridor 75-95 feet wide with additional work areas would be cleared. Of this, a 30-foot-wide route along the pipeline route would be maintained in early successional habitat. Decommissioning and planting selected roads in conjunction with precommercial thinning treatments (see other mitigations) would block up forested habitat in a period of about 40 years, and removal of culverts and roadbeds in riparian reduces sedimentation to the waters, all of which would improve habitat for Coho. This mitigation meets ACS objectives 2, 4, 5, 8 & 9. Note that this would be most effective if done in conjunction with the thinning proposed. This mitigation also offsets the impacts of soil compaction and displacement within the construction R/W.	0.3 mile
UNF	Upper Cow Creek	Road Decommissioning	Upper Cow Cr. Road Decommissioning	A construction corridor 75-95 feet wide with additional work areas would be cleared. Of this, a 30-foot -wide route along the pipeline route would be maintained in early successional habitat. Decommissioning and planting selected roads in conjunction with precommercial thinning treatments (see other mitigations) would block up forested habitat in a period of about 40 years, and removal of culverts and roadbeds in riparian reduces sedimentation to the waters, all of which would improve habitat for Coho. This mitigation meets ACS objectives 2, 4, 5, 8 & 9. Note that this would be most effective if done in conjunction with the thinning proposed. This mitigation also offsets the impacts of soil compaction and displacement within the construction R/W.	1.0 mile
UNF	Elk Creek South Umpqua	Fish Passage	Elk Cr. Fish Passage Culverts	Restoring stream crossings reconnects aquatic habitats by allowing the passage of aquatic biota, including Coho, and restoring riparian vegetation. Over time, these actions reduce sediment and restore shade. Restoration of these crossings includes riparian planting as a mitigation which would help offset the impact of shade removal at pipeline R/W crossings.	5 sites
UNF	Upper Cow Creek	Fish Passage	Upper Cow Cr. Fish Passage Culverts	Restoring stream crossings reconnects aquatic habitats by allowing the passage of aquatic biota, including Coho, and restoring riparian vegetation. Over time, these actions reduce sediment and restore shade. Restoration of these crossings includes riparian planting as a mitigation which would help offset the impact of shade removal at pipeline R/W crossings.	6 sites
UNF	Upper Cow Creek	Water Source Improvement	Upper Cow Cr Pump Chance	Construction of the pipeline and associated activities would increase fire suppression complexity. Pump chances increase capacity for agency response and help reduce potential fire losses to valuable habitats, including riparian vegetation that affects stream quality for Coho, by providing readily available water sources.	1 site
UNF	Elk Creek South Umpqua	Water Source Improvement	Elk Cr Pump Chance	Construction of the pipeline and associated activities would increase fire suppression complexity. Pump chances increase capacity for agency response and help reduce potential fire losses to valuable habitats, including riparian vegetation that affects stream quality for Coho, by providing readily available water sources.	2 sites
Kincaid's Lupine					
UNF	Elk Creek South Umpqua	Noxious Weed Treatment	Elk Cr. Roadside Noxious Weeds	Mitigate impacts to Unique habitats impacted by the project. There would be loss of forest habitat buffering the unique habitats and disruption to soil horizons enhancing the opportunities for nonnative plant species, which has the potential to affect ESA-listed plants, including Kincaid's lupine.	6.7 miles

TABLE 2.8-1 (continued)

ESA Listed and Proposed Species That Could Be Affected by the Project on NFS Lands

Admin. Unit	Watershed	Project Type	Project Name	Project Rationale	Quantity
Kincaid's Lupine (cont.)					
UNF	Elk Creek South Umpqua	Lupine Meadow Restoration	Elk Cr. Lupine Meadow Restoration	Mitigate impacts to Unique habitats impacted by the project. There would be loss of forest habitat buffering the unique habitats and disruption to soil horizons enhancing the opportunities for nonnative plant species. These impacts cannot be fully mitigated on site; therefore, restoration activities such burning, removal of encroaching conifers, and noxious weed control would be applied to an 101-acre meadow located in LSR 223 to restore habitats for lupine.	101 acres
UNF	Days Creek South Umpqua	Lupine Meadow Restoration	Upper Cow Cr. Lupine Meadow Restoration	Mitigate impacts to Unique habitats impacted by the project. There would be loss of forest habitat buffering the unique habitats and disruption to soil horizons enhancing the opportunities for nonnative plant species. These impacts cannot be fully mitigated on site; therefore, restoration activities such burning, removal of encroaching conifers, and noxious weed control would be applied to an 23-acre meadow located in LSR 223 to restore habitats for lupine.	23 acres
UNF	Upper Cow Creek	Water Source Improvement	Upper Cow Cr Pump Chance	Construction of the pipeline and associated activities would increase fire suppression complexity. Pump chances increase capacity for agency response and help reduce potential fire losses to valuable habitats, including habitats used by Kincaid's lupine, by providing readily available water sources.	1 site
UNF	Elk Creek South Umpqua	Water Source Improvement	Elk Cr Pump Chance	Construction of the pipeline and associated activities would increase fire suppression complexity. Pump chances increase capacity for agency response and help reduce potential fire losses to valuable habitats, including habitats used by Kincaid's lupine, by providing readily available water sources.	2 sites
Rough Popcornflower					
UNF	Elk Creek South Umpqua	Noxious Weed Treatment	Elk Cr. Roadside Noxious Weeds	Mitigate impacts to Unique habitats impacted by the project. There would be loss of forest habitat buffering the unique habitats and disruption to soil horizons enhancing the opportunities for nonnative plant species, which has the potential to affect ESA-listed plants, including rough popcornflower.	6.7 miles
UNF	Upper Cow Creek	Water Source Improvement	Upper Cow Cr Pump Chance	Construction of the pipeline and associated activities would increase fire suppression complexity. Pump chances increase capacity for agency response and help reduce potential fire losses to valuable habitats, including habitats used by rough popcornflower, by providing readily available water sources.	1 site
UNF	Elk Creek South Umpqua	Water Source Improvement	Elk Cr Pump Chance	Construction of the pipeline and associated activities would increase fire suppression complexity. Pump chances increase capacity for agency response and help reduce potential fire losses to valuable habitats, including habitats used by rough popcornflower, by providing readily available water sources.	2 sites

a/ Per standard industry terminology, large woody debris is referred to as LWD in our EIS and in appendix O.4 of this BA (Forest Service Mitigation Plan), but it is referred to as large wood, or LW, in the main body of this BA, including this table, at the request of the National Marine Fisheries Service.

ACS = Aquatic Conservation Strategy; ESA = Endangered Species Act; LRMP = Land and Resource Management Plan; LSOG = late successional and old growth; LSR = late successional reserve; LW = large wood; NMFS = National Marine Fisheries Service; NWFP = Northwest Forest Plan; RRNF = Rogue River National Forest; R/W = right-of-way; UNF = Umatilla National Forest; WNF = Winema National Forest

3.0 SPECIES AND CRITICAL HABITAT CONSIDERED, PROJECT EFFECTS, AND DETERMINATIONS OF EFFECT

3.1 INTRODUCTION

3.1.1 Determination of Effects

BAs may serve multiple purposes, but the primary role is to document an agency's conclusions and the rationale to support those conclusions regarding the effects of their proposed actions on protected resources. Generally, one of the following three determinations will apply:

- "No effect" (NE) means there will be no impacts, positive or negative, to listed or proposed resources. Generally, this means no listed or proposed resources will be exposed to the action and its environmental consequences. Concurrence from the relevant Service is not required for a NE determination.
- "May affect, but not likely to adversely affect" (NLAA) means that all effects are beneficial, insignificant, or discountable. Beneficial effects have contemporaneous positive effects without any adverse effects to the species or habitat. Insignificant effects relate to the size of the impact, and should never reach the scale where take occurs. Discountable effects are those extremely unlikely to occur. Based on best judgment, a person would not: (1) be able to meaningfully measure, detect, or evaluate insignificant effects; or (2) expect discountable effects to occur. NLAA determinations require written concurrence from the relevant Service.
- "May affect, and is likely to adversely affect" (LAA) means that any adverse effect to listed species may occur as a direct or indirect result of the proposed action or its interrelated or interdependent actions, and the effect is not beneficial, insignificant, or discountable. LAA determinations require formal consultation with the relevant Service.

3.1.2 Determinations of No Effect

There are five listed species, and one species proposed for listing as threatened, that occur or could occur within the counties crossed by the Project, but would not be affected by the proposed action. The six listed and proposed species include the Contiguous United States DPS of Canada lynx (*Lynx canadensis*), Coterminous United States Population of bull trout – Klamath River DPS (*Salvelinus confluentus*), yellow-billed cuckoo – Western DPS (*Charadrius nivosus nivosus*), streaked horned lark (*Eremophila aphestris strigata*), slender orcutt grass (*Orcuttia tenuis*), and the North American wolverine (*Gulo luscus*). Brief synopses of the rationales for these no effects determinations are provided below.

Canada lynx. When FWS (2000a) listed Canada lynx as threatened in a final rule, Oregon was included in the species' range based on 12 verified lynx records (see McKelvey et al. 1999) in the state during the previous 100 years. The records (in museum collections) were from the 1800s and early 1900s including one in the U.S. National Museum from the east side of the Cascade Range at Fort Klamath (pre-1900) in Klamath County (Verts and Carraway 1998). Recent lynx documented in the state were from Wallowa County (1964), Benton County (1974), and Harney County (1993), all in atypical habitats suggesting animals were dispersing from Canadian population centers (Verts and Carraway 1998; McKelvey et al. 1999). Currently, northeast Oregon/southeast Washington is recognized as a peripheral area in the lynx recovery plan (FWS 2005a) and could sustain short-term survival during lynx dispersal. Currently, there is no evidence of Canada lynx being present in the action area. There appears to be an extremely remote chance of a lynx dispersing into southwest Oregon but that is not foreseeable during the construction of the Project and as a result Canada lynx are not considered further in this BA.

Bull trout. Bull trout in the Klamath River DPS inhabit seven isolated stream areas in the Klamath River Basin (FWS 1998a). Critical habitat for bull trout in the coterminous United States includes critical habitat unit (CHU) 9, Klamath River Basin. Unit 9 includes three subunits: Upper Klamath Lake, Sycan River, and upper Sprague River subunit (FWS 2010a). The Upper Klamath Lake subunit is within the Long Lake Valley-Upper Klamath Lake fifth-field watershed, which is not crossed by the Pipeline Project. Agency Lake is the only waterbody in Unit 9 with hydrologic connectivity to the Klamath River (within the Lake Ewauna-Klamath River fifth-field watershed); connectivity is through Agency Straits, Upper Klamath Lake, and Link River. As of 2010, Agency Lake was not occupied by bull trout (FWS 2010b) and no bull trout are present in the action area. Neither the species nor potentially occupied habitat would be affected by the proposed action. Therefore, this species is not considered further in this BA.

Yellow-billed cuckoo. FWS listed the yellow-billed cuckoo – western DPS that nests west of the Continental Divide as threatened under the ESA on October 3, 2014 (79 *Federal Register* 59991). In Oregon, the western DPS included birds that nest along the Willamette River and Columbia River although the last confirmed nesting records are from the 1940s and the birds disappeared in Oregon by 1945 (Wiggins 2005). Although ORBIC (2017b) includes Klamath County within the range of yellow-billed cuckoo, surveys conducted during 1988 in Klamath County did not find any cuckoos (FWS 2013a). There are recent records (1990 to 2009) from Deschutes, Malheur, and Harney counties (FWS 2013a). Yellow-billed cuckoos are considered a riparian-obligate species and are usually found in large tracts of cottonwood/willow habitats with dense sub-canopies, but may also be found in urban areas with tall trees (FWS 2007b). No suitable habitats are present within the action area, and the species would not be affected by the proposed action. Therefore, this species is not considered further in this BA.

Streaked horned lark. The streaked horned lark was listed as threatened in Washington and Oregon (i.e., in Benton, Clackamas, Clatsop, Columbia, Lane, Linn, Marion, Multnomah, Polk, Washington, and Yamhill counties in Oregon) in October 2013 (FWS 2013b) with critical habitat designated in Washington and Oregon (i.e., Clatsop, Columbia, Lane, Linn, Marion, Multnomah, Polk, and Yamhill counties in Oregon; FWS 2013b). None of the counties affected by the Pipeline or the LNG Project are included in the streaked horned lark species range or include critical habitat. FWS (2013b, citing Gabrielson and Jewett 1940) has noted that there are historical records prior to 1940 of nonbreeding horned larks in Clatsop, Tillamook, Coos, and Curry Counties. Based on communication with FWS (2017b), streaked horned larks are not present in Coos Bay and have not been documented on the Oregon coast for more than 20 years. Streaked horned larks overwinter in areas near their nesting grounds, and therefore, would not be expected in the Coos Bay area in the wintertime (FWS 2017b). The species occurs in bare and sparsely vegetated habitats such as coastal dunes, beaches, gravel roads, airport runways, grazed pastures, and dry mudflats; however, it does not occur on rolling or steep areas at these sites. Where deflation plains occur, streaked horned larks are often behind the foredune (Pearson 2013). No such suitable habitats are present within the action area, and the species would not be affected by the proposed action. Therefore, this species is not considered further in this BA.

Slender Orcutt Grass. In 1997, the FWS (1997a) listed slender orcutt grass as threatened in California with critical habitat designated in California in 2003 (FWS 2003c) and revised in 2006 (FWS 2006e). Slender orcutt grass occurs across a wide range of elevations (90 to 5,781 feet), but is associated primarily with large, deep vernal pools that have relatively long periods of inundation on Northern Volcanic Ashflow and Northern Volcanic Mudflow substrates (FWS 2009g). The species is known from disjunct occurrences from the Modoc Plateau in northeastern California, west to Lake County, California, and south through the Central Valley to Sacramento County (FWS 2005e). The closest designated CHU (SLEND 1A) is in California more than 50 miles south of the Pipeline (FWS 2006e). The FWS (2018a) indicated that this species may be present within the action area of the Project, and the current range map and available GIS coverage of potential species range (FWS 2018b) identifies that the species could occur near the eastern end of the Pipeline Project; however, the species has not been documented in the vicinity of the Pipeline (ORBIC 2017a) and no suitable habitat occurs in the potential range of this species near the Pipeline (FWS 2006e). Based on the above, there would be no effect to slender orcutt grass, and this species is not considered further in this BA.

North American Wolverine. Wolverines were proposed for listing as threatened under ESA in 2013, but the proposal was withdrawn in 2014 because the threats cited were not sufficient to warrant listing under the ESA (FWS 2014a). However, the U.S. District Court for the District of Montana vacated the FWS' 2014 withdrawal of its proposed rule to list the DPS of the North American wolverine as threatened under the ESA. The wolverine is currently considered a species proposed for listing as threatened (FWS 2016a). Wolverines have been occasionally documented in Oregon, most recently in the Wallowa-Whitman National Forest in northeast Oregon during 2011-2012 (Magoun et al. 2013), but no evidence of a reproducing, self-sustaining population has been found. Currently, wolverines are found in the North Cascades in Washington and the Northern Rocky Mountains in Idaho, Montana, Oregon (Wallowa Range), and Wyoming. Individual wolverines have also moved into their historic range in the Sierra Nevada Mountains of California and the Southern Rocky Mountains of Colorado, but have not established breeding populations in these areas (FWS 2014a). FWS has modeled wolverine habitat throughout the western U.S., and although there is modeled wolverine habitat in western Oregon, the FWS states that the map does not represent areas occupied by wolverine or areas with the potential to be occupied by wolverine (FWS 2013c). There is no evidence of wolverines being present in the action area. There appears to be an extremely remote chance of a wolverine dispersing into southwest Oregon, but that is not foreseeable during the construction of the Pipeline, and as a result, the North American wolverine is not considered further in this BA.

3.1.3 Format

There are 34 species listed as threatened, endangered, or proposed for listing under the ESA considered in this section. Included are 11 mammals (eight marine mammals, three terrestrial mammals), four birds, five herpetofauna (four reptiles and one amphibian), six fish, one invertebrate, and seven plants. This section was organized to address similar information and environmental analyses consistently among the diversity of organisms that could be affected by the Project. The following five sections are included for each species:

1. Species Account and Critical Habitat in which the current status under the ESA is identified, past threats that led to listing and current threats to continued existence, recovery plan components if available, abbreviated species' life history, population estimates and/or trends, and critical habitat that has been designated or proposed;
2. Environmental Baseline in which the species analysis area (portions of the Project where species are affected by the proposed action) relevant to each species is described, as well as the species' presence within the action area, species' habitat within the action area, and species' critical habitat present within the action area are described;
3. Effects of the Proposed Action in which direct and indirect effects to the species and critical habitats are evaluated in each applicable action area component;
4.
4. Conservation Measures that have been proposed by Pacific Connector and Jordan Cove, if any; and
5. Determination of Effects in which the action agency evaluates how the proposed action would affect the species and any designated critical habitat.

This BA assesses the Project as designed and proposed by the applicant; however, the FERC and the Forest Service have recommended that four route variation be included in the proposed action (as described in chapter 3 of the FERC EIS) including 1) the Blue Ridge Variation, 2) Survey and Manage Species Variation, 3) East Fork Cow Creek Variation, and 4) Pacific Crest Trail Variation. Appendix R provides the quantitative differences to listed species that these variations would have compared to the proposed action. As presented in appendix R, we have concluded that inclusion of these variations into the proposed action would not change the effects determinations presented in this BA.

3.2 MAMMALS

3.2.1 Blue Whale

3.2.1.1 Species Account and Critical Habitat

Status

The blue whale was listed as endangered throughout its range under the Endangered Species Conservation Act (ESCA) on December 2, 1970 (FWS 1970) and has been listed under the ESA since its implementation in 1973. The Eastern North Pacific blue whale population is classified as depleted and strategic under the Marine Mammal Protection Act (MMPA).

Threats

Commercial whaling played a large role in the decrease of the blue whale population (Sears and Perrin 2009). At least 9,500 blue whales were taken by commercial whalers in the North Pacific Ocean from 1910-1965 (NMFS 2013a). Commercial whaling in the eastern North Pacific is no longer a threat to blue whales. Current threats to the species include vessel strike, anthropogenic noise, hybridization with other species, pollution including entanglement in fishing gear, and environmental ocean changes that may result from climate change.

Monnahan et al. (2015) proposed that estimated ship strike levels of 10 to 35 whales annually did not pose a threat to the status of the eastern North Pacific stock, but estimates of carrying capacity of this blue whale stock differed depending on the level of ship strikes: 97 percent of carrying capacity with 10 annual strikes and 91 percent of carrying capacity with 35 annual strikes. The highest estimates of blue whale ship strike mortality (35/year; Monnahan et al. 2015) and 40/year; Rockwood et al. (2017) are similar, and annually represent approximately 2 percent of the estimated population size. The observed annual incidental mortality and injury rate (0.2/year) from ship strikes from 2012 to 2016 does not include undetected and unreported ship strikes of blue whales. One blue whale ship strike death was observed during the most recent five-year period of 2012 to 2016 (Carretta et al. 2018a), resulting in an observed annual average of 0.2 ship strike deaths. Observations of blue whale ship strikes have been highly variable in previous five-year periods, with as many as 10 observed (nine deaths plus one serious injury) during 2007-2011 (Carretta et al. 2013). The highest number of blue whale ship strikes observed in a single year (2007) was five whales (Carretta et al. 2013). Over the 10-year period 2007-2016, 11 blue whale ship strikes were observed (Carretta et al. 2013, 2018a). In addition, four unidentified whales were also observed struck by ships during the same 10-year period. Injured whales do not always strand or, if they do, they do not always have obvious signs of trauma. Consequently, additional mortality from ship strikes could be going unreported (Carretta et al. 2018a). The risk of ship strike to blue whales is discussed in more detail below (see section 3.2.1.3).

Anthropogenic noise has been identified by NMFS (1998) as a factor influencing the distribution of blue whales. Noise from ships and boats, and other anthropogenic sources may interfere and mask cetacean communication, finding prey, avoiding predators, and possibly navigation (Würsig and Richardson 2009). Underwater noise levels vary spatially and temporally throughout the blue whales habitat. This threat factor is discussed with relevance to the Oregon coast in more detail in section 3.2.1.3.

Hybridization between blue whales and fin whales has been documented, and may decrease the fitness of the hybrid offspring (Berube and Aguilar 1998). It is difficult to quantify the level to which hybridization occurs or the risk that hybridization may pose to existing blue and fin whale population; however, it is likely a contributing factor to the species current status and risk factors.

The effects of pollution on blue whales are also difficult to quantify. Pollutant spills that occur in areas occupied by blue whales or their prey species have possible health consequences to individuals. Entanglement with fishing gear, particularly gillnets, is a more tangible threat to blue whales (as well as to many other species of marine life) but the number of entangled blue whales, and the extent of injuries or death is not well understood and again difficult to quantify with relevance to the Eastern North Pacific population (NMFS 1998, 2015a). Although difficult to quantify, these are likely contributing factors to the species current status and risk factors.

The effects of climate change on blue whales is also uncertain. The impacts from climate change could have repercussions throughout the food chain of the North Pacific Ocean, and this may have consequences on the metabolic demands of blue whales in warmer oceans. Marine populations may shift their distributions towards the poles or in the ocean depths (Fogarty and Powell 2002). Distributional variations may also occur in response to changes in ocean stratification. However, quantifying the effect of climate change as a threat to blue whales is not currently possible.

Of these identified threats, vessel strike and underwater noise have relevance to the Project and are further discussed with reference to the Oregon coast in section 3.2.1.3.

Species Recovery

NMFS drafted a recovery plan in July 1998 for the blue whale. The goals of the recovery plan are to identify actions that will result in the minimization or elimination of effects from human activities that are detrimental to the species recovery (NMFS 1998). The stepdown outline to achieve the goal includes the following:

- Determine stock structure of blue whale populations occurring in U.S. waters and elsewhere.
- Estimate the size and monitor trends in abundance of blue whale populations.
- Identify and protect habitat essential to the survival and recovery of blue whale populations.
- Reduce or eliminate human-caused injury and mortality of blue whales.
- Minimize detrimental effects of directed vessel interactions with blue whales.
- Maximize efforts to acquire scientific information from dead, stranded, and entangled blue whales.
- Coordinate state, federal, and international efforts to implement recovery actions for blue whales.
- Establish criteria for deciding whether to delist or down list blue whales (NMFS 1998).

Life History, Habitat Requirements, and Distribution

Blue whales are the largest animals on earth, and occur throughout the world's oceans in three separate populations: Northern Atlantic, Northern Pacific, and Southern Hemisphere. This migratory species moves seasonally between high and low latitude regions. In the eastern North Pacific Ocean, blue whales generally inhabit the Gulf of California and offshore waters of Central America during late fall and winter then migrate northwards off the west coast of North America during April and May. During the spring and summer, the whales are widely dispersed, with many blue whales occurring off the California coast, some migrating to Canadian waters while others disperse north to the Gulf of Alaska or west toward the Aleutian Islands (Sears and Perrin 2009). Blue whales also exhibit some variability in the seasonal movements, habitat use, and timing patterns.

Blue whales inhabit and feed in the coastal and pelagic environments and, as a result, are found over the continental shelf and farther offshore in deep waters. They prey mainly on two krill species, *Euphausia pacifica* and *Thysanoessa spinifera* (NMFS 1998). *E. pacifica* is an offshore euphausiid that is smaller than the more neritic euphausiid *T. spinifera*. Recent studies have shown a shift in the distribution of blue whales closer to the coast of California due to a shift in feeding more on *T. spinifera* (NMFS 1998). Blue whales typically travel alone or in pairs, but can be found in larger aggregations in feeding areas. This species generally dives for between 5 to 20 minutes, and can reach depths of 150 to 200 meters (492 and 656 feet), but shallow dives are common (Shirihai and Jarrett 2006).

Blue whales are thought to reach sexual maturity between 5 and 15 years of age, with parturition occurring in the warm winter waters. The calving interval is approximately two years (NMFS 1998). The gestation period for blue whales is between 10 and 12 months, and the calves are weaned between 6 and 8 months. Little is known of the longevity and natural mortality of blue whales, but the lifespan is estimated at up to 90 years (Shirihai and Jarrett 2006). Ice entrapment is not a known factor of natural mortality for the Pacific population of blue whales, but there has been documented killer whale predation on this population (NMFS 1998). Shark predation also occurs, though this is usually limited to neonatal and juvenile animals.

Blue whales are occasionally washed ashore, but based on records spanning 72 years (1930 to 2002), blue whales are the least frequent of five balaenopterid species found stranded on Oregon and Washington coasts, with only one female reported stranded in Washington (Norman et al. 2004).

Population Status

Blue whales occurring along the Pacific Coast of the U.S. are part of the Eastern Northern Pacific population. The best estimate of the population size is 1,647 whales, based on the time period of 2008–2011 (Calambokidis and Barlow 2013). The minimum population size is estimated at approximately 1,551 whales (Carretta et al. 2018a). The potential biological removal (PBR) for this blue whale population is 9.3 whales per year, but because this population spends only one-quarter of its time in United States waters, the PBR is reduced to 2.3 whales per year in U.S. waters (Carretta et al. 2018a). The Eastern North Pacific blue whale population has not been observed to increase since the early 1990s, and this is thought to be due to density-dependent effects rather than specific threat factors (Carretta et al. 2017). As of 2013, this population is now thought to be at 97 percent carrying capacity (Monnahan et al 2015).

Critical Habitat

Critical habitat for this species has not been designated.

3.2.1.2 Environmental Baseline

Analysis Area

The analysis area applicable to blue whales, and all the marine mammal species presented in this document, includes the fan shaped area directly off Coos Bay out to the continental shelf break as shown in figure 3.2.1-1). Following the biological oceanographic convention, the edge of the continental shelf was defined as the 200 m contour (see Lalli and Parsons 1993). At this location along the Oregon coast, the continental shelf break is approximately 12 nmi from shore. This marks the division between the inshore neritic and the offshore oceanic realms (Lalli and Parsons 1993). As the potential effects to blue whales would be associated with the LNG carriers inbound and outbound from the LNG terminal, the marine analysis area was refined to include that portion of the ocean under the jurisdiction of the United States relevant to the Project-related traffic.

Exports of LNG originating from the LNG Project would likely be to markets primarily in Asia. Shipping traffic between Asia and the U.S. West Coast travels the “Great Circle route,” arriving and departing the West Coast perpendicularly (east-west) or diagonally (southeast-northwest) to the coast (Pacific States/British Columbia Oil Spill Task Force 2002; Berg and Lawrenson 2015). It is expected that the LNG traffic would exit Coos Bay on a westward course, and return on a parallel, but eastwards route, as the Coast Guard has indicated that this is appropriate for LNG carrier traffic between Oregon and Asia (Berg and Lawrenson 2015). For the purpose of the potential effects assessment it is assumed that the path of travel is perpendicular to the coast. The analysis area described for blue whales is the same as for all whale species for determination of the potential effects related to the LNG Project. For brevity, this section will be referenced for the other marine mammal species identified in this document.

Species Presence

While inter-annual variability exists, long-term acoustic data indicate that blue whales are seasonally present in the waters between Oregon and Vancouver Island, British Columbia, Canada from July to January, but that they occupy waters farther offshore than in the more southerly parts of their U.S. range (Stafford et al. 1999). However, more recent data also indicates the use of both the inshore and offshore waters off the coast of Oregon (Carretta et al. 2018b). Acoustic data further indicate that blue whales are present in offshore Oregon waters for an average of 21 weeks with detections commencing in October, and that they occur in lower densities than in the more southern regions of the U.S. range (Burtenshaw et al. 2004). The acoustic data suggest that the fall and winter blue whales present off Oregon are less densely aggregated than in other areas of the eastern North Pacific (Burtenshaw et al. 2004). Feeding aggregations of blue whales are not currently documented to occur in Oregon waters.

Line-transect ship surveys have been conducted off the coasts of Oregon and Washington during the summer and fall of 1996, 2001, 2005, and 2008 (Barlow and Forney 2007; Forney 2007; Barlow 2010). The line-transects were predetermined to survey for pelagic cetaceans within approximately 300 nmi of the U.S. West Coast. The sightings data have been used to estimate population sizes (Barlow and Forney 2007; Forney 2007; Barlow 2010), as well for habitat modeling to determine important areas and habitat-based density estimates (see Becker et al. 2012 and Calambokidis et al. 2015).

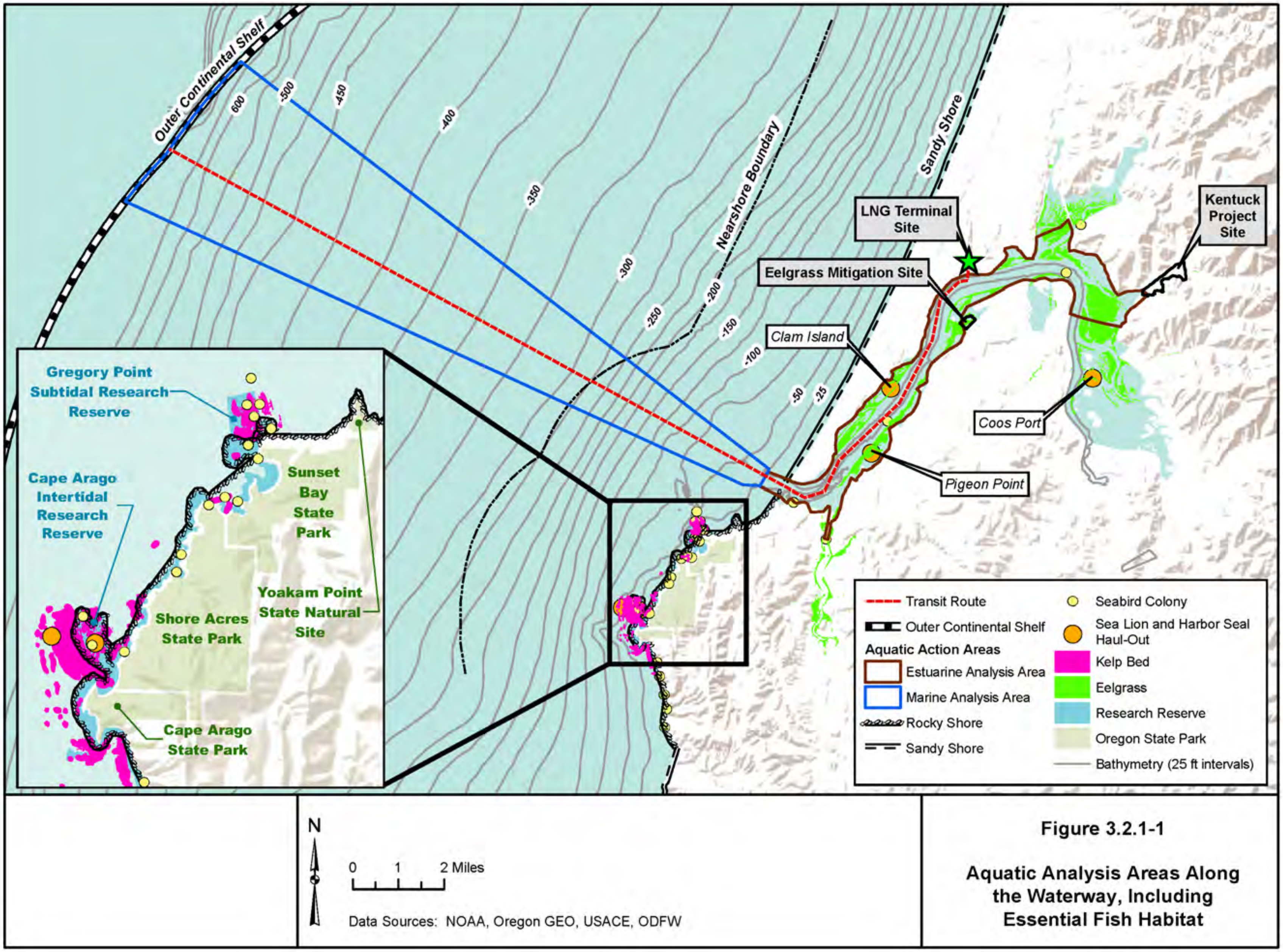


Figure 3.2.1-1

Aquatic Analysis Areas Along the Waterway, Including Essential Fish Habitat

Habitat

Blue whales are not evenly distributed throughout the marine habitats of the U.S. West Coast, and tend to be aggregated, particularly along the continental shelf edge, with a preference for Californian waters, rather than off Oregon or Washington (Calambokidis et al. 2015). The U.S. West Coast is one of the most important feeding areas during summer and fall, although increasingly blue whales have been found feeding outside of this area (Carretta et al. 2014a). Most blue whales of this stock are believed to migrate in the winter to highly productive areas off Baja California and the Gulf of California (Carretta et al. 2018b).

Though blue whales inhabit inshore and offshore regions, the habitat-based density models of Becker et al. (2012) indicate that blue whale densities increase with decreasing latitude from Washington to California, with highest densities off San Francisco and Santa Barbara. Nine Biologically Important Areas have been identified in western U.S. waters, with all occurring off the coast of California (Calambokidis et al. 2015).

Predicted mean densities of blue whales using the continental shelf habitats off Oregon are relatively lower in the northern waters than off central and southern Oregon and range from 0.0006 to 0.0058 whales/square kilometer (km^2) throughout the state (Calambokidis et al. 2015). For comparison with other coastal areas, the lowest densities are predicted for Washington waters (0.0002 to 0.0005 whales/km^2), while the highest densities occur off southern California (0.0074 to 0.0102 whales/km^2; Calambokidis et al. 2015).

Critical Habitat

Critical habitat has not been designated for this species.

3.2.1.3 Effects of the Proposed Action

Direct and Indirect Effects

Ship Strike

There is an ongoing threat of ship strikes to large cetaceans around the world, causing mortality or injury. Data suggest that cetaceans collide with ships relatively infrequently (Laist et al. 2001; Jensen and Silber 2003; Douglas et al. 2008; Carretta et al. 2013). Research has identified a number of factors, related to both vessels and whales, that can influence the probability of a vessel-whale strike (e.g., Richardson et al. 1995; JWGVSAI 2012; Taggart 2007; Laist et al 2001). However, it is recognized that estimates are undoubtedly negatively biased because vessel strikes can go unreported as the event is either not witnessed, the injured or deceased animal is not observed, or the stranded carcass is not discovered.

Data provided by Carretta et al. (2013) indicated one blue whale was struck in the Oregon-Washington Exclusive Economic Zone (EEZ) between 2007 and 2011, which yielded an annual rate of 0.20 blue whales struck for this region. Jensen and Silber (2003) reported 0.31 blue whales struck per year between 1987 and 2002 along the entire U.S. Pacific Coast. The most recent estimated number of annual ship strike deaths was 18 blue whales, though this includes only the period July to November when whales are most likely to be present in the California Current[21] and the time of year that overlaps with cetacean habitat models generated from line-transect surveys

[21] The California Current is a Pacific Ocean current that moves southward along the western coast of North America, beginning off southern British Columbia and ending off southern Baja California Peninsula.

(Becker et al. 2016; Rockwood et al. 2017). The existing estimates of 18/year of ship strike to blue whales are above the calculated PBR for this species at 2.3 whales/year within the U.S. EEZ. Most ship strikes occur where vessel densities overlap with container port ships and blue whale feeding aggregations. There is still uncertainty about the actual rate of anthropogenic mortality due to many factors including understanding of the current carrying capacity for blue whales (Monnahan et al. 2015).

The LNG Project is expected to add as many as 120 vessels per year in and out of Coos Bay. In terms of the number of east-west transits expected, this adds an additional 240 vessel transits through the marine analysis area. Therefore, constructing and operating the Project would increase the risk of ship strikes because of the spatial overlap between blue whales in the marine analysis area and the transiting Project-related vessels.

Ship Strike Risk Modeling

The risk of ship strikes to large cetaceans has been assumed to be the product of ship traffic and the cetacean population densities. An index of relative ship strike risk within an explicitly defined gridded study area was described by Williams and O'Hara (2009). In that assessment, the whale density estimates at each grid point were multiplied by the nearest value of shipping intensity using regular-interval ship locations from agencies' remote monitoring of shipping in Canadian waters. Similar fine-scale data are not available within the marine analysis area. However, in order to appropriately assess the potential impact from ship strikes to the different marine mammal species, a quantitative metric was employed.

A Whale Strike Risk Estimation Model (WSREM) was developed to evaluate the relative risk to the different whale species, with the addition of vessels transiting to the LNG Terminal added to the existing conditions. The WSREM metric considered the ship strike risk to be the product of the species density, the length of the whale, the proportion of the time spent at the surface, the annual number of vessels, the number of transits/vessel, and the distance travelled per transit within the marine analysis area. This value was then multiplied by the proportion of the year each species is present in the analysis area, and divided by the spatial extent of the analysis area to yield a comparable metric in whales/km^2. The final metric is expressed in whales/1,000 km^2 for ease of comparison by reducing the number of decimal places for each metric. The upper and lower whale density estimates were based on the habitat specific densities for blue whales, fin whales and humpback whales (Becker et al. 2012; Calambokidis et al. 2015). Quantified comparable estimates for other species were not available, but the existing data were examined to qualitatively determine the level of risk to these species.

The WSREM metric was calculated with the following physical variables (table 3.2.1-1).

TABLE 3.2.1-1

Physical Variables Included in the WSREM for all Species

Marine Analysis Area (km^2)	85.80
Number of Vessels	
LNG carriers Only	120
Existing Traffic Conditions	50
Exiting Traffic Plus LNG carriers	170
Number of Transits per Vessel	2
Distance Travelled Per Transit, km	24.54

This WSREM was based on several assumptions including the following:

- all species in analysis area had an equal probability of being struck,
- there is an equal probability of vessel strike throughout the analysis area,
- all vessels have an equal probability of striking whales,
- all vessels transit the maximum length within the marine analysis area,
- all vessels complete two full transits of the marine analysis area, and
- the species are evenly distributed throughout the marine analysis area.

For conservative results, the maximum length of each species was included, but because vessel strike risk is related to the length of the whale, this assumption will result in an overestimate for all but the largest members of each species. Additionally, the risk is also related to the length and draft of the vessel, but due to the variations in different vessels, the WSREM included the area of the analysis area and assumed an equal risk throughout for all vessels for conservative results. This approach did not aim to quantify the number of individuals that could be struck due to the number of uncertainties associated with the different input variables, but rather assess the relative risk to whales from adding LNG Project–related vessels. The WSREM metric does not include any behavioral responses, learned responses, or previous experiences that may be associated with different age classes and different species of whale. Nevertheless, the WSREM is used to estimate the change in relative risk from current conditions with the forecasted number of vessels transiting to the LNG terminal. The WSREM metric can account for change over time in response to the whales' actual distributions and habitat use which can change in response to environmental variables through the inclusion of the habitat based density estimates, the time spent at the surface which will may differ by age classes, and the number of vessels transiting which can change in response to global economic forces. As these variables can be updated, the WSREM is dynamic as it is easily adjusted to compare to future conditions with regard to shipping traffic, Project-related traffic, and updated estimates of whale species habitat-specific densities.

Estimated Ship Strikes to Blue Whales

Determination of the WSREM for blue whales (table 3.2.1-2) included the following variables:

- Blue whale length: 30.48 meters (https://www.fisheries.noaa.gov/species/blue-whale)
- Time at Surface: 5 percent (Lagerquist et al. 2000)
- Density – Lower = 0.0036 whales/km^2 (Calambokidis et al. 2015)
- Density – Upper = 0.0058 whales/km^2 (Calambokidis et al. 2015)
- Proportion of year in marine analysis area: July to January = 0.583

TABLE 3.2.1-2

Results of WSREM for Blue Whales

Marine Traffic	Risk Lower Estimate (whales/1,000 km^2)	Risk Upper Estimate (whales/1,000 km^2)
LNG Carriers Only	0.22	0.35
Existing Traffic Only	0.09	0.15
Combined Results	0.31	0.50

Because the Project would increase the vessel traffic in Coos Bay, from approximately 50 vessels per year to 170 vessels per year (as a result of the additional 120 vessels per year from the Project), the estimated whale strike risk would increase from existing levels. The WSREM yields a combined risk to blue whales in the marine analysis area ranging from 0.31 to 0.50 whales/1,000 km^2. This risk was limited to the time period that blue whales are known to occur off the coast of Oregon during seven months of the year (July–January).

Although the risk of ship strikes to blue whales would increase due to the addition of LNG carriers, this increase is not thought to be significant for the Eastern North Pacific stock as the coast of Oregon does not contain identified critical habitat nor is it a recognized area for feeding aggregations, and that current documented ship strikes in this region are low. However, the potential for ship strike to blue whales could not be ruled out.

Underwater Noise

All vessels produce noise from the machinery and equipment onboard. The propeller cavitation produces most of the broadband noise with dominant tones derived from the propeller blade rate. Propellers create more noise if damaged, operating asynchronously, or operating without nozzles. Engines and auxiliary machinery can also radiate noise during operation which is related to ship size (larger ships are generally noisier than small ones), speed (noise increases with ship speed), and mode of operation (ships underway with full loads, towing or pushing loads, are noisier than unladen ships) (Greene and Moore 1995).

When whales are exposed to low-level sounds from distant or stationary vessels, they appear to ignore the sounds. However, in general, baleen whales move away, abruptly change direction, or dive to avoid close approach by vessels. Baleen whales can interrupt normal behavior and swim away from strong or rapidly changing vessel noise, especially if a vessel is headed directly toward the whale (Richardson 1995). However, radiated ship noise of oncoming ships may not be immediately detected by whales near the surface due to bow null-effect acoustic shadow zones (Allen et al. 2012). Because of these acoustic shadow zones, whales may not hear approaching ships to allow time for their avoidance response even though whale auditory ranges overlaps with peak frequencies of ship noise. Masking is also a potential issue related to ship noise, in which whales might not be able to hear each other over the noise that nearby vessels make.

Steam turbine power has been replaced by dual-fuel diesel electric (DFDE) power plants adapted to utilizing LNG gas boil-off and diesel fuel to power electric drives in many recently constructed LNG carriers. The DFDE propulsion system is more fuel efficient with less engine noise and vibration (Gilmore et al. 2005). Whether or not lower noise-producing propulsion systems would cause increased ship-strikes with marine mammals is unknown.

Ambient noise in the northeast Pacific Ocean has changed throughout the twentieth century. Comparisons of ambient noise from the 1990s with noise measurements taken during the 1960s indicates an increase by about 10 decibels (dB; Andrew et al. 2002). More recent long-term analyses of vessel-traffic related noise shows that along the US west coast, noise levels are either holding steady or increasing slightly off Southern California, but decreasing off Oregon and Washington (Andrew et al. 2011). In addition to the anthropogenic sources, ambient ocean noise is a product of wind, precipitation, wave noise, and sounds generated by a diversity of marine wildlife (McDonald et al. 2008). Other sources of underwater noise include occasional events such as earthquakes and meteorological events (i.e., storms including high winds, thunder), and in high latitudes ice formation and thawing. The recent long-term acoustic analyses in the eastern North Pacific Ocean indicate non-linear changes to the ambient ocean noises over time and space.

As a result of overlap in the frequency ranges emitted and used by vessels and cetaceans, anthropogenic noise, including that from vessels, may affect communication, prey detection, predator avoidance, and possibly navigation (Würsig and Richardson 2009). While anthropogenic noise and vessel disturbance may affect blue whales, there is little information available to describe or quantify the effects, and it is difficult to determine whether, or how, vessel noise affects blue whales (NMFS 2013a). For instance, a vocalizing blue whale that had been calling prior to nearby passage of a merchant ship continued to call during the passage even though the ship noise at the whale's position exceeded the ambient sound level by as much as 26 dB (McDonald et al. 1995). Additionally, underwater noise (intensity, duration and sound energy) can have short and long term effects on the hearing of marine animals. Anthropogenic noise can cause hearing loss in cetaceans which can be temporary (abbreviated TTS for Temporary Threshold Shift) or permanent (abbreviated PTS for Permanent Threshold Shift). Repeated TTS may lead to PTS in which sensory hair cells in the inner ear are destroyed with damage to the cochlea (Nordmann et al. 2000). NMFS technical guidance for assessing the effects of anthropogenic noise on marine mammals was reviewed and updated in July 2016 (NMFS 2018). The updated acoustic thresholds cover the onset of both TTS and PTS for Level A, though Level B remains unchanged (table 3.2.1-3).

TABLE 3.2.1-3

NOAA Fisheries In-water Acoustic Thresholds for Marine Mammals

Criterion	PTS Onset (Received Level)	
Level A: Hearing Groups a/	**Impulsive**	**Non-Impulsive**
Low-Frequency Cetaceans (LF)	PK: 219 dB SEL_{cum}: 183 dB	SEL_{cum}: 199 dB
Mid-Frequency Cetaceans (MF)	PK: 230 dB SEL_{cum}: 185 dB	SEL_{cum}: 198 dB
High-Frequency Cetaceans (HF)	PK: 202 dB SEL_{cum}: 155 dB	SEL_{cum}: 173 dB
Phocid Pinnipeds (PW)	PK: 218 dB SEL_{cum}: 185 dB	SEL_{cum}: 201 dB
Otariid Pinnipeds (OW)	PK: 232 dB SEL_{cum}: 203 dB	SEL_{cum}: 219 dB
Criterion b/	**Criterion Definition**	**Threshold**
Level B	Behavioral disruption for impulsive noise (e.g., impact pile driving)	160 dB_{rms}
Level B	Behavioral disruption for continuous noise (e.g., vibratory pile driving, drilling)	120* dB_{rms}

a/ Level A: Dual Thresholds (impulsive): Use one resulting in large effect distance (isopleth) SEL_{cum} thresholds incorporates weighting functions.
b/ Level B: All decibels referenced to 1 micropascal (re: 1 µPa). Note all thresholds are based off root mean square (rms) levels.
*The 120 dB threshold may be slightly adjusted if background noise levels are at or above this level.

A review of LNG carriers in service during 2013 (Colton 2013; MarineTraffic 2013) revealed there are 267 vessels with capacities of 148,000 m^3 or less, the current size limit for LNG carriers utilizing the LNG Terminal. Hatch et al. (2008) estimated underwater noise levels from various commercial ships while transiting the Stellwagen Bank National Marine Sanctuary off the Massachusetts coast. Estimates of sound levels from the Berge Everett (also known as the BW Suez Everett), an LNG carrier built in 2003 with 138,028 m^3 capacity (93,844 gross tonnage), are used here to estimate exposure of marine mammals to project-related shipping noise. The reported noise levels from that vessel serves as the standard for the following analysis of noise effects on blue whales (as well as other whales, where applicable) within the marine analysis area.

The LNG carrier in the Hatch et al. (2008) study produced average sound levels (with one standard error) of 182 ± 2 dB re 1 micropascal (µPa) @1 meter (Hatch et al. 2008). Using the Practical Spreading Loss Model, the sound attenuates to 120 dB at about 13.6 kilometers (km). Doubling this distance to account for both sides of the vessel (27.8 km), and taking into account the lower and upper density estimates for blue whales (see *Estimated Ship Strikes to Blue Whales* in section 3.2.1.3), there could be an estimated 0.10 to 0.16 blue whales/km within the area of sound attenuation to 120 dB. Assuming 120 LNG carriers call at the LNG Project annually, with each carrier making two transits through the marine analysis area per call and a 30-year life span of the Project, it is estimated that the number of blue whales that could be present and potentially affected could range between 432 and 648 blue whales within the 120 dB attenuation area (0.06*240*30=432 or 0.09*240*30=648) over the life of the Project.

Further, because tractor tugs would travel to meet each incoming LNG carrier and return to the port after guiding each outgoing LNG carrier from the Project, blue whales could be exposed to noise levels above 120 dB in the marine analysis area. The distance that the noise from tractor tugs could attenuate to 120 dB averaged about 5 km, as compared to 120 dB attenuation of about 13.6 km for LNG carriers. Because the lateral area within the 120 dB attenuation area for tractor tugs would be roughly 37 percent of that for LNG carriers, as many as between 160 and 240 blue whales could occur within the 120 dB attenuation area for tractor tugs over the life of the Project.

Existing commercial vessels within the marine analysis area produce underwater noise levels that are comparable to or exceed noise from the LNG carrier described by Hatch et al. (2008). Noise generated by various types of commercial ships (container ships, crude oil tankers, product tankers, bulk carriers, and others) were recently evaluated by McKenna et al. (2012). Underwater noise levels varied by ship type and also by vessel length, gross tonnage, vessel speed, and to some extent, vessel age (older vessels tended to be louder than newer vessels). For example, a 54,000-Gross Ton container ship generated the highest acoustic source level of 188 dB re 1 µPa @ 1 meter while a 26,000 Gross Ton chemical tanker had the lowest at 177 dB re 1 µPa @1 meter (McKenna et al. 2012). Noise levels from the vessels examined in that study are assumed to be typical of ship noise in the marine analysis area and would produce radiated noise levels that would exceed the threshold for Level B for continuous noise at 120 dB_{rms} (see table 3.2.1-3, above).

Some blue whales may be exposed to sound levels from LNG carriers and tugs that could cause behavioral disturbance. However, sound levels to which blue whales (or other marine mammals considered in this BA) would be exposed would be well below the peak sound levels and exposure would be well below the cumulative exposure levels that were developed by NMFS in 2016 and those found in NMFS (2018).

In particular, average sound level of LNG carriers studied by Hatch et al. was 182 dB (re 1 µPa @1 meter) while the cumulative sound exposure level (SEL_{cum}) threshold values for low-frequency and mid-frequency whales are 199 dB and 198 dB, respectively. Cumulative exposure would not occur because both the noise source and the whales would be moving and would only be in proximity for a short duration.

Fuel Spills

Direct effects on blue whales from fuel or equipment-related spills at sea include irritation and burning from direct contact, ulcers and internal bleeding if ingested, and inhalation of toxic fumes. Inhalation of petroleum vapors can cause pneumonia in marine animals, due to large amounts of foreign material (vapors) entering the lungs (Lipscomb et al. 1994). Indirect effects include contamination of food sources.

Unintentional spills or releases of diesel fuel and/or gasoline are possible. According to the 2016 Annual Report of the Pacific States/British Columbia Oil Spill Task Force, Oregon has had one the lowest rate of calls of spills compared to other Pacific U.S. states and British Columbia to the emergency response hotline from 1999 to 2015, with the annual number of calls generally less than 25/year (Oil Spill Task Force [OSTF] 2016). The state of Oregon participates in an international program ("Spills aren't Slick") coordinated through the Pacific Oil Spill Prevention Education Team that recognizes there are numerous avenues from fuel docks to recreational boaters, to commercial fishing and transport that may contribute to the annual rate of spills and releases. From this data source, it appears that the background rate of spills off the Oregon coast (incidence of spills in proportion to total vessel operation) by fishing vessels, recreation vessels, and other vessel types is generally low and expected to continue at low frequencies in the foreseeable future as a result of the existing programs and coordinated efforts to minimize this risk to the environment.

The Federal Water Pollution Control Act, as amended by the Clean Water Act (CWA; 33 U.S.C. 1251–1387), prohibits the discharge of oil upon the navigable waters of the U.S., which include out 12 nmi from shore, Contiguous Zones, and, where it can be determined that the natural resources of the United States are impacted, out to the EEZ (200 miles). In addition to U.S. Law, International Regulation under Annex I to the International Convention for the Prevention of Pollution from Ships (commonly referred to as MARPOL 73/78)[22] requires that all ships have an oily water separator, which is a piece of equipment used to pump a vessel's bilges. As the bilge water is pumped through this equipment, water is discharged overboard, while the oil is diverted to a holding tank. Ships are also required to have waste oil holding tanks of sufficient capacity to keep all waste oil aboard for later disposition either burned in an incinerator or discharged ashore in compliance with applicable regulations.

LNG carriers calling on the LNG Project would be required by the Coast Guard to have a vessel response plan in order to be adequately prepared for accidental spills. LNG carriers would also be required to obtain a vessel general permit from the U.S. Environmental Protection Agency (EPA) that would outline regulations for avoiding release of even small quantities of fuel or lubricants during normal operations such as washing the vessel deck. As a result, effects to blue whales from accidental spills are expected to be insignificant and discountable.

Critical Habitat

The proposed action would not affect critical habitat because none has been designated.

3.2.1.4 Conservation Measures

To reduce impacts on whales, numerous conservation measures would be implemented. The conservation measures described for blue whales would also apply to the other marine mammal species in this document.

During the 96-hour pre-notification process required of all LNG carriers calling on the LNG terminal, the LNG carriers would consult the Local Notice to Mariners (issued by the Coast Guard)

[22] The U.S. regulations implementing MARPOL Annex I are found in 33 CFR subchapter O, parts 150-160.

and U.S. Coast Pilot to understand seasonal migration patterns, times, and routes and obtain current information on whale sightings in the waters off Coos Bay and the latest recommendations and advisories from the NMFS and Coast Guard. The LNG Carrier Master would take this into account and adjust the vessel speed and route accordingly. In addition, three tractor tugs would guide the LNG carrier from a point approximately 5 nmi offshore of the entrance to Coos Bay and on to the LNG terminal.

The LNG carrier operators would be required to consult the current whale sightings in the continental shelf waters near Coos Bay, prior to transiting to or from the LNG terminal. Vessel operations would be required to be aware of the blue whale distributions in the continental shelf waters near Coos Bay, and adjust operations accordingly to avoid aggregations of blue whales as navigably possible. Vessels transiting to and from the LNG terminal would be required to post a watch for marine mammals for the duration of the vessels' transit across the continental shelf and have the information relayed directly to the vessel master.

LNG carriers would be required to reduce speed to 10 knots or less when cow-calf pairs, or large groups are observed near an underway LNG carrier, when navigably possible. LNG carriers would also be requested to route around and maintain a 100-yard distance from the whales observed and to avoid crossing in front of the whales and maintain a parallel route, when navigably possible. In addition, for safety of the vessel and crew, course adjustments would need to be made gradually away from the whales' location or direction of travel. Lastly, the LNG carrier operators would be encouraged to review and adopt when possible guidelines to reduce underwater noise from commercial ships (International Maritime Organization [IMO] 2014).

To further increase the awareness of local marine mammal species and risk factors, Jordan Cove would provide a Ship Strike Avoidance Measures Package to shippers calling on the LNG terminal in Coos Bay. This package would include:

- Training to LNG carrier bridge crews, including the use of a reference guide such as the *Marine Mammals of the Pacific Northwest, including Oregon, Washington, British Columbia and South Alaska* (Folkens 2001). This is a pamphlet that would be provided to LNG carriers calling on the terminal and would be included as part of the terminal use agreement to the shippers.
- A copy of *A Prudent Mariner's Guide to Right Whale Protection* (NMFS 2009b) or *Mariners Guide to Whales, Dolphins and Porpoises of Western Canada* [CORI 2017]. *A Prudent Mariner's Guide to Right Whale Protection* is specific to right whales, but NMFS has stated that the guidance and avoidance measures are also applicable to fin, humpback, and sperm whales. A *Mariners Guide to Whales, Dolphins and Porpoises of Western Canada* focuses on Pacific Ocean species. In the event, that a U.S.-based Pacific guide is developed before operations commence, this guide would be used.
- Measures discussed in the 2010 workshop in California ("Reducing Vessel Strikes of Large Whales in California" [DeAngelis 2010]) as relevant for the species expected in coastal Oregon.
- Sightings of marine mammals are to be documented and reported to a central database. This would be arranged with consultation of NMFS and the Oregon Institute of Marine Biology. This reporting would assist in understanding patterns of distribution and occupancy in the continental shelf waters of Oregon by blue whales.

- Written guidance on expectations regarding:
  - Active watch for marine mammals.
  - Sightings data documentation, and reporting procedures.
  - Vessel speeds of 10 knots or less when mother-calf pairs or groups are sighted.
  - Maintenance of a minimum distance of 100 yards from whales, when navigably possible. This is particularly relevant if advance notice of whales locations are provided by NMFS.
  - Maintenance of a parallel course to the whale(s) and avoidance of excessive speed or abrupt course changes until the vessel and whale are no longer proximal.
  - When whales are sighted in a ship's path or in proximity to a moving ship, reduce speed to 10 knots or less or shift the engine to neutral until whales are clear of the area or path of the ship, as navigably possible.
- Gudielines describing the Oregon Emergency Response system (1-800-452-0311) to report any observed spills

LNG carrier masters would also be asked to report sightings of any injured or dead whales as soon as is practicable, regardless of whether the injury or death is caused by the ship. If the injury or death is caused by collision with the ship, within the U.S. the appropriate regulatory agency (e.g., NMFS) would be notified within 24 hours of the incident. Information to be provided would include the date and location (latitude/longitude) of the strike, the ship name, the species, or a description of the animal, if possible.

3.2.1.5 Determination of Effects

Species

The Project **may affect** blue whales because:

- blue whales occur within the marine analysis area ; and
- the Project would increase shipping traffic (LNG carriers) from current levels within the marine analysis area.

The Project is **likely to adversely affect** blue whales because:

- based on existing information, ship strikes on blue whales within the marine analysis area are expected to be low but current estimates reflect mortality above PBR within the U.S. EEZ;
- the increase in annual ship traffic due to the proposed action is expected to result in a localized increase of the risk of ship strike to blue whales; and
- based on acoustic analysis, LNG carrier noise would contribute to overall noise within the marine analysis area while transiting to and from Coos Bay and effects of ship noise on blue whales could exceed NMFS interim noise exposure criteria for Level B single non-pulse noise.

Critical Habitat

No critical habitat has been designated or proposed for blue whales.

3.2.2 Fin Whale

3.2.2.1 Species Account and Critical Habitat

Status

Fin whales were listed as endangered under the ESCA on June 2, 1970 (FWS 1970). Under the ESA, this status remains in effect today for the Northeast Pacific stock of fin whales (NMFS 2015a). Under the MMPA, this stock is classified as depleted and strategic (NMFS 2015a). The stock structure within the eastern North Pacific Ocean is unclear for this species, but there are three management stocks recognized under the MMPA in U.S. Pacific waters: 1) Alaska (Northeast Pacific), 2) California/Oregon/Washington, and 3) Hawaii (NMFS 2015a). The focus of this analysis is on the California/Oregon/Washington stock (Carretta et al. 2018a).

Threats

Commercial whaling was the primary reason for the depletion of fin whales; however, this threat ceased when commercial whaling for this species in the North Pacific ended in 1976 (NMFS 2012a). Ship strikes and disturbance by vessels are the current threats to fin whales (NMFS 2010a). Ship strikes were implicated in the deaths of eight fin whales between 2012 and 2016 (Carretta et al. 2018a). The risk of ship strike to fin whales is discussed in more detail below (see section 3.2.2.3) These are likely underestimates, because ship strikes with cetaceans can go unnoticed, as the whale may not strand or have obvious signs of trauma and therefore go unnoticed and unreported.

As with blue whales, anthropogenic noise is identified by NMFS (2010a) as a factor influencing the distribution of fin whales. Noise from vessels and other anthropogenic sources may interfere and mask cetacean communication, predator-prey detection, and possibly navigation (Würsig and Richardson 2009). Coastal developments and associated anthropogenic noise may compromise the migration routes and seasonal areas used by fin whales (NMFS 2010a). As discussed previously for blue whales, pollution and climate change may affect fin whales or their prey species. The potential effect of climate change on fin whales is uncertain, but there may be effects that impact habitat selection, prey availability, breeding behaviors, and migration patterns (NMFS 2010a).

Species Recovery

NMFS finalized a recovery plan in 2010 (NMFS 2010a) and the most current five-year status review was released in December 2011 (NMFS 2011a). The goal of the recovery plan is to achieve the delisting of the species (NMFS 2010a).

The recovery plan identifies the following recovery actions:

- coordinate state, federal, and international actions to implement recovery actions and maintain international regulation of whaling for fin whales;
- determine population discreteness and stock structure;
- develop and apply methods to estimate population size and monitor trends in abundance;
- conduct risk analyses;
- identify, characterize, protect, and monitor habitat important to fin whale populations in U.S. waters and elsewhere;

- identify causes and reduce the frequency and severity of human-caused injury and mortality;
- determine and minimize any detrimental effects of anthropogenic noise in the oceans;
- maximize efforts to acquire scientific information from dead, stranded, and entangled or entrapped fin whales; and
- develop a post-delisting monitoring plan.

Life History, Habitat Requirements, and Distribution

Fin whales are a baleen whale and the second-longest whale species. They are widely distributed throughout the world's oceans. The gestation period is assumed to be less than a year, and fin whale calves are nursed for 6 to 7 months. Most mating and calving takes place in winter. In the North Pacific, fin whales appear to prefer a diet of euphausiids and large copepods, followed by schooling fish such as herring, walleye pollock, and capelin (NMFS 2010a).

Fin whales can be found in groups of three to seven, but group sizes have been recorded as large as 50 to 100 animals in rich feeding grounds. Dive times are typically 3 to 15 minutes, with depths from 100 to 230 meters (328 to 755 feet). A series of two to five shallow dives for between 10 and 20 seconds is common (Shirihai and Jarrett 2006).

The reproductive age of fin whales is believed to have decreased from 12 to six years for females and 11 to four for males from the 1950s to the mid-1970s as a result of the overharvesting. They are believed to reproduce every two to three years upon reaching sexual maturity. Fin whales live between 85 to 90 years (Shirihai and Jarrett 2006).

The seasonal movements, habitat use, and distribution of California/Oregon/Washington fin whales are not well understood. However, this species is known to occur year-round off the coast of Oregon, with seasonal abundance fluctuations with numbers being lower during the winter and spring compared to the summer and fall (Carretta et al. 2017; Green et al. 1992). It is likely that the distribution of this stock extends seasonally outside these coastal waters.

Population Status

The best estimate of the California/Oregon/Washington stock of fin whales is 9,029 whales (CV=0.12), based on line transect data from 1991 to 2014 (Nadeem et al. 2016; Carretta et al. 2018a). There is strong evidence this population is increasing from the time of the cessation of whaling (Carretta et al. 2014a; Moore and Barlow 2011). The minimum population is estimated at approximately 8,127 whales in 2014 (Carretta et al. 2018a). The annual PBR for this fin whale stock is 81 (Carretta et al. 2018a).

Critical Habitat

Critical habitat for this species has not been designated.

3.2.2.2 Environmental Baseline

Analysis Area

The analysis area applicable to fin whales is the marine analysis area as described for blue whales (see section 3.2.1.2).

Species Presence

The same line-transect ship surveys discussed above for blue whales (Barlow and Forney 2007; Forney 2007; Barlow 2010) were used to estimate fin whale populations off the coasts of Oregon and Washington. The mean density of fin whales in the Oregon-Washington stratum is 0.129 whales per 100 km^2 or 0.038 whales per 100 square nautical miles (nmi^2). Based on habitat modeling, the predicted densities of fin whales in Oregon coastal waters range from 0.0013 to 0.0048 whales/km^2, with densities in the continental shelf region off Coos Bay ranging from 0.0028 to 0.0036 whales/km^2 (Calambokidis et al. 2015).

Habitat

Fin whales occur in both nearshore and pelagic waters (Calambokidis et al. 2015) but, based on the line transect data referred to in the previous section, fin whales are typically found in the continental slope and pelagic zones of the Oregon coast (NMFS 2014a). Observations show fin whales to be present year-round in central and Southern California; year-round in the Gulf of California; and occurring off Oregon in the summer. However, acoustic signals from fin whales have also been detected year-round off northern California, Oregon, and Washington, with a concentration of vocal activity between September and February (NMFS 2010a). Because fin whales feed on euphausiids, similar to blue whales, they may likewise follow primary production blooms of phytoplankton and associated euphausiid biomass increases off the Oregon coast as the blooms advance from south to north (Burtenshaw et al. 2004). Green et al. (1992) found fin whales using continental slope waters 85 to 90 km west of Newport, Oregon. Though this species has been observed in continental shelf waters, a greater proportion of sightings has occurred over the continental slope (Green et al. 1992).

Critical Habitat

Critical habitat for this species has not been designated.

3.2.2.3 Effects of the Proposed Action

Direct and Indirect Effects

<u>Ship Strikes</u>

There is an ongoing threat of ship strikes to fin whales throughout the world's oceans. Reduction of human-caused injury and mortality to fin whales is a principal objective for the species' recovery (NMFS 2010a). Ship strikes were implicated in the deaths of eight fin whales between 2012 and 2016 (Carretta et al. 2018a). The estimated number of annual ship strike deaths in the California Current taking into account the potential for unreported strikes is 43 fin whales (Becker et al. 2016; Rockwood et al. 2017; Martin et al. 2015), which is below the calculated PBR (81) (Carretta et al. 2018a). Further, Nadeem et al. (2016) report that this population of fin whales has increased since the early 1990s. Ship strike mortality was recently estimated for fin whales in the California Current (Rockwood et al. 2017), using an encounter theory model (Martin et al. 2015) that combined species distribution models of whale density (Becker et al. 2016), vessel traffic characteristics (size + speed + spatial use), along with whale movement patterns obtained from satellite-tagged animals in the region to estimate encounters that would result in mortality. As stated above, the estimated number of annual ship strike deaths was 43 fin whales, though this includes only the period July to November when whales are most likely to be present in the

California Current and the time of year that overlaps with cetacean habitat models generated from line-transect surveys conducted during those months (Becker et al. 2016; Rockwood et al. 2017).

The average observed annual mortality and serious injury due to ship strikes was 1.6 fin whales per year during 2012-2016. However, reports from Oregon suggest low levels of ship strike in comparison to other parts of the Pacific Ocean off the coast of the United States.

Ship-strike risk was estimated for fin whales as described above for blue whales (see section 3.2.1.3).

Estimated Ship Strikes to Fin Whales

Determination of the WSREM for fin whales (see table 3.2.2-1) included the following variables:

- Fin whale length: 25.91 meters (https://www.fisheries.noaa.gov/species/fin-whale)
- Time at Surface: 5 percent (Ray et al. 1978)
- Density – Lower = 0.0028 whales/km^2 (Calambokidis et al. 2015)
- Density – Upper = 0.0036 whales/km^2 (Calambokidis et al. 2015)
- Proportion of year most likely to occur in marine analysis area: June through February = 0.75

TABLE 3.2.2-1

Results of WSREM for Fin Whales

Marine Traffic	**Risk Lower Estimate (whales/1,000 km^2)**	**Risk Upper Estimate (whales/1,000 km^2)**
LNG carriers Only	0.19	0.24
Existing Traffic Only	0.08	0.10
Combined Results	0.26	0.34

As with blue whales, the estimated vessel strike risk increases from existing levels but is again limited to the time of year that fin whales are known to occur off Oregon. Therefore, although the risk is increased from the existing risk levels with the addition of vessels transiting to the LNG terminal, this risk is still considered to be low based on the results of the WSREM and low documented rates of actual ship strikes in Oregon waters. Although there is a localized increase in the risk of ship strikes to fin whales by LNG carriers, this localized increase is not significant for the California/Oregon/Washington stock of fin whales as the coast of Oregon does not contain identified critical habitat nor is it a recognized area for feeding aggregations. However, the potential for ship strike to fin whales could not be ruled out.

Underwater Noise

Determining and minimizing detrimental effects of anthropogenic underwater noise on fin whales is a principal objective for the species' recovery (NMFS 2010a). The potential effects of underwater noise on fin whales are as described in section 3.2.1.3 for blue whales.

Based on the same evaluation as presented in the blue whale discussion, there could be 0.06 to 0.07 fin whales/km^2 within the area of sound attenuation to 120 dB during the time of year that fin whales are present off the coast of Oregon. Based on the above data, and because fin whales are present in densities of roughly 0.06 to 0.07 fin whales per km^2 within the area of sound attenuation to 120 dB, there could be between 432 and 504 fin whales potentially occurring within the 120 dB attenuation area over the life of the Project. Similar to the analysis for blue whales, as many as between 160 and 186 fin whales could occur within the 120 dB attenuation area for tractor tugs over the life of the Project. Some fin whales may be exposed to sound levels produced by Project related vessels that could cause behavioral disturbance.

Fuel Spills

The potential effects of fuel spills on fin whales, as well as the laws and regulations regarding environmental protection are the same as described as for blue whales (see section 3.2.1.3). As a result, effects to fin whales from accidental spills or release of fuel or lubricants at sea are expected to be insignificant and discountable.

Critical Habitat

The proposed action would not affect critical habitat because none has been designated.

3.2.2.4 Conservation Measures

The same conservation measures to minimize potential effects that were described in section 3.2.1.4 (blue whales) apply to fin whales.

3.2.2.5 Determination of Effects

Species

The Project **may affect** fin whales because:

- fin whales occur within the marine analysis area; and
- the Project would increase shipping traffic (LNG) within the marine analysis area.

The Project is **likely to adversely affect** fin whales because:

- the increase in annual ship traffic due to the Project is expected to result in a localized increase of the risk of ship strike to fin whales; and
- based on acoustic analysis, LNG carrier noise would contribute to overall noise within the marine analysis area while transiting to and from Coos Bay and effects of ship noise on fin whales could exceed NMFS interim noise exposure criteria for Level B single non-pulse noise.

Critical Habitat

No critical habitat has been designated or proposed for fin whales.

3.2.3 Killer Whale

3.2.3.1 Species Account and Critical Habitat

Status

Eight stocks of killer whale are recognized within Pacific United States waters, with three relevant to the Oregon coast (NMFS 2013b):

1. Eastern North Pacific Southern Resident stock – occurring from Alaska to California, with a summer preference for the inland waters of Washington and southern British Columbia (winter preferences are not defined), listed as endangered under the ESA

November 18, 2005 (NMFS 2005a). The Southern Resident population is classified as depleted and strategic under the MMPA;
2. Eastern North Pacific Transient stock – occurring from Alaska to California (unlisted);
3. Eastern North Pacific Offshore stock – occurring from Southeast Alaska to California (unlisted).

A status review of Southern Resident killer whales conducted in 2002 concluded that listing as threatened or endangered was not warranted because Southern Resident killer whales were not a species or DPS for ESA application (NMFS 2005a). The status review recognized, however, that the Southern Resident killer whale was a depleted stock under the MMPA. A challenge to NMFS' decision to not the list the species ("not warranted") and subsequent judicial intervention resulted in an updated status review, which found that the Southern Resident killer whale stock is discrete and significant with respect to other resident stocks and should be considered a DPS for listing under ESA (NMFS 2005a).

NMFS (2012b) published a 90-day finding on a petition to remove (delist) the Southern Resident killer whale DPS from the ESA list. In 2011, NMFS completed a five-year review of the status of Southern Residents killer whales and concluded that no change was needed in the species' ESA listing status; the Southern Resident killer whale DPS would remain listed as endangered (NMFS 2011b).

Threats

The Southern Resident killer whale DPS primarily occurs in the inland transboundary waters of British Columbia and Washington in the summer and fall and in outer coastal waters in winter and spring. The spring and winter habitat use (including Oregon waters) is not well defined, and therefore the threats associated with this time of year can only be generalized. The NMFS (2008a) identified the factors that currently pose a risk for Southern Residents, including the following:

- reductions in quantity or quality of prey;
- high levels of organochlorine contaminants and increasing levels of many "emerging" contaminants (e.g., brominated flame retardants), putting Southern Residents at risk for serious chronic effects similar to those demonstrated for other marine mammals (e.g., immune and reproductive system dysfunction);
- commercial and recreational vessel traffic and risk of ship strikes;
- sound and disturbance from vessel traffic; and
- oil spills.

Reductions in prey availability, primarily that of salmon, over the past 150 years has reduced the carrying capacity for the Eastern North Pacific Southern Resident stock (NMFS 2008a). Other reasons for the reduction in Southern Resident stock numbers includes the live-capture of whales for aquaria, and targeted shooting that was common before 1960 (NMFS 2013b).

Commercial and recreational vessel traffic have increased considerably during the past decades. The threats to killer whales from acoustic disturbance, and risk of ship strike are as previously discussed for blue and fin whales.

Environmental pollution is a known threat to killer whales. High levels of polychlorinated biphenyls (PCBs) have been found in the Southern Resident stock, and increasing levels of polybrominated diphenyl ethers and other contaminants are being found in ocean habitats with increasing frequency (NMFS 2008a). Ross et al. (2000) found that the Southern Resident stock was one of the most contaminated cetaceans worldwide, and noted that fish-eating marine mammals that are found in industrialized coastal waters are generally high in PCB concentration levels.

Killer whale food sources may be damaged and they may gain new stressors with certain climate changing processes similar to those discussed above for blue whales (Fogarty and Powell 2002).

Species Recovery

NMFS published a recovery plan for the Southern Resident killer whales in 2008 (NMFS 2008a). The goal of the recovery plan is to remove the species from the ESA. The interim goal is to reclassify the Southern Resident killer whale DPS from endangered to threatened. The following is a list of recovery measures needed to achieve the goals and objectives provided in the recovery plan (NMFS 2008a):

- Protect the Southern Resident killer whale population from factors that may be contributing to its decline or reducing its ability to recover (salmon stock, pollution, vessel disturbance).
- Protect Southern Resident killer whales from additional threats that may cause disturbance, injury, or mortality, or impact habitat (oil spills, acoustic effects, disease, invasive species).
- Develop public information and education programs.
- Respond to killer whales that are stranded, sick, injured, isolated, pose a threat to the public, or exhibit nuisance behaviors.
- Encourage transboundary and interagency coordination and cooperation.
- Monitor status and trends of the Southern Resident killer whale population.
- Conduct research to facilitate and enhance recovery efforts for Southern Resident killer whales.

Life History, Habitat Requirements, and Distribution

Killer whales are found in all oceans, but the Southern Resident killer whale population occurs only in the coastal waters of the western U.S. and Canada. Southern resident killer whales live in stable matrilineal societies, with the groups consisting of family units of both sexes and a range of ages. Southern resident killer whales prey upon a number of different fish species including salmonids, lingcod (*Ophiodon elongates*), halibut (*Hippoglossus stenolepis*), rockfish (*Sebastes* spp.), and Dover sole (*Microstomus pacificus*); their diet varies seasonally, consisting mostly of Chinook and chum salmon (*Oncorhynchus tshawytscha* and *O. keta*) during the summer and fall months (Fisheries and Oceans Canada 2011; Hanson et al. 2010). Genetic stock identification analyses indicate that the main Chinook salmon stocks that Southern Resident killer whales target are from the relatively large drainages of Washington and California (Hanson 2015). Less is known of the diet composition during the winter and spring months, and research into this important life history component is continuing.

Sexual maturity of female killer whales is size dependent and occurs when the whales reach lengths of approximately 15 to 18 feet. Mating appears to occur at any time, with no identified breeding season (American Cetacean Society 2004). The female Southern Resident killer whales average births every 4.9 to 7.7 years, and are polygamous. This species can live beyond the reproductive years with males living up to about 50 years and females nearing 100; however, it is possible that males may continue to be reproductively viable throughout their lives. Males tend to have death rates that increase by 18 percent each year after reaching 30 years old (American Cetacean Society 2004).

Killer whale dives are relatively short, with patterns consisting of several shallow dives with breaths every 10 to 35 seconds, followed by deeper, longer dives lasting up to about 17 minutes (Shirihai and Jarrett 2006).

Population Status

In 1993, there were 96 individual killer whales in the three pods that comprise the Eastern North Pacific Southern Resident stock. The population increased to 99 whales in 1995, then declined to 79 whales in 2001, and most recent population size is 77 whales, as of 2017 (CFWR 2017; Carretta et al. 2018a).

It is believed that the entire population is identified and accounted for each year due to extensive effort and photographic identification of individual animals. The recent analysis of long-term population growth, from 1979 to 2011, for the Southern Resident killer whale DPS indicates the maximum annual growth rate is 3.5 percent (Carretta et al. 2017). The PBR is calculated at 0.13 whales per year and appears to be approaching a rate of zero for human-related mortality and serious injury (Carretta et al. 2018a).

Southern Resident killer whales are known to use the outer coasts of British Columbia, Washington, Oregon and California, particularly during the winter and spring months (Hanson 2015). Observations of Southern Resident killer whales in Oregon are infrequent and have been restricted to offshore areas near Depoe Bay (1999 and 2000), near Yaquina Bay (2000), and near the Columbia River (2006) (NMFS 2006a). Passive acoustic and telemetry data also indicate that during the winter/spring months Southern Resident killer whales transit Oregon waters, though more utilized habitats appear to be in northern California and Washington (Hanson 2015). Because the Eastern North Pacific Southern Resident killer whale stock has been sighted along the Oregon coast and as far south as Monterey Bay, California (Carretta et al. 2018a), these animals may occur in the marine analysis area on an infrequent basis with likely short residency times based on the sparse sightings data.

Critical Habitat

Critical habitat for the Eastern North Pacific Southern Resident stock of killer whales was designated on November 28, 2006 (NMFS 2006a). Three specific areas were designated:

1. the Summer Core Area in Haro Strait and waters around the San Juan Islands;
2. Puget Sound; and
3. the Strait of Juan de Fuca.

None of the identified critical habitats are in Oregon waters.

On February 24, 2015, NMFS published a 12-month finding (80 *Federal Register* 9682) stating the intention to move forward with a proposed rule to designate critical habitat in coastal waters along California, Oregon, and Washington. A proposed rule was expected to be published in 2017; the revised timeline is to publish a proposed rule in 2019 and a final rule in 2020. NMFS has indicated that critical habitat may be designated in the Project marine analysis area during Section 7 consultation for the Project.

3.2.3.2 Environmental Baseline

Analysis Area

The analysis area applicable to killer whales is the marine analysis area as previously described for blue whales (see section 3.2.1.2).

Species Presence

Most sightings of the ESA-listed Southern Resident killer whales have occurred during summer and fall within inland waters of Washington and southern British Columbia. The specific areas that make up their winter range are uncertain (Carretta et al. 2018a), but acoustic detections have shown a higher than expected usage of the waters near the Columbia River (Hanson et al. 2013). While Southern Resident killer whales are known to occur off the Oregon coast, the data indicate their presence in this part of their range is lower than the more northerly extents (Hanson et al. 2013).

While Southern Resident killer whales may occur in or travel through the marine analysis area, this occurrence is likely on an infrequent and seasonal basis. Green et al. (1992) found that killer whales were widely distributed in Oregon waters, but that all sightings were over continental shelf waters, particularly near the shelf break. These sightings were thought be transient (mammal-eating) type killer whales, but this was not definitive (Green et al. 1992). Killer whales occasionally enter lower Coos Bay in search of prey resources (COE 1994), but these are likely to be transient killer whales (mammal eating), not Southern Resident killer whales. The available sightings data for Southern Resident killer whales in Oregon (see above) indicate that the habitats used are in the more northern areas of the state, and in areas with larger riverine drainages.

Habitat

Killer whales are less restrained by depth, temperature, and salinity of the water than other whales (NMFS 2008a). Based on satellite tag data, Southern Resident killer whales spend most of their time on the coast in waters less than 200 meters deep and waters where there is more salmon abundance. Documented occurrences off of Oregon have led to the belief that the California Current ecosystem is used by this stock (NMFS 2008a). Habitat-based density estimates were not available for Southern Resident killer whales, and are likely inappropriate due to the small population size and social dynamics.

Critical Habitat

No critical habitat for southern resident killer whales occurs in or near Oregon waters.

3.2.3.3 Effects of the Proposed Action

Direct and Indirect Effects

<u>Ship strikes</u>

Ship strikes are a concern for killer whales. However, of 10 whale species studied by Jensen and Silber (2003), killer whales were the least likely to be struck by ships, with one documented occurrence of a killer whale calf being struck by a ship. One killer whale from the Southern Resident stock was killed by a ship strike in 2006, but this was an unusual occurrence because that whale (L98) had become habituated to vessel interaction while it resided in Nootka Sound after being separated from its pod. In the five-year period, 2007–2011, no killer whales had been struck by vessels (Carretta et al. 2013, 2014b).

Available information indicates that killer whales are less susceptible to ship-strike than larger baleen whales, as carcasses indicating trauma and/or wounds from boat propellers have not been reported along the Oregon and Washington coasts (Norman et al. 2004). From 1995 to 2006, 10 killer whales were injured (eight) or killed (two) within the inland waterways of British Columbia (including L98; see Williams and O'Hara 2009) but none of the records were from whales struck in the open ocean.

Estimated Ship Strike Risk to Southern Resident Killer Whales

Due to the lack of data and habitat-based density estimates, it was not possible to quantify the risk of vessel strike to Southern Resident killer whales in the marine analysis area. However, qualitatively this risk is considered to be very low based on the apparently low use of the region by Southern Resident killer whales and the low rate at which these animals are struck in other open ocean parts of their eastern North Pacific range. It is worth noting that southern resident killer whales are known to successfully live in areas (e.g., Puget Sound) with extensive deep sea traffic with few ship strikes (Carretta et al. 2018a). Regardless, all vessel strike–related conservation actions would also pertain to killer whales.

Underwater Noise

Determining and minimizing any detrimental effects of anthropogenic underwater noise on killer whales is a principal objective for the species' recovery (NMFS 2008a). Killer whales are highly vocal, producing a variety of clicks, whistles, and pulsed calls for echolocation and social communication (Ford 2009). As described for blue whales above, Southern Resident killer whales are also exposed to a variety of underwater noises. Southern Resident killer whales critical habitat was delineated in the inshore waters of Washington and British Columbia that are also used by a variety of vessel traffic, including those going to commercial ports near Seattle and Vancouver. Studies have shown that killer whales can increase their call amplitude by 1 dB for every 1 dB increase in background ambient noise levels (Holt 2008).

Due to the lack of occupancy data and habitat-based density estimates, it was not possible to quantify the potential exposure to underwater noise by Southern Resident killer whales in the marine analysis area. However, qualitatively this risk is considered to be low based on the apparently low use of the region by Southern Resident killer whales.

While effects from Project LNG carrier–related noise on killer whales are possible in the marine analysis area, the noise sources are not novel. They are within the experience of Southern Resident killer whales, given their use of waters in and near shipping lanes in U.S. and Canadian critical habitats, which include Juan de Fuca Strait with designated traffic separation schemes for deep sea vessel transit between the open Pacific waters and the Ports of Seattle and Vancouver. The exposure would be commensurate with existing noise levels and would not be expected to cause injury or disturbance.

It is unlikely that LNG carriers transiting the marine analysis area would produce noise at levels that could negatively affect Southern Resident killer whales, due to their low usage of the marine analysis area waters, their experience with commercial vessel traffic, and the absence of critical habitat in Oregon.

Prey Resources

Because the Coos Bay estuary and associated riverine habitats crossed by the Pipeline are salmon habitats, and Southern Resident killer whales primarily target salmon stocks, the construction and operation of the Project have the potential to affect the prey resources for this marine mammal. However, as discussed below, the effects are likely to be low because Southern Resident killer whales primarily target salmon stocks from other river systems and Southern Resident killer whales spend a low proportion of their time on the Oregon coast.

The construction of the Project has the potential to affect salmon habitat that could, in turn, affect Southern Resident killer whales if there were a significant reduction in their primary prey species, which are Chinook salmon. However, relatively few adult fall Chinook salmon and fewer adult spring Chinook salmon are expected to be present in Coos Bay and in known riverine habitats at the time of construction.

The distribution of spawning fall and spring Chinook (ODFW 2017d) includes streams in several of the fifth-field watersheds crossed by the Pipeline Project (Coos River, Coquille River, South Umpqua River, and Upper Rogue River subbasins) although no spring Chinook salmon apparently inhabit streams within the Coos River subbasin. There is relatively little Chinook salmon habitat within the four subbasins crossed by the Pipeline compared to the habitats available within Oregon (smaller yet if comparisons included occupied habitats in Washington and California), particularly for occupied and spawning habitats used by spring Chinook.

Recent research indicates that Southern Resident killer whales prey on adult Chinook salmon, at least on the whales' summer range in the Salish Sea, as Chinook salmon return to the Fraser River (Ford et al. 2016). During late summer and fall, the Southern Resident killer whale feeds on Puget Sound Chinook (as well as chum and coho) salmon. Some whales may travel as far south as Monterey Bay, California, during winter. Whales prey on Chinook salmon from Grays Harbor, the Columbia River, the Klamath, and Sacramento river systems (spring-run Chinook) during winter and early spring (NOAA 2014). Abundance of Chinook salmon prey has been positively related to fecundity of the Southern Resident killer whale DPS (Ward et al. 2009).

The Project would affect a very small portion of Chinook salmon habitat and consequently would affect a very small portion of the prey base utilized by southern resident killer whales as they occasionally travel along the coast from Washington to California. However, this potential effect is considered to be low because in this area the salmonid fishes have not been identified as primary habitats or targeted prey species of southern resident killer whales. Because the Project could potentially affect a very small portion of Chinook salmon habitat, it would not have a measurable impact on the prey base for Southern Resident killer whales.

Fuel Spills

The potential effects of fuel spills on killer whales, as well as the laws and regulations regarding environmental protection, are the same as described as for blue whales (see section 3.2.1.3). As a result of these factors limiting the effects of spills, and low usage of the marine analysis area by killer whales, the effects of fuel spilled from LNG carriers are expected to be insignificant and discountable.

Critical Habitat

The proposed action would not affect designated critical habitat because that habitat is located in the inland waters of British Columbia and Washington, does not extend into the open Pacific waters, and is not near Oregon. Currently, there is no identified critical habitat for this species in Oregon.

3.2.3.4 Conservation Measures

The same conservation measures to minimize potential effects to blue whales that were described in section 3.2.1.4 apply to killer whales.

3.2.3.5 Determination of Effects

Species

The Project **may affect** Southern Resident killer whales because:

- these whales may occur within the marine analysis area during construction and operation of the Project; and
- the Project would increase shipping traffic (LNG carriers) within the marine analysis area.

However, the Project is **not likely to adversely affect** killer whales because:

- Killer whales are transient through the marine analysis area and the marine analysis area is not recognized as a regularly used area.
- Killer whales primarily target salmonids from other larger river systems. No expected change in the quantity or quality of prey species populations that may occur within the marine analysis area is expected as a result of the Project.
- The increase in annual ship traffic due to the Project is expected to result in a localized potential increase of the risk of ship strike to killer whales; however, killer whales are less likely to be struck than baleen whales and the risk of ship strike is expected to remain discountable due to the low usage of the area by Southern Resident killer whales.
- Jordan Cove would provide a ship strike avoidance measures package to shippers transporting LNG cargo from the LNG terminal that would consist of multiple measures to avoid striking marine mammals.
- LNG carrier noise would contribute to overall noise within the marine analysis area while transiting to and from the LNG Terminal and effects of ship noise on Southern Resident killer whales could exceed NMFS interim noise exposure criteria for Level B single non-pulse noise, but are not expected to affect Southern Resident killer whales due to their low usage of the area.
- An insignificant amount of habitat for prey species would be affected and would not result in measurable impacts to the killer whale's prey base.
- No expected change in the quantity or quality of prey species populations that may occur within the marine analysis area is expected as a result of the Project.

Critical Habitat

The Project would have **no effect** on designated critical habitat for the Eastern North Pacific Southern Resident stock because:

- there is currently no designated critical habitat in Oregon;
- the nearest critical habitat to Coos Bay is the Strait of Juan de Fuca, Washington, more than 390 nmi north; and
- no LNG carriers associated with LNG Project are expected to transit designated critical habitat.

3.2.4 Humpback Whale

3.2.4.1 Species Account and Critical Habitat

Status

Humpback whales were listed as endangered under the ESCA on December 2, 1970 (FWS 1970). This status remained under the ESA implemented in 1973. As discussed in the Draft 2018 Stock Assessment (Carretta et al. 2018a), NMFS conducted a global Status Review of humpback whales (Bettridge et al. 2015) and, in September 2016, revised the ESA listing of the species (81 *Federal Register* 62259). Currently, four out of 14 DPSs are protected as endangered, and one is listed as threatened (81 *Federal Register* 62259). Whales along the Oregon coast belong to the Central American and Mexican DPSs, listed as threatened and endangered under the ESA, respectively.

The DPSs that occur in waters under the jurisdiction of the United States do not necessarily equate to the existing MMPA stocks. Some of the listed DPSs partially coincide with the currently defined California/Oregon/Washington stock. Until such time as the MMPA stock delineations are reviewed in light of the DPS designations, NMFS considers this stock to be endangered and depleted for MMPA management purposes (e.g., selection of a recovery factor, stock status). Consequently, the California/Oregon/Washington stock is automatically considered as a "strategic" stock under the MMPA.

Threats

Commercial whaling was the primary contributor to the decline of Pacific humpback whale populations (NMFS 1991). This threat is no longer present. The main threats are entanglement in fishing gear and vessel strikes (NMFS 2013c). Anthropogenic noise is also considered a habitat concern for this species (NMFS 1991; Carretta et al. 2018a). The effects of climate change on the North Pacific Ocean coastal ecosystem may also affect humpback whales, but as with the previously discussed species, it is currently not possible to quantify this potential threat factor.

Bettridge et al. (2015) identified vessel collisions and entanglement in fishing gear as the primary threat to the Central American DPS. The primary threats to the Mexican DPS include adverse effects from a number of human activities, including fishing activities, effluent and runoff from human population centers as coastal development increases, activities associated with oil and gas development, and vessel traffic that results in underwater noise and ship strikes (Bettridge et al. 2015).

Species Recovery

NMFS finalized a recovery plan in 1991 (NMFS 1991). The plan identifies three main goals: biological, numerical and political; the intent is to achieve humpback whale populations that are large enough to be resilient to episodic changes, that the population equals at least 60 percent of the historical environmental carrying capacity for the Atlantic and Pacific ocean basins where whales enter U.S. jurisdictional waters, and that populations are abundant enough that the species can be down listed or delisted. The plan's four major objectives are:

- Maintain and enhance habitats used by humpback whales currently or historically;
- Identify and reduce direct human-related injury and mortality;
- Measure and monitor key population parameters; and
- Improve administration and coordination or recovery program for humpback whales.

Life History, Habitat Requirements, and Distribution

The humpback whale is a large baleen whale occupying all ocean basins. Migration and reproduction is tied to seasonal progression (NMFS 1991). The Pacific humpback whales over-winter in temperate and tropical waters and migrate in summer to waters of high biological productivity in higher latitudes (NMFS 1991). Breeding and parturition take place in wintering areas, when little feeding takes place. Although along the U.S. West Coast, one stock of humpback whales is recognized by NMFS, there appears to be division into two separate feeding groups: 1) California and Oregon, and 2) northern Washington and British Columbia. The humpback whale diet of both groups consists of krill, along with fish including cod, pollock, anchovies, and mackerel.

Two DPSs of humpback whales occur off the Oregon Coast and are listed under the ESA: the Central American DPS and the Mexican DPS. Whales in the Central America DPS breed along the Pacific coast of Costa Rica, Panama, Guatemala, El Salvador, Honduras, and Nicaragua (Bettridge et al. 2015). Whales from this breeding ground feed almost exclusively offshore of California and Oregon in the eastern Pacific, with only a few individuals identified at the northern Washington–southern British Columbia feeding grounds (Bettridge et al. 2015). Whales in the Mexican DPS breed along the Pacific Coast of mainland Mexico, the Baja California Peninsula, and the Revillagigedos Islands (Bettridge et al. 2015). The Mexican DPS feeds across a broad geographic range from California to the Aleutian Islands, with concentrations in California-Oregon, northern Washington–southern British Columbia, northern and western Gulf of Alaska, and Bering Sea feeding grounds (Bettridge et al. 2015).

Humpback whales generally travel alone or in pairs, with cow-calf pairs often very close together. Group sizes range from 12 to 15 animals. Dives usually last from 3 to 15 minutes, but can last up to 40 minutes, particularly in breeding habitats. Humpback whales can dive to 150 meters (492 feet). Humpback whales display cooperative hunting behaviors including a coordinated encirclement of prey in bubble nets (Shirihai and Jarrett 2006).

Sexual maturity for humpback whales is generally reached between 4 and 6 years of age. Once mature, females tend to give birth every two to three years (NMFS 1991). The gestation period is 11 to 12 months, with calves being weaned by 12 months of age. Calves may continue to associate with their mothers for one to two years. Information is lacking on lifespan and natural mortality but humpbacks are known to live to be at least 50 years old (Shirihai and Jarrett 2006). Predators include killer whales and sharks, though as with other large baleen whales, predators generally target neonates or juveniles.

Population Status

The best estimate of abundance for the California/Oregon/Washington stock of humpback whales is 2,900 (CV≈0.048), with a minimum population estimate of 2,784 animals (Calambokidis et al. 2017; Carretta et al. 2018a). The observed annual growth rate of the California/Oregon/Washington stock is estimated between 6 and 7 percent (Carretta et al. 2017). The PBR for humpback whales is estimated at 33.4 animals, but because this stock spends half its year outside U.S. waters, the U.S. allocation of the PBR is reduced to 16.7 whales/year (Carretta et al. 2018a).

Bettridge et al. (2015) cite preliminary estimates of abundance of the Central America population of approximately 500 to 600 animals, with an unknown trend (Calambokidis et al. 2008; Barlow et al. 2011). Estimates of abundance of the Mexico DPS are 6,000 to 7,000 (Calambokidis et al. 2008), or higher (Barlow et al. 2011), with a trend that is unknown but unlikely to be declining (Bettridge et al. 2015).

Critical Habitat

Critical habitat for this species has not been designated.

3.2.4.2 Environmental Baseline

Analysis Area

The analysis area applicable to humpback whales is the marine analysis area as described for blue whales (see section 3.2.1.2).

Species Presence

Systematic surveys have documented humpback whales in Oregon waters between May and November (Green et al. 1992). However, as the population size has increased since these surveys, humpback whales may now occur outside of this temporal frame, though would likely be limited by this species' annual migratory patterns.

Based on habitat modeling, the predicted mean densities of humpback whales off the Oregon coast range from 0.003835 to 0.008106 whales/km^2, with densities off Coos Bay higher than in some other coastal areas at 0.005330 to 0.008106 whales/km^2 (Calambokidis et al. 2015). This difference in densities could be related to the productivity and bathymetric relief of the coastal waters of south/central Oregon (see next section). These stock data were used in the absence of humpback whale DPS–specific density information off the coast of Oregon.

Habitat

Humpback whales are present along the west coast of the United States primarily during the spring and fall migrations. They are present off the coast of the United States in migratory routes and feeding grounds where they search alone or in groups for krill and small fish, and employ "bubble netting" to corral and trap their prey (Shirihai and Jarrett 2006). Modeled habitat use indicates that humpback whales are strongly associated with latitude and bathymetric features (including depth, slope and distance to the 100-meter isobath). Predictive habitat modeling identified seven humpback whale feeding Biologically Important Areas, with one in northern Oregon at Stonewall and Heceta Bank from May – November, and one just south of the Oregon/California border at Point St. George from July to November (Calambokidis et al. 2015). Preferred habitat for this species off Oregon includes the continental shelf and slope waters (Green et al. 1992).

Critical Habitat

Critical habitat for this species has not been designated.

3.2.4.3 Effects of the Proposed Action

Direct and Indirect Effects

Ship Strikes

There is an ongoing threat of ship strikes to humpback whales around the world. From published accounts, humpback whales collide with ships relatively often compared to other species, with calves being particularly vulnerable (Laist et al. 2001). Jensen and Silber (2003) found that humpback whales were second most likely behind fin whales to be struck by ships. They reported two humpback whales struck between 1995 and 2000 along the U.S. Pacific Coast, whereas Douglas et al. (2008) reported only one strike off Washington between 1980 and 2006, with an average rate of 0.04.

Thirteen humpback whales (8 deaths, 2.6 serious injuries, and 2 non-serious injuries) were reported struck by vessels between 2012 and 2016. The observed average annual serious injury and mortality of humpback whales attributable to ship strikes during 2012-2016 is 2.1 whales per year (Carretta et al. 2018a). However, only one humpback whale was reported as struck in Oregon waters, and review of the case-specific details indicated that the whale had breached and landed on a sail boat (Carretta et al. 2013). As with other species, these estimates are likely conservative because ship strikes may go unknown and unreported.

A recent estimate of the number of annual ship strike deaths in the California Current was 22 humpback whales, though this includes only the period July to November when whales are most likely to be present in the California Current and the time of year that overlaps with cetacean habitat models generated from line-transect surveys (Becker et al. 2016; Rockwood et al. 2017; Carretta et al. 2018a). This estimate was based on an assumption of a moderate level of vessel avoidance (55 percent) by humpback whales, as measured by the behavior of satellite-tagged whales in the presence of vessels (McKenna et al. 2015). The estimated mortality of 22 humpback whales annually due to ship strikes represents approximately 0.7 percent of the estimated population size of the stock (22 deaths/2,900 whales). The results of Rockwood et al. (2017) also include a no-avoidance encounter model that results in a worst-case estimate of 48 humpback whale ship strike deaths per year, which represents 1.6 percent of the estimated population size. The number of vessel strikes attributable to each breeding ground DPS (Central America, Mexico) is unknown. Using the moderate level of avoidance model from Rockwood et al. (2017), estimated vessel strike deaths of humpback whales are 22 per year. A comparison of average annual vessel strikes observed over the period 2012 to 2016 (2.6/year) versus estimated vessel strikes (22/year) indicates that the rate of detection for humpback whale vessel strikes is approximately 12 percent. In addition to observed ship strikes of 2.1/year plus the estimated observed annual mortality and serious injury due to commercial fishery entanglements in 2012-2016, non-fishery entanglements, recreational crab pot fisheries, and serious injuries assigned to unidentified whale entanglements equal 18.8 animals, which exceeds the PBR of 16.7 animals for the California, Oregon, and

Washington stock (Carretta et al. 2018a). The estimate above would equate to 38.6 humpback whales annually. This exceeds the central Pacific range-wide PBR estimate of 33.4 humpback whales.

Estimated Ship Strike Risk

Ship-strike risk was estimated for humpback whales, as described above for blue whales (see section 3.2.1.3).

Estimated Ship Strikes to Humpback Whales

Determination of the WSREM for humpback whales (Table 3.2.4-1) included the following variables:

- Humpback whale length: 18 meters (NMFS 2017a) (http://www.fisheries.noaa.gov/pr/species/mammals/whales/humpback-whale.html)
- Time at Surface: 5 percent (NMFS 2017b)
- Density – Lower = 0.0053 whales/km^2 (Calambokidis et al. 2015)
- Density – Upper = 0.0081 whales/km^2 (Calambokidis et al. 2015)
- Proportion of year in marine analysis area: spring and fall = 0.5

TABLE 3.2.4-1

Results of WSREM for Humpback Whales

Marine Traffic	Risk Lower Estimate (whales/1,000 km^2)	Risk Upper Estimate (whales/1,000 km^2)
LNG carriers Only	0.16	0.25
Existing Traffic Only	0.07	0.10
Combined Results	0.23	0.35

Because the Project is expected to increase the vessel traffic in Coos Bay, from approximately 50 vessels per year to 170 vessels per year (as a result of the additional 120 vessels per year from the Project), the estimated whale strike risk would increase from existing levels. The WSREM yields an increased risk to humpback whales from the existing conditions at 0.07 to 0.10 whales/1,000 km^2 to 0.23 to 0.35 whales/1,000 km^2 in the marine analysis area. As with other species, the risk is limited to the time period that humpback whales are known to occur off Oregon, during the spring and fall migrations.

While the risk is increased from the existing risk levels with the addition of Project-related vessels, this risk is still considered to be low based on the low documented rates of actual ship strikes in Oregon waters and WSREM results.

Underwater Noise

Humpback whales are well known for their vocalizations, particularly in breeding habitats. Male humpback whales sing long, complex songs that function to attract females and may play roles in establishing dominance hierarchies or cooperative behavior among males (Clapham 2009). Studies have found that low frequency sounds, whether generated by sonar or ships, cause singing humpback whales to lengthen their singing, perhaps as compensation for the acoustic interference (Miller et al. 2000). Characteristics of humpback whale songs (duration, tempo or pace, frequency structure) indicated masking of songs by noise from large boats (Norris 1995).

Determining and minimizing any detrimental effects of anthropogenic underwater noise on humpback whales is a principal objective for the species' recovery (NMFS 1991). The potential effects of underwater noise on humpback whales are the same as described for blue whales.

Based on the same evaluation as presented in the blue whale discussion, there could be 0.07 to 0.11 humpback whales/km^2 within the area of sound attenuation to 120 dB during the time of year that these whales are present off the coast of Oregon. Based on the above data, and because humpback whales are present in densities of between 0.07 and 0.11 humpback whales per km^2 within the area of sound attenuation to 120 dB, there could be between 504 and 792 humpback whales potentially occurring within the 120 dB attenuation area over the life of the Project. Again, as similar to the analysis for blue whales, as many as between 186 and 293 humpback whales could occur within the 120 dB attenuation area for tractor tugs over the life of the Project.

Some humpback whales may be exposed to sound levels produced by the Project-related vessels that could cause behavioral disturbance.

Fuel Spills

The potential effects of fuel spills to humpback whales, as well as the laws and regulations regarding environmental protection are the same as described as for blue whales (see section 3.2.1.3). As a result, effects to humpback whales from accidental spills or release of fuel or lubricants at sea are expected to be insignificant and discountable.

Critical Habitat

The proposed action would not affect critical habitat because none has been designated.

3.2.4.4 Conservation Measures

The same conservation measures described to minimize potential effects to blue whales that were described in section 3.2.1.4 apply to humpback whales.

3.2.4.5 Determination of Effects

Species

The Project **may affect** humpback whales because:

- humpback whales occur within the marine analysis area; and
- the Project would increase shipping traffic (LNG carriers) within the marine analysis area.

The Project is **likely to adversely affect** humpback whales because:

- the increase in annual ship traffic due to the Project is expected to result in a localized increase of the risk of ship strike to humpback whales; and
- based on acoustic analysis, LNG carrier noise would contribute to overall noise within the marine analysis area while transiting to and from Coos Bay and effects of ship noise on humpback whales could exceed NMFS interim noise exposure criteria for Level B single non-pulse noise.

Critical Habitat

No critical habitat has been designated or proposed for humpback whales.

3.2.5 Sei Whale

3.2.5.1 Species Account and Critical Habitat

Status

Sei whales were listed as endangered under the ESCA on December 2, 1970 (FWS 1970) and have been listed as endangered throughout its range under the ESA since its implementation in 1973. Sei whales off the U.S. West Coast are in the Eastern North Pacific stock and are classified under the MMPA as depleted and strategic.

Threats

Commercial whaling was the cause of the sei whale population decline. This cause is no longer a threat in the eastern North Pacific Ocean; however as with other whale species, vessel strike, interactions with fisheries gear, and anthropogenic noise are contemporary threats (Carretta et al. 2014b; Carretta et al. 2018a; NMFS 2011c). In addition, the effect of climate change on the eastern North Pacific ecosystem may be a threat factor for sei whales, but the magnitude of the threat is currently not quantifiable.

Species Recovery

A draft plan for recovery of the sei whale (and fin whale) was issued in 1998 (NMFS 1998a) and the plan was finalized in 2011 (NMFS 2011c). The goal of the recovery plan is to promote recovery of the species in order to eventually down list and ultimately delist this species. The two main objectives for sei whales are to 1) achieve sufficient and viable populations in all ocean basins, and 2) ensure significant threats are addressed (NMFS 2011c). The recovery plan lists the following tasks as those necessary to achieve the goal:

- Coordinate state, federal, and international actions to maintain international regulation of whaling for sei whales.
- Develop and apply methods to collect sei whale data.
- Support existing studies to investigate population discreteness and population structure of sei whales using genetic analyses.
- Continue to collect data on “unknown” threats to sei whales.
- Maximize effort to acquire scientific information from dead, stranded, and entangled sei whales.
- Estimate population size and monitor trends in abundance.
- Initiate new studies to determine population discreteness and population structure of sei whales.
- Conduct risk analyses.
- Identify, characterize, protect, and monitor habitat important to sei whale populations in U.S. waters and elsewhere.
- Investigate human-caused threats, and, should they be determined to be medium or high, reduce frequency and severity.
- Develop a post-delisting monitoring plan (NMFS 2011c).

Life History, Habitat Requirements, and Distribution

The sei whale is a large baleen whale found in both the northern and southern hemispheres. They feed in temperate waters on zooplankton (especially copepods and euphausiids), small schooling fish, and squid (Shirihai and Jarrett 2006). Calving occurs in midwinter, in low latitude portions of the species' range (OBIS-SEAMAP 2007). Sei whales are generally found alone or in pairs, although sometimes they may be found in groups of up to five. They generally dive between 5 and 20 minutes relatively close to the surface (Shirihai and Jarrett 2006). They are known for moving away from boats, and being one of the fastest swimming large whales, capable of speeds up to 26 knots (Laist et al. 2001).

Females reach reproductive age when 10 years old. Once mature, females give birth every 2 to 3 years to one calf. The gestation time is between 11 and 13 months, and calves are weaned between 6 and 9 months. It is expected that sei whales live up to 70 years (Shirihai and Jarrett 2006).

Population Status

Sei whales are encountered less frequently than other baleen whales that were depleted by commercial whaling. The best estimate of abundance for California, Oregon and Washington waters combined is 519 (CV=0.40), with a minimum population estimate of 374 whales (Carretta et al. 2018a). There are no data to estimate the current population trend for sei whales (Carretta et al. 2018a). The PBR for sei whales is 0.75 (Carretta et al. 2018a).

Critical Habitat

Critical habitat for this species has not been designated.

3.2.5.2 Environmental Baseline

Analysis Area

The analysis area applicable to sei whales is the same as described for blue whales (see section 3.2.1.2).

Species Presence

Sei whales are an offshore species and generally do not occupy coastal habitats. Nine confirmed sightings of sei whales were made in California, Oregon, and Washington waters during ship and aerial surveys between 1991 and 2008 (Carretta et al. 2017). Two of the reported sightings were off the coast of Oregon (Carretta et al. 2007), but were westward of the continental shelf break. As there were only two sightings in pelagic waters westward of the continental slope of Oregon, it is unlikely this species would be encountered by LNG carriers.

Habitat

Sei whales tend to use temperate waters, and do not associate with specific coastal features (Carretta et al. 2007) and are uncommonly associated with waters of continental shelves (Horwood 2009). Consequently, they are seldom observed.

Critical Habitat

Critical habitat for this species has not been designated.

3.2.5.3 Effects of the Proposed Action

Direct and Indirect Effects

Ship Strikes

As with all large whale species, the risk of ship strike is a risk factor for sei whales. Sei whales are struck by ships less often than most other whales (Jensen and Silber 2003). There has been one documented ship strike of a sei whales in the most recent 5-year period, 2012-2016 (Caretta et al. 2018), although some uncertainty exists over whether the strike occurred pre- or post-mortem. Additional mortality from ship strikes probably goes unreported because the whales do not strand or, if they do, they do not always have obvious signs of trauma. The average observed annual mortality due to ship strikes is 0.2 sei whales per year for the period 2012-2016 (Carretta et al. 2018a). The current PBR for sei whales from California to Washington is 0.75 whales per year.

Estimated Ship Strike Risk to Sei Whales

Currently, data on this species are insufficient to estimate a Project-specific ship strike risk. However, qualitatively the risk of vessel strike within the marine analysis area is considered to be extremely low as a result of the rarity of the species, the low rate of population increase, and habitat preference for waters further from shore.

Underwater Noise

Determining and minimizing any detrimental effects of anthropogenic underwater noise on sei whales is a principal objective for the species' recovery (NMFS 2011c). The potential effects of underwater noise on sei whales is assumed to be the same as described for blue whales (see section 3.2.1.3).

Currently data on this species are insufficient to estimate a Project-specific vessel noise exposure level. However, qualitatively the risk of that behavioral disturbance would occur is considered to be low as a result of the rarity of the species, the low rate of population increase, and habitat preference for waters further from shore.

Fuel Spills

The potential effects of fuel spills on sei whales, as well as the federal requirements regarding environmental protection, are the same as described as for blue whales (see section 3.2.1.3). As a result of the federal environmental protections, the low probability of occurrence in the marine analysis area, and the overall rarity of this species, effects to sei whales from accidental spills or release of fuel or lubricants at sea are expected to be insignificant and discountable.

Critical Habitat

The proposed action would not affect critical habitat because none has been designated.

3.2.5.4 Conservation Measures

The same conservation measures described to minimize potential effects to blue whales by LNG carriers that were described in section 3.2.1.4 apply to sei whales.

3.2.5.5 Determination of Effects

Species

The Project **may affect** sei whales because:

- sei whales may occur within the marine analysis area during operation of the Project; and
- the Project would increase shipping traffic (LNG carriers) from current levels within the marine analysis area.

However, the Project is **not likely to adversely affect** sei whales because:

- the likelihood of encountering sei whales in the marine analysis area is low and considered discountable;
- all conservation measures for other species would also apply to sei whales, if a chance encounter occurred with this species.

Critical Habitat

No critical habitat has been designated or proposed for sei whales.

3.2.6 Sperm Whale

3.2.6.1 Species Account and Critical Habitat

Status

Sperm whales were listed as endangered under the ESCA on December 2, 1970 (FWS 1970) and have been listed as endangered throughout their range under the ESA since its implementation in 1973. For the MMPA stock assessment reports (Carretta et al. 2018b), sperm whales within the Pacific United States are divided into three discrete, non-contiguous areas: 1) California, Oregon, and Washington waters; 2) waters around Hawaii; and 3) Alaskan waters. The latter two areas are not addressed in this assessment. Sperm whales are classified as depleted and strategic under the MMPA.

Threats

Commercial whaling was the cause of population reduction and for the endangered status (NMFS 2012c). This threat no longer exists in the eastern North Pacific Ocean. Contemporary threats include fisheries gear entanglement, ingestion of plastic debris, collisions with vessels, contaminants and pollutants, and possibly increasing levels of anthropogenic ocean noise (NMFS 2014b, 2010b; Carretta et al. 2018b). As discussed previously for other large whale species, the effect of climate change on sperm whales is uncertain, but there may be effects that impact habitat selection, prey availability, breeding behaviors, and migration patterns (NMFS 2010a, NMFS 2010b).

Most populations were depleted by modern whaling, and commercial whaling ended in 1988 with a moratorium issued by the International Whaling Commission (NMFS 2010b). However, Japan continues to take a small number of sperm whales each year (NMFS 2010b). The only commercial fishery that is considered to likely incidentally take sperm whales is the offshore drift gill-net fishery. From 2007 to 2015, the California and Oregon thresher shark and swordfish drift gill-net fishery accounted for one death, and an unspecified fishery was reported to have caused three deaths (Carretta et al. 2018b). A total of 18 sperm whales were stranded in Washington and Oregon from 1930 to 2002, with seven in Oregon and 11 in Washington (Norman et al. 2004).

Species Recovery

A draft recovery plan was released in June 2006 (NMFS 2006b) and a five-year status review was initiated on January 22, 2007 (NMFS 2007a). The recovery plan was finalized in 2010 (NMFS 2010b). The goal of the recovery plan is to eventually downlist and then delist the species. To that end, the final recovery plan lists the following recovery measures:

- Coordinate state, federal, and international actions to implement recovery actions and maintain international regulation of whaling for sperm whales.
- Develop and apply methods to estimate population size and monitor trends in abundance.
- Determine population discreteness and population structure of sperm whales.
- Conduct risk analyses.
- Identify and protect habitat essential to the survival and recovery of sperm whale populations in U.S. waters and elsewhere.
- Investigate causes and reduce the frequency and severity of human-caused injury and mortality.
- Determine and minimize any detrimental effects of anthropogenic noise in the oceans.
- Maximize efforts to acquire scientific information from dead, stranded, and entangled or entrapped sperm whales.
- Develop post-delisting monitoring plan.

Life History, Habitat Requirements, and Distribution

Sperm whales are the largest of the toothed whales and exhibit sexual dimorphism, with males larger than females. They are a deep water species, and prey upon deep water squid, sharks, skates, and fishes. They are deep divers, with the average dive depth greater than 400 meters (1,300 feet) that can last longer than 2 hours (NMFS 2007a). Cows, calves, and juveniles can be found in groups ranging from 10 to 50 animals, with bachelor groups of males occurring separately (Shirihai and Jarrett 2006).

The peak breeding season occurs from March/April to May; however, breeding is known to also occur between December and August. Length of the gestation period is not exactly known, but likely ranges from 15 to 18 months (NMFS 2010b). Most sperm whales are fully sexually mature in their twenties, although females begin ovulation between the ages of seven and thirteen. Females give birth every 4 to 6 years once sexually mature, with senescence occurring sometime after the age of 40. Sperm whales have a low reproductive rate, with a maximum of no more than two percent per year. Compounding the effects of this slow rate of increase is that larger and older mature males were targeted by commercial whalers, and this has been a primary reason for the reduction of reproductive rates, meaning that both large and older males and females are needed to increase the rate of reproduction (NMFS 2010b).

Longevity exceeds 60 years for sperm whales. Known natural reasons for mortality include predation, competition, and disease. Calves are susceptible to predation by killer whales and sharks. Diseases that are believed to have an impact on sperm whales include myocardial infarction, gastric ulceration, and a type of cumulative bone necrosis that is believed to be caused by deep dives and resulting nitrogen bubbles during ascents (NMFS 2010b).

Population Status

Moore and Barlow (2017) provided estimates of sperm whale abundance in California, Oregon, and Washington waters out to 300 nmi using a trend-model analysis of line-transect data collected from seven surveys conducted from 1991 to 2014. Based on 2014 survey data, the best estimate of sperm whale abundance in the California Current is 1,997 (CV=0.57) animals (Carretta et al. 2018b), with a minimum population estimate of 1,270 (Moore and Barlow 2017). The current population trend is not clear, but the PBR is estimated at 2.5 animals/year (Carretta et al. 2014a).

Critical Habitat

Critical habitat for this species has not been designated.

3.2.6.2 Environmental Baseline

Analysis Area

The analysis area applicable to sperm whales is as described for blue whales (see section 3.2.1.2).

Species Presence

Sperm whales are widely distributed across the entire North Pacific and into the southern Bering Sea in summer, but the majority are thought to be south of latitude 40º N in winter (Carretta et al. 2018b). Sperm whales have been reported off Oregon between March and September (Mate 1981), and Green et al (1992) documented sperm whales during the summer and fall.

Habitat

Sperm whales prefer areas along the continental slope where water is as deep as 1,000 to 3,000 meters (3,280 to 9,843 feet) (Shirihai and Jarrett 2006). This deep water species can utilize the entire water column, but has shown a preference for foraging on or near the bottom (NMFS 2010b).

Critical Habitat

Critical habitat for this species has not been designated.

3.2.6.3 Effects of the Proposed Action

Direct and Indirect Effects

<u>Ship Strike</u>

Ship strikes with sperm whales are infrequent in coastal U.S. waters, compared with other large whale species. From the available literature, one sperm whale was struck by a ship off the U.S. West Coast in 1965 (Jensen and Silber 2003) resulting in injury but not mortality, another single animal was reported injured by an apparent ship strike (propeller injury) off the Oregon coast and another was reported as a possible ship-strike in Washington State between 1980 and 2006 (Douglas et al. 2008). More recently (2007-2011), two sperm whales were reported struck, with one of these from the waters offshore of Lane County, Oregon – the other was in the offshore waters of Washington (Carretta et al. 2013). The data from Carretta et al. (2013) yield an average yearly rate of 0.40 strikes per year for the U.S. Pacific west coast, although no ship strikes were reported for the five-year period between 2008 and 2012 (Carretta et al. 2014b). For the most recent five-year period of 2011 to 2015, one ship strike death of a sperm whale was documented, in 2012 (Carretta et al. 2017) and the mean annual average mortality and serious injury is ≥0.2

whales. Due to the low probability of a sperm whale carcass washing ashore, estimated ship strike deaths are likely underestimated.

Ship Strike Risk Modeling

The ship strike risk to sperm whales could not quantitatively addressed because habitat based density estimates were not available for the marine analysis area. Qualitatively, the risk of ship strike to sperm whales in the marine analysis area is considered to be very low based on the spatial separation of the analysis area and preferred habitats of this species. Ship strike to sperm whales in the Oregon continental shelf analysis area is possible as animals do occasionally move outside of preferred habitats, but death or injury of sperm whales by ship strikes in the marine analysis area is considered unlikely.

Underwater Noise

Determining and minimizing any detrimental effects of anthropogenic underwater noise on sperm whales is a principal objective for the species' recovery (NMFS 2010b). The potential effects of underwater noise on sperm whales are the same as described for blue whales (see section 3.2.1.3).

Reduced calling or cessation of vocalizations by sperm whales have been documented in response to pingers and military sonar signals, low-frequency sounds used in acoustic thermometry,[23] and seismic surveys (Weilgart 2007). However, sperm whales and other cetaceans have been documented remaining in or returning to high noise environments, probably motivated by food and/or availability of mates (Weilgart 2007). In those situations, an individual's hearing could be damaged. For example, two sperm whales killed by collision with a ferry in waters off the Canary Islands never responded behaviorally to low frequency sounds that were generated as a test to warn and repel sperm whales from the ferry routes. Histological analyses of the inner ears of both animals showed nerve degeneration and fibrous growth in response to low frequency inner ear damage, consistent with prolonged exposure to noise from heavy maritime traffic (André and Degollada 2003). It is also possible that the whales did hear the warning signal, but did not correlate the warning signal with the approach of the ferry.

The exposure to Project-related sound levels that could cause disturbance to sperm whales could not be quantitatively addressed because habitat-based density estimates were not available for the marine analysis area. However, qualitatively, effects of Project-related noise on sperm whales are possible in the marine analysis area, but increased noise levels are not expected to influence or affect sperm whales due to their general absence from the nearshore waters over the continental shelf.

Fuel Spills

The potential effects of fuel spills on sperm whales, as well as the laws and regulations regarding environmental protection, are the same as described as for blue whales (see section 3.2.1.3). As a result of these regulatory requirements, and the low probability of occurrence in the marine analysis area, effects to sperm whales from fuel spills are expected to be insignificant and discountable.

[23] Acoustic thermometry can detect changes in ocean temperature by receiving low-frequency sounds transmitted across an ocean basin because the speed of sound is proportional to water temperature. Acoustic Thermometry of Ocean Climate, or ATOC, is an international program involving 11 institutions in seven nations.

Critical Habitat

The proposed action would not affect critical habitat because none has been designated.

3.2.6.4 Conservation Measures

The same conservation measures described to minimize potential effects to blue whales that were described in section 3.2.1.4 apply to sperm whales.

3.2.6.5 Determination of Effects

Species

The Project **may affect** sperm whales because:

- sperm whales may occur within the marine analysis area during operation of the Project; and
- the Project would increase shipping traffic (LNG carriers) from current levels within the marine analysis area.

However, the Project is **not likely to adversely affect** sperm whales because:

- sperm whales generally do not inhabit the continental shelf waters off Oregon, making it highly unlikely that this species would occur in the analysis area;
- Jordan Cove would provide a ship strike avoidance measures package to shippers calling on the LNG terminal that consists of multiple measures to avoid striking marine mammals; and
- LNG carrier noise would contribute to overall noise within the marine analysis area while transiting to and from the LNG terminal but effects of ship noise on sperm whales are not expected due to the low probability of occurrence in the marine analysis area.

Critical Habitat

No critical habitat has been designated or proposed for sperm whales.

3.2.7 North Pacific Right Whale

3.2.7.1 Species Account and Critical Habitat

Status

North Pacific right whales were listed as endangered under the ESCA (35 Federal Register 18319, Dec. 2, 1970) (FWS 1970) and remained classified as endangered when the ESA was passed in 1973 (NMFS 2013d). Consequently, the North Pacific right whale is listed as depleted and strategic under the MMPA. Sightings of this species are extremely rare due to commercial whaling that continued through the 1960s (NMFS 2013d).

The North Pacific population has been further divided into a western and an eastern population, with the eastern population primarily located in the U.S. EEZ (NMFS 2013d). The eastern North Pacific right whale population is the most endangered stock of large whales in the world for which abundance estimates are available (NMFS 2015b). The western population is located primarily in the EEZ of the Russian Federation, Japan and China (NMFS 2013d); therefore, the western population is not addressed further.

Threats

Commercial whaling decimated this population, which continued illegally into the 1960s. There are a variety of potential threats to eastern North Pacific right whale population, that are similar to other large baleen whales and includes vessel interactions (strikes and disturbance), anthropogenic noise, contaminants, interactions with marine debris and fishery gear entanglements (NMFS 2013d). However, the magnitude of these threats cannot be assessed due to the species' rarity and scattered distribution (NMFS 2013e). Impacts from direct hunts as well as changes in prey species resulting from climate change are also unknown (NMFS 2013d). One of the greatest threats to this population's survival is its very small size, estimated at about 30 individuals (NMFS 2013d).

Species Recovery

A recovery plan for the North Pacific right whale was published in June 2013 (NMFS 2013d). The primary goal of this recovery plan is data collection to facilitate improved population size estimation, monitoring trends in abundance, and determining the population structure (NMFS 2013d). The goals of the recovery plan are to first downlist the right whale from endangered to threatened and then eventually delist the species all together. These goals are attained through two objectives:

1. Achieve sufficient and viable populations throughout the ocean basin; and
2. Ensure threats are addressed.

The recovery plan describes the criterion for determining when the objectives are met, which includes descriptions of factors that may interfere with population growth. The outline for Recovery Action includes the following:

- coordinate state, federal, and international actions to maintain international regulation of whaling for North Pacific right whales;
- determine right whale occurrence, distribution, and range;
- identify, characterize, protect, and monitor habitat important to North Pacific right whale populations;
- estimate population size and monitor trends in abundance; and
- investigate human-caused threats and, should they be determined to be medium or high, reduce frequency and severity.

Life History, Habitat Requirements, and Distribution

North Pacific right whales are large, black baleen whales with a stocky body, and are distinguishable by their lack of dorsal fin. Further distinguishing characteristics include a broad, deeply notched tail and callosities on the head. The few data gathered indicate that right whales generally live for about 50 years with females having their first calf at 9-10 years. Right whales feed on zooplankton; however, their feeding method differs than that of most baleen whales. This species moves through the water open-mouthed and removes prey from patches of zooplankton, a method known as skimming (NMFS 2013d).

The International Whaling Commission has identified four different habitat categories for the right whale that include feeding, calving, nursery, and breeding. Breeding and nursery habitats are not known, but are thought to be in shallow coastal waters. Calving occurs in the winter in lower latitudes, while feeding occurs in the spring and summer in higher latitudes (NMFS 2013d).

Historical populations of eastern North Pacific right whales occupied waters ranging from the Gulf of Alaska to Baja, Mexico. Recent sightings of eastern North Pacific right whales have occurred in Bristol Bay, the southern Bering Sea, near Hawaii, and off California.

Population Status

The rarity of sightings and few individuals seen in any one year indicate the eastern North Pacific population is very small. The minimum population estimate for eastern North right whales is 26 individuals (Muto et al 2017). There are no data on population trends and calf sightings are extremely rare. The PBR for this species is 0.05 whales, or 1 whale every 20 years, however, this is considered unreliable as the population is far below the historical population, which exceeded 11,000 whales (NMFS 2015b).

Critical Habitat

Two areas have been designated as critical habitat for the North Pacific right whale. One area is within the Gulf of Alaska and the other area is within the Bering Sea (NMFS 2013d); neither area is in or near the Oregon coast.

3.2.7.2 Environmental Baseline

Analysis Area

The analysis area applicable to North Pacific right whales is the continental shelf as described for blue whales (see section 3.2.1.2).

Species Presence

Since 1950, there have been at least four sightings of North Pacific right whales off Washington, but none off Oregon (NMFS 2013d). No abundance or density estimates are available for Oregon (Forney 2007).

Habitat

Based on habitat preferences during calving in the Atlantic Ocean, the Southern California Coast and Baja Peninsula were judged to provide suitable calving habitat for North Pacific right whales (Good and Johnston 2009) but no evidence of calving is present in historical records (Gendron et al. 1999).

The distribution of eastern North Pacific right whales includes the U.S. West Coast extending south to Baja California (NMFS 2013e). North Pacific right whales have been sighted off the California coast and coastal Baja California during winter (January to early April) and spring (April to June) and may indicate a seasonal pattern of migration to southwestern coast during winter (Gendron et al. 1999). There are so few North Pacific right whales left that it is difficult to determine what constitutes their preferred habitat, but it is unlikely that the continental shelf waters of Oregon are key habitats based on the complete lack of sightings and acoustic recordings.

Critical Habitat

Two areas have been designated as critical habitat for the North Pacific right whale, one within the Gulf of Alaska, the other within the Bering Sea (NMFS 2013d). Neither are in or near the marine analysis area.

3.2.7.3 Effects of the Proposed Action

Direct and Indirect Effects

<u>Ship Strike</u>

As with all large whales, ship strike is a concern for North Pacific right whales (NMFS 2013d). However, due to the lack of habitat use data, it was not possible to quantify the Project-related ship strike risk to eastern North Pacific right whales. However, qualitatively, the risk of vessel strike within the marine analysis area is considered to be extremely low due to the rarity of the species, the low rate of population increase, and the lack of sightings from this part of the range.

<u>Underwater Noise</u>

Determining and minimizing any detrimental effects of anthropogenic underwater noise on eastern North Pacific right whales is a principal objective for the species' recovery (NMFS 2013d). Existing data indicate that this species' response to noise disturbance and vessel activities depends on their behavior at the time; feeding or courting right whales may be relatively unresponsive to loud sounds and slow to react to approaching vessels (NMFS 2013d). However, due to the extremely low population size, lack of data on use of the continental shelf of Oregon, and very low probability of occurrence, the noise associated with the LNG carriers or the assisting tug boats is unlikely to influence or affect North Pacific right whales.

<u>Fuel Spills</u>

The potential effects of fuel spills on North Pacific right whales, as well as the Federal Requirements regarding environmental protection are the same as described as for blue whales (see section 3.2.1.3). NMFS (2013d) lists the relative impact to recovery of North Pacific right whales from contaminants and pollution, including oil spills, as unknown due to lack of data from past spills and unknown likelihood of future spills occurring and eastern North Pacific right whales being exposed to the spilled oil. As a result of this and the extreme rarity of the species, effects to North Pacific right whales from fuel spills are expected to be insignificant and discountable.

Critical Habitat

The proposed action would not affect critical habitat as none has been designated in or near Oregon.

3.2.7.4 Conservation Measures

The same conservation measures described to minimize potential effects to blue whales that were described in section 3.2.1.4 apply to North Pacific right whales, in the rare event that they were encountered by Project-related vessels.

3.2.7.5 Determination of Effects

Species

The Project **may affect** right whales because:

- right whales may occur within the marine analysis area during operation of the Project; and
- the Project would increase shipping traffic (LNG carriers) from current levels within the marine analysis area.

However, the Project is **not likely to adversely affect** right whales because:

- there is no existing information to indicate that ship strikes to right whales occur within the marine analysis area; and
- likelihood of encountering North Pacific right whales within the marine analysis area is discountable, but if they were encountered, the conservation measures would equally apply to this species.

Critical Habitat

The Project would have **no effect** on critical habitat for the North Pacific right whale because no critical habitat has been designated in Oregon.

3.2.8 Gray Whale (Western North Pacific Stock)

3.2.8.1 Species Account and Critical Habitat

Status

In 1970, the gray whale was listed as endangered under the ESCA (FWS 1970), and in 1973 was listed as endangered throughout its range under the ESA. There are two geographic distributions of a single species of gray whale in the North Pacific Ocean: 1) the eastern North Pacific population, and 2) the western North Pacific stock (Carretta et al. 2018a). The eastern population is found along the west coast of North America from Baja California, Mexico to the Bering, Beaufort, and Chukchi Seas, while the western stock is found primarily in eastern Asia and Russia. However, western North Pacific gray whales have recently been documented in the range of the eastern North Pacific gray whale population (Weller et al. 2012). In 1994, the eastern population was removed from the ESA list due to numerical recovery (NMFS 1994), but the western Pacific stock maintained its ESA endangered status (NMFS 1994; Carretta et al. 2018a). The western Pacific gray whale stock is classified as depleted under the MMPA (Carretta et al. 2018a). The eastern Pacific population will not be further discussed, except where relevant to the western North Pacific gray whale stock.

Threats

Commercial whaling decimated the western North Pacific gray whale stock, and it was considered extinct until a small group of animals was discovered in the 1990s (Marine Mammal Commission 2017). Though commercial whaling is no longer a threat (Swartz et al. 2006), a variety of anthropogenic threats threaten this small stock including: entrapment and entanglement in fishing gear, vessel collision, oil spills, illegal and/or resumed legal whaling, acoustic disturbance, physical disturbance and contamination of prey populations, and habitat degradation (Weller et al. 2002; Brownell et al. 2010). Activities related to oil and gas exploration, such as geophysical seismic surveying, pipe-laying and drilling operations, increased vessel traffic, and oil spills near the primary feeding ground near Sakhalin Island, Sea of Okhotsk, are of primary concern to the recovery of the western North Pacific stock (Reeves et al. 2005).

In addition, natural threats also exist. These include predation, disease, entrapment in ice, starvation, and the small stock size. This latter point is compounded by the low numbers of reproductively active females which could limit recovery (Reeves et al. 2005).

Species Recovery

No recovery plan exists for the western North Pacific gray whale.

Life History, Habitat Requirements, and Distribution

Gray whales are a medium size migratory baleen whale that primarily inhabits the shallow coastal waters along the margins of the North Pacific Ocean. As the name implies, these animals have a gray coloration that can be mottled with white patches, scars and external parasites. Gray whales generally feed in northern areas in the summer and early autumn, then migrate south for the winter to the breeding and calving grounds (Swartz et al. 2006).

During the summer, the western North Pacific gray whale stock occupies feeding areas in the Sea of Okhotsk, and the Bering Sea off the southeastern Kamchatka Peninsula, Russia (Carretta et al. 2018a; Weller et al. 2012; Reeves et al. 2005). The main feeding habitat is the shallow (5-15 meters [16-50 feet] depth) shelf of northeastern Sakhalin Island, particularly off the southern portion of Piltun Lagoon, where the main prey species appear to be amphipods and isopods (Weller et al. 1999). Offshore feeding grounds in 30-35 meters (approximately 98-115 feet) depth southeast of Chayvo Bay are also sometimes used, where benthic amphipods and cumaceans are the main prey species (Fadeev 2003). Other habitats include the waters off western Kamchatka (Reeves et al. 2005), and in Severnaya Bay on the north coast of Sakhalin (IUCN 2006).

The migration route and wintering reproductive areas are poorly known, but may include the eastern shore of Sakhalin Island, Japanese coasts, and the Chinese coast from the northern Yellow Sea to the Hainan Strait in the south (references in Weller et al. 2012). No sightings off South Korea have been reported since 1968 (Reilly et al 2008). Most recent Japanese observations are on the Pacific side, suggesting this is now the more important migration route (Reilly et al 2008). The calving grounds are unknown but may be around Hainan Island, this being the southwestern end of the known range (Brownell and Chun 1977).

Migratory gray whales travel alone or in small, unstable groups up to 16 individuals, but in northern feeding grounds gray whales are often solitary (Leatherwood et al. 1982; NOAA 2016). Recent information from telemetry studies, photo-identification, and genetic studies has documented western North Pacific gray whales occurring in the range of the eastern North Pacific gray whale population (Weller et al. 2012). It is not known if this is a distributional anomaly, a recent occurrence, or has been occurring but undocumented for longer periods of time.

Observations outside the putative usual range for the western North Pacific gray whale have occurred during the winter migratory period (Weller et al. 2012; Carretta et al. 2018a). Up to 27 individual western North Pacific gray whales have been identified in the range of the eastern North Pacific gray whale (Mate et al. 2011; Weller et al. 2012; NOAA 2015a). Western gray whales that have migrated to eastern Pacific have been observed in small groups and/or close to conspecifics (Weller et al. 2012). It is thought that perhaps not all western North Pacific gray whales share a common wintering ground (Weller et al. 2013).

Population Status

Both stocks of gray whales were greatly reduced from commercial whaling in the eighteenth and nineteenth centuries. The eastern gray whale has returned to pre-exploitation population numbers (eastern gray whale population consists of approximately 20,990 individuals; Caretta et al. 2016a, Weller 2010). Abundance of western gray whales prior to commercial hunting has been estimated to be between 1,500 and 10,000 individuals (Yablokov and Bogoslovskaya 1984 in Reeves et al. 2005), but by the 1930s the population was considered extinct or was so low in abundance that whales were not observed (Weller et al. 2002). A small number are now known to exist.

A recent population assessment of the western gray whale estimates that there are approximately 175 individuals, excluding calves (Cooke et al. 2016); the total population estimate including calves was approximately 155 in 2012 (IUCN 2012). An increase in the western gray whale population was observed from 2005 to 2015; the estimated average annual rate of population increase during this period was 2 to 4 percent (Cooke et al. 2016). Although population growth has been observed for the western gray whale, the population is relatively small so that additional deaths, particularly females, could jeopardize the recovery of the population (Reeves et al. 2005). The overall PBR for gray whales in the western population is 1 whale per every 14 years (Carretta et al. 2018a).

Details of the life history of the western North Pacific stock are not well known. However, calf production has been monitored annually since 1995 through photo-identification surveys off Sakhalin Island, and the numbers are very small ranging from two calves in 1995 to 15 calves in 2011 (Burdin et al. 2012; Mate et al. 2011).

As described above, western North Pacific gray whales have recently been identified in the range of the eastern North Pacific gray whale (Mate et al. 2011, Weller et al. 2012; NOAA 2015a).

Critical Habitat

Critical habitat for this species has not been designated.

3.2.8.2 Environmental Baseline

Analysis Area

The analysis area applicable to western gray whales is the marine analysis area as previously described for blue whales (see section 3.2.1.2).

Species Presence

The degree to which western gray whales occur in Oregon waters is uncertain, however a few records do exist from the known spatial and temporal overlap with the eastern gray whale population (Weller et al. 2012). These records include six western North Pacific gray whales off Vancouver Island, two off California, 13 whales in San Ignacio Lagoon, Mexico, and three migrating from Russia to the west coast of North America (Weller et al. 2012; Lang et al. 2011; Urban et al. 2013; Mate et al. 2015). One whale, named “Flex,” was confirmed within 11 nmi (20 km) of the central Oregon coast (Mate et al. 2011).

Therefore, western North Pacific gray whales may occasionally occur in the marine analysis area, but the frequency of occurrence and duration of stay cannot be quantified. Qualitatively, if western gray whales did occur in the analysis area, it would most likely be related to the winter migration, with a very low probability of occurrence given the small size and rarity of this stock.

Habitat

Gray whales are a coastal species that occupy shallow continental shelf waters up to 152 meters (500 feet). They typically use the nearshore waters within about 20 miles of shore (Greene et al. 1995). Weller et al. (2012) also noted that western gray whales may spend an extended period of time feeding off the coast of the Pacific Northwest prior to setting out for the long-distance, open water crossing to summer feeding grounds off the coast of Russia.

Critical Habitat

Critical habitat for this species has not been designated.

3.2.8.3 Effects of the Proposed Action

Direct and Indirect Effects

Ship Strikes

As with other baleen whales, ship strike is a concern for western North Pacific gray whales (Weller et al. 2002), and although no vessel strikes to western gray whales have been reported, Reeves et al. (2005) stated that at least one western gray whale off the northeastern coast of Sakhalin Island had scars that appeared to be caused by a vessel. However, due to the lack of habitat use data and frequency of occurrence in the marine analysis area, it was not possible to quantify ship strike risk from the Project.

Qualitatively, the risk of vessel strike within the marine analysis area is considered to be extremely low due to the small population size, the low rate of population increase, that occurrence in Oregon waters currently appears infrequent, existing data indicate that movements to the eastern North Pacific are temporally limited to the winter migratory period, and that this stock primarily inhabits the western North Pacific Ocean.

Underwater Noise

The effects of underwater noise on western North Pacific gray whales is difficult to characterize. Disturbance from underwater noise is a recognized potential threat in the foraging grounds of western North Pacific gray whales (Reilly et al. 2008), and it is known from eastern North Pacific gray whale research that underwater noise along the migratory corridor could result in altered routes (Brownell et al. 2010; Gailey et al. 2016). However, recent behavioral observations of western gray whales from 4-D seismic surveys off northeastern Sakhalin Island, Russia, found no significant change in whale movement in response to the loud seismic activity, but did observe variation in the orientation of gray whales in relation to vessel activity depending on whether the vessel was less than 15 km, or greater than 25 km distance away (Gailey et al. 2016). Threats from underwater noise within the migratory route of the western gray whale is considered a low conservation concern due to the many factors contributing to existing noise along the annual migratory corridor that gray whales have been subjected to including military training ranges, oil and gas exploration and development areas, and shipping lanes that converge at some of the world's busiest and largest port cities (Brownell et al. 2010).

Due to the small population size, the low rate of population increase, that occurrence in Oregon waters currently appears infrequent, existing data that indicate movements to the eastern North Pacific are temporally limited to the winter migratory period, and that this stock primarily inhabits the western North Pacific Ocean, the noise associated with LNG carriers of the assisting tug boats is unlikely to influence or affect the western North Pacific grey whales within the marine analysis area.

Fuel Spills

The potential effects of fuel spills on western North Pacific gray whales, as well as the laws and regulations regarding environmental protection, are the same as described as for blue whales (see section 3.2.1.3). While chemical pollution in migratory corridors is a recognized threat (Weller et al. 2002), the marine analysis area is outside the putative migratory corridors for western North Pacific gray whales. As a result of this and the rarity of the members of this population in the eastern North Pacific, effects to the western North Pacific gray whales from fuel spills are expected to be insignificant and discountable.

Critical Habitat

The proposed action would not affect critical habitat because none has been designated.

3.2.8.4 Conservation Measures

The same conservation measures described to minimize potential effects to blue whales that were described in section 3.2.1.4 apply to western North Pacific gray whales, in the rare event that they were encountered by Project-related vessels.

3.2.8.5 Determination of Effects

Species

The Project **may affect** gray whales because:

- gray whales may occur within the marine analysis area during operation of the Project; and
- the Project would increase shipping traffic (LNG carriers) from current levels within the marine analysis area.

The Project is **not likely to adversely affect** gray whales from the western population because:

- western North Pacific gray whales generally do not inhabit the continental shelf waters of Oregon;
- the western North Pacific gray whale stock is very small, with a typical range that is well beyond the limits of the marine analysis area; and
- the likelihood of encountering western North Pacific gray whales in the marine analysis area is discountable, but if they were encountered, the conservation measures would equally apply to this species.

Critical Habitat

No critical habitat has been designated or proposed for the western North Pacific stock of gray whales.

3.2.9 Gray Wolf

3.2.9.1 Species Account and Critical Habitat

Status

The gray wolf was listed as endangered in 1974 (FWS 1974). FWS delisted the gray wolf within the Northern Rocky Mountain (NRM) DPS on May 5, 2011. The NRM DPS includes wolves in Montana, Idaho, Wyoming, the eastern one-third of Washington and Oregon, and a small part of north-central Utah (FWS 2011a). However, some gray wolves in the Pacific Northwest, including western Washington, western Oregon, and northern California, are not included in the NRM DPS and are still listed as endangered. FWS still regards any wolf residing in the western two-thirds of Oregon as a listed species that is therefore protected under the ESA (ODFW 2017b).

New information on gray wolf taxonomy, cited by FWS (2013d), indicates that the gray wolf subspecies in the contiguous United States does not warrant listing under the ESA, and FWS (2013d) published a proposed rule to remove the gray wolf from the list of endangered and threatened wildlife. In 2015, FWS acted on a petition to reclassify the gray wolf as threatened throughout the conterminous United States. The FWS (2015a) found that the petition did not warrant initiation of a status review and the gray wolf, except for the NRM DPS and nonessential experimental populations. On March 15, 2019, FWS proposed to delist gray wolves in the lower 48 states and Mexico, including wolves in western Oregon; in May 2019, FWS extended the comment period related to this action (84 *Federal Register* 26393). The gray wolf remains federally listed as endangered in western Oregon.

Threats

Wolves in the Pacific Northwest (Oregon and Washington) were pursued and killed by humans through the 1940s and were generally restricted to remote mountainous areas, primarily in National Forests of the Cascades, before they were completely extirpated from the region (FWS 2012a).

Mech and Boitani (2010) summarize the following as ongoing threats to the species: 1) competition with humans for livestock, especially in developed countries; 2) exaggerated concern by the public concerning the threat and danger of wolves; and 3) fragmentation of habitat, with resulting areas becoming too small for populations with long-term viability.

Species Recovery

FWS released a recovery plan for gray wolves in the NRM DPS in 1987 (FWS 1987). The plan focused on recovery in Montana, Wyoming, and Idaho. Although eastern Oregon and eastern Washington coincided with the historical distribution of wolves in the NRM DPS, no recovery areas were designated for either state. Recovery goals of the NRM DPS of equitably distributed wolf population containing at least 300 wolves and 30 breeding pairs in three recovery areas within Montana, Idaho, and Wyoming for at least three consecutive years were reached in 2002 (FWS et al. 2016). By 2012, the entire NRM DPS was delisted, and wolves were managed under State authority in those areas (FWS et al. 2016).

No recovery plan has been developed for ESA-listed gray wolves in western Oregon. ODFW (2017b) has developed a draft Wolf Conservation and Management Plan (Oregon Wolf Plan) to achieve recovery of the species and manage wolves in the state once they became de-listed from the federal ESA. Wolves are delisted statewide under the Oregon ESA, but are protected as a special status game mammal.

The Oregon Wolf Plan established recovery goals to protect wolves from overutilization for commercial, recreational, scientific, and educational purposes. The plan would serve as a deterrent to illegal killing of wolves by the public in the absence of federal protections. With the delisting of the NRM DPS in 2011, the Oregon Wolf Plan applies to wolves in the eastern one-third of the state. The boundary between east and west wolf management zones is defined by U.S. Highway 97 from the Columbia River to the junction of U.S. Highway 20, southeast on U.S. Highway 20 to the junction with U.S. Highway 395, and south on U.S. Highway 395 to the California border (ODFW 2017b). Wolves west of that boundary are still under federal protection.

Life History, Habitat Requirements, and Distribution

Gray wolves are predators of large ungulates, including elk, mule deer, white-tailed deer, and moose, where available, and occasionally of other, smaller prey such as ground squirrels, snowshoe hare, and grouse (Larsen and Ripple 2006). Wolves are habitat generalists that only require ungulate prey and human-caused mortality rates that are not excessive (FWS 2013e). Habitats supporting wolves historically varied considerably, but extant populations in the NRM DPS and British Columbia utilize forest habitats adjacent to open habitats (meadows, prairies, tundra). Prey availability and minimal human presence and/or harassment are important components of suitable habitat (WDFW 2009). Wolves appear most vulnerable to human disturbance in and around denning and rendezvous sites (Larsen and Ripple 2006). Based on these characteristics, key components of wolf habitat that appear consistent across the diversity of landscapes inhabited by wolves include the following: 1) a sufficient year-round prey base of ungulates and alternate prey, 2) suitable and somewhat secluded denning and rendezvous sites, and 3) sufficient space with minimal exposure to humans (Larsen and Ripple 2006).

Wolves normally do not breed until at least 22 months of age (Mech 1970). In the northern Rockies, the breeding season peaks in mid- to late February (ODFW 2010). Wolves localize their movements around a den site and whelp (i.e., give birth) in late April, following a 63-day gestation period. After the pups are about eight weeks old, they are moved to a series of rendezvous sites (ODFW 2010).

Wolves are highly social and their formation of packs, centered on male-female pair bonding, is essential to successful reproduction, survival of offspring, and successful hunting (FWS 1987). Most packs produce one litter per year ranging from one to nine pups. Wolf pairs (packs) establish home ranges/territories, centered on the den location, and are defended against other wolves (ODFW 2017a). Wolf pack territory size is a function of prey density, and can range from 25 to 1,500 square miles (FWS 2013e). Bunnell and Kremsater (1990) concluded that wolves need about 7,818 square miles (mi^2) (20,250 km^2) to maintain a viable population of 50 individuals. Herman and Willard (1978) summarized that gray wolves choose home territories with a variety of topographic features. Forests, open meadows, rocky ridges, and lakes or rivers all comprise a pack’s territory. Both male and female wolves disperse, sometimes more than 600 miles (FWS 2013e).

Because of the proximity of northeastern Oregon to Idaho packs, dispersing wolves initially occupied areas in northeastern Oregon. Wolf breeding pairs in these areas could be considered more secure and stable because of their proximity and connectivity to the wolves in Idaho. Wolf movement and dispersal between the two populations would allow gene flow between the populations. Oregon’s close proximity to the Idaho and Greater Yellowstone populations that number more than 786 wolves provides certainty that dispersing wolves will continue to enter Oregon at an unknown rate (ODFW 2017b).

Population Status

In 2018, an estimated minimum of 137 wolves in 16 packs and 15 breeding pairs were documented in Oregon (ODFW 2019), including wolves in the southwest part of the state. At the end of 2018, the Oregon Wolf Plan conservation objective of four breeding pairs for three years had not been reached in the West Wolf Management Zone (the boundary shown in figure 3.2.9-1) and wolves there were still managed under Phase I. The wolf population in the East Wolf Management Zone continued to exceed the Oregon Wolf Plan minimum objective in 2018 of seven breeding pairs, and wolves were managed under Phase III (ODFW 2019). A breeding pair of wolves is defined as an adult male and an adult female with at least two pups surviving to the end of December.

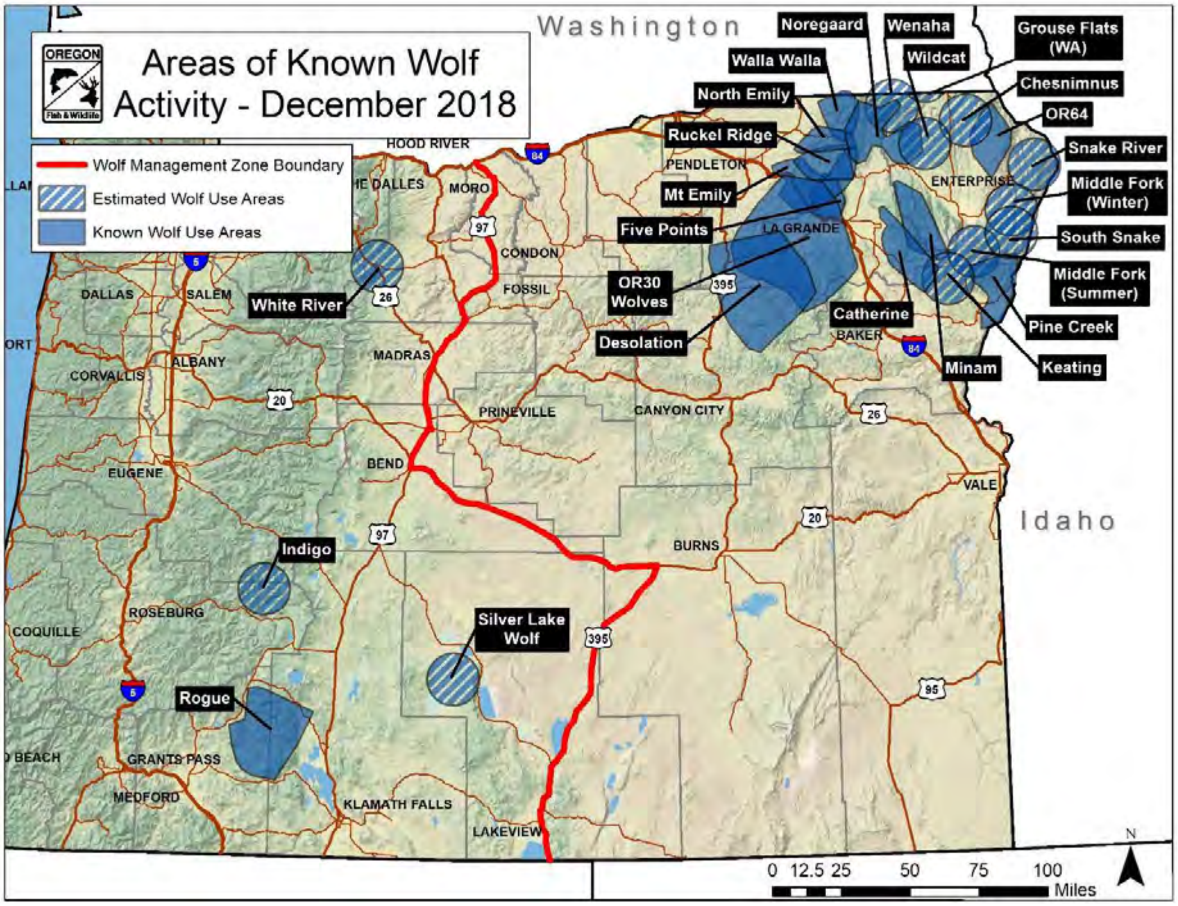


Figure 3.2.9-1 Areas of Known Wolf Activity as of December 2018 (from ODFW 2019)

Critical Habitat

Critical habitat for the gray wolf has not been designated in Oregon.

3.2.9.2 Environmental Baseline

Analysis Area

The action area includes all areas that would be affected directly or indirectly by the proposed action. The gray wolf analysis area is based on the Area of Known Wolf Activity (AKWA) initially designated for OR-7 (now the Rogue pack) in 2014 in Jackson, Klamath, and Douglas Counties (ODFW 2014). Although current known and estimated wolf use areas in the southern Cascades were refined in April 2019, the gray wolf analysis area is based on this larger initially identified area because it includes the extent of suitable wolf habitat in the vicinity of the Pipeline, and the areas where wolves have the potential to occur. The analysis area for gray wolves extends as far as project-related noise attenuates to ambient noise, assumed to be 40 dB on both sides of the construction right-of-way, which varies based on the construction activity and local environmental conditions as described below.

Species Presence

The Rogue pack currently occupies portions of southwestern Oregon, including habitats north of the Project in Jackson and Klamath Counties (ODFW 2019; figure 3.2.9-1). The Rogue pack was initiated by a single male wolf (OR-7) that dispersed from northeastern Oregon in 2010. Wolf OR-7 was born in northeastern Oregon in spring 2009, a member of the Imnaha pack that inhabits the Imnaha River drainage in Wallowa County, Oregon (ODFW 2017b). OR-7 dispersed from the Imnaha pack in September 2011 and was located (via radio telemetry) within Baker, Grant, Harney, Deschutes, Lake, Klamath, and Douglas Counties during its migration. OR-7 traveled more than 373 miles in a straight line distance from where he was born to northern California (FWS 2013d). Since moving, the wolf had been living in the southern Cascades in Jackson, Klamath, and Douglas Counties, Oregon (ODFW 2014) and in Siskiyou, Modoc, Shasta, Lassen, Tehama, Butte, and Plumas Counties, California (CDFW 2013).

In 2014, OR-7 was joined by a female, probably from the same area, and they produced their first litter that year. In 2014, FWS indicated that the den was located on the west slope of the Cascades between Crater Lake and Mt. McLoughlin, in the Rogue River National Forest (Young 2014). Additional pups were born in 2016 (ODFW 2017b). The AKWA for the Rogue Pack covered 359.3 square miles in 2015 and was about 7.1 miles northeast of MP 131.76 at its closest point (ORBIC 2017b). In 2016, the AKWA shifted in size and shape but was still within 9 miles from the Pipeline Project. The proposed route is greater than 6 miles from the 2014 den. The pack has spent the majority of its time in the South Cascades in the upper Rogue River watershed and the Rogue Wildlife Management Unit in eastern Jackson County. In 2018, the Rogue pack consisted of a minimum of six wolves and was considered a breeding pair (ODFW 2019).

A second AKWA (Keno) was established in southwest Oregon in 2014 with limited evidence that three wolves inhabited an area of approximately 280 square miles. The Keno AKWA occurred southwest of the Pipeline, overlapping the route from MP 173.93 to MP 176.41. In 2016 and 2017, three different wolves were documented in the Keno AKWA but there were no reports of breeding. In January 2015, ODFW designated an estimated Wolf Use Area for this wolf activity (Keno,; ODFW 2017b). However, the 2018 Annual Report (ODFW 2019) did not acknowledge the Keno Estimated Wolf Use area.

Several other radio-collared wolves dispersed from northeastern Oregon to southwest Oregon. One single male wolf (OR25) dispersed in 2015 and established an AKWA spanning northern Klamath County with portions in adjacent Jackson County and Lake County. A radio-collared female wolf (OR28) dispersed in late 2015 and was joined by a collared male (OR3) to establish the Silver Lake AKWA which coincided with the Silver Lake Wildlife Management Unit in western Lake County. The pair produced one pup in 2016 but the male was killed in 2016 (ODFW 2017b). In 2018, ODFW (2019) reported 11 depredation incidents on livestock (ten livestock and one working dog dead) within the Rogue AKWA. In late 2018, wolves were discovered in the central portion of the Oregon Cascades. At least three wolves were using an area in the eastern Indigo Wildlife Management Unit of Lane and Douglas Counties. Given the recent occurrence of both dispersing and resident wolves in the southwestern Cascades in the vicinity of the Pipeline, wolves are expected to occur in the wolf analysis area.

Habitat

The Pipeline route crosses the gray wolf analysis area for about 33 miles, from MP 147.7 to MP 180.7. The Pipeline would cross state-designated Very Sensitive Wildlife Areas[24] (ODFW 2017c) in the Rogue Wildlife Management Area for about 8 miles from MP 147.7 to MP 155.8.

Black-tailed deer and Roosevelt elk occur within the gray wolf analysis area. Those big game species are likely to provide a prey base for wolves, especially during winter when animals are concentrated and old, sick individuals are more easily preyed on, and/or carrion is more readily available. Often, big game will remain on or near winter ranges during birthing, which also would provide wolves that are present with accessible prey (newborns). The gray wolf analysis area coincides with multiple big game winter ranges:

- elk and deer winter range in the Keno Wildlife Management Area;
- Very Sensitive Wildlife Areas (big game winter ranges) in the Rogue Wildlife Management Area;
- Very Sensitive Wildlife Areas (big game winter ranges) and Sensitive Big Game Ranges in the Dixon Wildlife Management Area; and
- Sensitive Big Game Ranges in the Indigo Wildlife Management Area.

Based on ODFW population index data, black-tailed deer in the Rogue Wildlife Management Area Unit had been significantly increasing ($P<0.01$) between 1998 and 2012. In western Oregon, black-tailed deer are found in heavy brush areas at the edges of forests and chaparral thickets, but not in dense forests. Black-tailed deer prefer early successional stages created by clear-cuts or burns, because they provide grasses, forbs, and shrubs (ODFW 2006a; Csuti et al. 2001). Most black-tailed deer that summer in the high Cascades winter at lower elevations on the west slope, although some may winter east of the Cascade crest (ODFW 2006a).

Critical Habitat

Critical habitat for the gray wolf has not been designated in Oregon.

3.2.9.3 Effects of the Proposed Action

Direct and Indirect Effects

<u>Project-Related Noise</u>

Construction of the Project would result in noise that could affect gray wolves. Ambient sound levels in much of the Pipeline Project area are expected to be similar to the Washington Fish and Wildlife Office's determination (FWS 2003a) of 40 dB in the Olympic National Forest. Considering ambient sound as a base, noise levels associated with some common machines and activities which would be present during construction are included in table 3.2.9-1. Distances at which noise would attenuate to ambient levels would depend on local conditions such as tree cover and density, topography, weather (humidity), and wind, all of which can alter background noise conditions.

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[24] Very Sensitive Wildlife Areas include ODFW-mapped big game winter range (ODFW 2017c) used by Jackson County in their comprehensive planning process. Very Sensitive Wildlife Areas are considered part of Jackson County's Goal 5 resources and residential development and seasonal access restrictions may apply.

TABLE 3.2.9-1

Common Sound Levels for Equipment/Activities Potentially Associated with the Pipeline

Measured Sound Source	Range of Reported dB Values (at Distance Measured 50 ft)	Relative Sound Level a/
Chain Saw (various types/conditions)	61 – 93	Low - Very High
Pickup Truck (idle to driving)	55 – 71	Very Low - Moderate
Mowers	68 – 85	Low - High
Log Truck	77 – 97	Moderate - Very High
Dump Truck	84 – 98	High - Very High
Rock Drills	82 – 98	High - Very High
Pumps, Generators, Compressors	87	High
Drill Rig	88	High
General Construction	84 – 96	High - Very High
Track Hoe	91 – 106	Very High - Extreme
Helicopter or Airplane (various types/conditions)	96 – 112	Very High - Extreme
Rock Blast	112 b/	Extreme

Source: FWS 2006a.

a/ A general, subjective ranking of noise levels created by the sources considered when used for analysis of relative noise effects on species.

b/ Blasting required for the Pipeline project would be underground and muffled which should result in a lower dB value at 50 feet.

These Project-related noises could disturb wolves potentially present if close enough to detect the noise above ambient levels, assumed to be 40 dB. For example, rock ditching (including use of a rock drill, pickup truck, dump truck, and mitigated blasting) is anticipated to attenuate to ambient levels at 11,670 feet assuming no intervening vegetation, or 7,352 feet assuming 100 feet of dense intervening vegetation.[25] On the other hand, noise from a pickup truck generating 70 dB while driving would attenuate to ambient levels about 800 feet away assuming no intervening topography or vegetation and a noise reduction rate of 7.5 dB for every doubling of distance from the source. Pipeline noise from helicopters or blasting (i.e., the two loudest activities) could potentially be detected by wolves in the Rogue pack as their Wolf Use Area is within five miles of the Pipeline. Additionally, dispersing or currently undocumented wolves in the immediate vicinity of the Pipeline would detect construction noise.

The response of wolves to Project-related noise would probably be similar to their response to other anthropogenic activities such as recreation, hunting, and logging that already occurs within the gray wolf analysis area. In the absence of information specific to wolves' responses to existing anthropogenic noise, we summarize here wolves' response to other anthropogenic disturbance. Larsen and Ripple (2006) found that road density, human density, and human presence were all lower in wolf pack areas than random polygons within their study area, although this avoidance was not attributed to noise specifically, and dispersing wolves have been shown to travel through areas of high road densities in order to find suitable habitat (Mech 1995). Thiel (1985) found that wolf breeding occurred in areas with relatively low road densities, although Mech (2006) suggested that these findings were a result of wildlands being the only place where wolves avoided human persecution historically. Additionally, wolves have been documented denning in wheat fields in Europe (Vila et al. 1993 as cited in Mech 2006), and denning and raising pups in other areas of high human disturbance (Heilhecker et al. 2008; Thiel et al. 1998 as cited in Mech 2006).

[25] Noise attenuation assumes "soft site" (absorptive ground) conditions and point-source noise reduction of 7.5 dBA for every doubling of distance (WSDOT 2008).

Based on the tolerance to human presence that wolves have shown as described above, the likelihood that Project-related noise would adversely disturb a wolf is expected to be very remote. Wolves may be sensitive to human disturbance during the denning season (ODFW 2010). As described above, wolves give birth in late April, and pups are moved to a series of rendezvous sites after they are about eight weeks old. As a result, in the unlikely event that a den is present within the gray wolf analysis area, timing restrictions for NSO and migratory birds would limit the potential for a den site to be disturbed due to overlap in the areas used by these species and overlap in breeding seasons. Timber removal would be avoided within 0.25 mile of an NSO activity center between March 1 and September 30, and all timber would be removed outside of the primary migratory bird breeding season (April 1–July 15). As a result, dens are unlikely to be disturbed during construction if present within the gray wolf analysis area, and the effects of Project noise on wolves if present, including denning wolves, are expected to be insignificant.

Vehicle-Related Mortality

A small number of wolves have been killed by vehicles. For example, 80 percent of all wolf mortalities in the Northern Rocky Mountain population are caused by humans but only 3 percent are due to accidental human interactions including vehicle collisions and capture mortality (FWS 2012a). The chance that a Project-related vehicle would kill or injure a gray wolf would be minimized through implementation of BMPs including speed limits, as described under section 3.2.9.4, Conservation Measures, below. Therefore, the likelihood of vehicle-related mortality of wolves as a result of the Project would be very low.

Habitat Alteration

The portion of the Pipeline that coincides with the gray wolf analysis area passes through several types of habitats for 33.05 miles (from MP 147.66 to MP 180.73); including Southwest Oregon Mixed Conifer-Hardwood Forest for 15.8 miles; Westside Oak and Dry Douglas-fir Forest and Woodlands for 0.5 mile; Ponderosa Pine Forest and Woodland for 5.2 miles; and Montane Mixed Conifer Forest for 6.3 miles (habitat categories follow Johnson and O'Neil 2001). Most of the Pipeline in the gray wolf analysis area passes through forested habitats that are regenerating (11.8 miles), clearcut (0.03 mile), mid-seral (4.5 miles), late successional (6.5 miles), or old growth (5.1 miles). Within the gray wolf analysis area, the construction of the Pipeline would remove 87.0 acres of old-growth forest (more than 175 years old), 97.8 acres of late successional forest (80 to 175 years old), 77.7 acres of mid-seral forests (40 to 80 years old), 249.72 acres of regenerating forest (5 to 40 years old), and 0.7 acre of recent clearcut forest (0 to 5 years old). The Pipeline Project would create a 95-foot-wide cleared corridor through those forest-woodland types and seral stages.

Corridors created within forested habitats are used for movement and foraging by big game species. A study conducted in Alberta by Brusnyk and Westworth (1985) focused on forage and browse production and big game use on a 17-year-old pipeline right-of-way and on a two-year-old right-of-way. Deer appeared to utilize browse in the 17-year-old corridor but returned to adjacent undisturbed forest, probably utilizing available hiding or thermal cover. Deer utilized the corridors for travel in early winter prior to when deep snow limited travel. Elk utilized forage on the two-year-old right-of-way primarily where portions were adjacent to forested habitats. The principal conclusion of this study was that pipeline corridors increased local habitat diversity and that diversity (i.e., juxtapositions of browse or forage to undisturbed forested habitat) increased use of the corridors by ungulates; however, this increase was not necessarily due to increased vegetative production within pipeline rights-of-way. Increased herbivore density provides a food source for predators (Forman 1995), so predator density can be increased along the edge created by the corridor as well.

Locally Concentrated Human Activities

Wolves could be affected by increased human presence during pipeline construction if attracted to garbage at the workplace and/or drawn to roadside carrion killed by Project vehicles. Wolves attracted to the Project would be at an increased risk of vehicle-related mortality and could be drawn into conflict with humans, which could result in the need for lethal removal. However, all trash, food waste, and other items attractive to predators would be picked up and removed from the Project area on a daily basis to minimize potential attraction of predators, including the gray wolf.

The response of gray wolves to increased human activities during construction would likely be similar to their response to other anthropogenic disturbances including activity related to recreation, hunting, and logging that already occurs within the area, as described above under *Project-Related Noise*. Denning wolves, when disturbed by humans, tended to move pups to an alternate site although reproductive success of wolves was not influenced by human disturbance (Frame et al. 2007). During winter, wolves subject to heavy snowmobile use were found to have higher levels of fecal glucocorticoids than wolves inhabiting areas with no snowmobile use (Creel et al. 2002), indicating a physiological stress response to snowmobile stimuli (Creel et al., 2002). Project-related stimuli could elicit a similar response in wolves within the Rogue AKWA or dispersing wolves, if any were present at the time of construction. However, the closest documented den to the Project is more than six miles away. Additionally, disturbance during construction would be temporary. As a result, the effects of increased human activities on wolves during construction are expected to be insignificant.

Critical Habitat

Critical habitat for the gray wolf would not be affected because none has been designated in Oregon.

3.2.9.4 Conservation Measures

Pacific Connector has stated that all trash, food waste, and other items attractive to predators and scavengers would be picked up and removed from the Project area on a daily basis to minimize potential attraction of predators, including the gray wolf. Additionally, Pacific Connector would avoid removing timber within 0.25 mile of an NSO activity center between March 1 and September 30, and avoid removing all timber outside of the primary migratory bird breeding season (April 1 -July 15). Pipeline construction, including blasting and helicopter activity, would occur after the NSO critical breeding period (March 1 - July 15) within 0.25 mile of an NSO activity center. These seasonal restrictions would benefit any denning wolf in those areas.

Additionally, Pacific Connector would minimize construction vehicle speeds in the Project Area, which would significantly reduce the potential for vehicle-related mortality of wolves.

Pacific Connector would also restore habitats utilized by wildlife and implement other impact minimization measures within the Pipeline Project area:

- Pacific Connector would replant certain forested areas according to state and federal (BLM and Forest Service) and private landowner reforestation requirements as outlined in the

ECRP (i.e., planting trees outside of the 30-foot maintenance corridor). Reforestation planting prescriptions provided by the BLM and Forest Service have been used to develop the reforestation prescriptions.

- Large rocks and boulders would be used as OHV barriers along the right-of-way and at road crossings to block access at OHV points to restrict traffic on the right-of-way and protect habitat.
- Pacific Connector would use special seed mixes to attract wildlife species and restore/enhance natural vegetation and wildlife habitat .

3.2.9.5 Determination of Effects

Species

The Project **may affect** the gray wolf because:

- dispersing and resident wolves have been documented within the gray wolf analysis area;
- the OR-7 wolf family den was located in the vicinity of the Pipeline in 2014;
- construction noise could disturb wolves if present in the vicinity of the Pipeline; and
- increased human presence associated with construction activities could impact wolf behavior and movements, including the chance of collisions with vehicles.

However, the Project is **not likely to adversely affect** the gray wolf because:

- human presence and noise generated during construction may be detected by wolves if present, but wolves have been shown to tolerate some human disturbance and could move away from Project-related disturbance to adjacent suitable habitats;
- the one known den in southwestern Oregon is at least six miles from the Pipeline;
- following construction, the Pipeline corridor is likely to increase local habitat diversity, forage, and be used for movements by ungulates that would be prey for gray wolves; and
- trash would be removed on a daily basis and speed limits for construction vehicles would limit roadside carrion that otherwise could attract wolf to the Project and result in human-wolf conflict.

Critical Habitat

The Project would have **no effect** on critical habitat for the gray wolf as none has been designated in Oregon.

3.2.10 Pacific Marten

3.2.10.1 Species Account and Critical Habitat

Status

On October 9, 2018, the FWS proposed to list the coastal DPS of Pacific marten *(Martes caurina)* as a threatened species under the ESA (83 *Federal Register* 50574–50582). The most current information for this species is provided in an updated species status assessment (SSA) report, which provides a comprehensive account of the species, its life history needs, and stressors to the overall viability and extinction risk for the Pacific marten (FWS 2018c).

Threats

The 2018 SSA identifies various factors (stressors) that are directly and indirectly affecting what the coastal DPS of Pacific marten (commonly referred to as the coastal marten) needs for long-term viability. These include loss of habitat due to wildfire, timber harvest, and vegetation management. Trapping, collisions with vehicles, and rodenticides are all impacting marten individuals, and the threat of disease carries the risk of further reducing populations. Changes in vegetation composition and distribution have also made coastal martens more susceptible to predation from larger carnivores. These threats are expected to be exacerbated by the species' small and isolated populations. Linnell et al. (2018) suggests that small population size, consistent annual human-caused mortality (primarily trapping and road kills), and isolation indicate this coastal marten population is likely to remain vulnerable to extirpation.

Species Recovery

While the coastal DPS of Pacific marten is proposed to be listed as a threatened species, it is not yet protected by the ESA, and there is no species recovery plan in place.

Life History, Habitat Requirements, and Distribution

The coastal marten is a mammal in the weasel family and is native to forests of coastal Oregon and coastal California. It occurs primarily in older forests, although there is one remnant population occupying the coastal dune forest of central Oregon. Coastal marten historically ranged throughout coastal Oregon and coastal northern California but has not recently been detected throughout much of the historical range, despite extensive surveys. The species exists in four small populations and is absent from the northern and southern ends of its historical range. In Oregon, there are two isolated, extant population areas: central coastal and southern coastal. The LNG terminal and associated facilities fall within the southern portion of the central coastal extant population area and the Pipeline route crosses historical range.

The central coastal Oregon extant population area centers on the coastal forest of the Oregon Dunes National Recreational Area and covers 403 km^2 and is managed by the Siuslaw National Forest. This extant population area is considered isolated from other populations (FWS 2018c). Most of this area comprises coastal forest that is less than 70 years old and consists of shore pine (*Pinus contorta*) and transitional shore pine/Douglas-fir–hemlock forests. These forests grow on nutrient-poor sandy soils, dominated by young stands of shore pine and Sitka spruce (*Picea sitchensis*). The dense understory is dominated by willow (*Salix hookeri),* Pacific waxmyrtle (*Myrica californica*), and berry-producing ericaceous shrubs such as evergreen huckleberry (*Vaccinuium ovatum*) and salal (*Gaultheria shallon*). These shore pine forests have a variable tree overstory; however, the common denominator with this habitat and older forest habitats is the presence of dense, spatially extensive ericaceous shrub understories and diverse and abundant prey. Coastal martens have a generalist diet that changes seasonally with prey availability. Overall, their diet is dominated by mammals (primarily voles in central coastal Oregon population), but birds, insects, and fruits are seasonally important.

Martens rest and den in locations that protect them from predation and weather elements, including large logs, cavities in snags, chambers, and broken tops. Coastal martens that occupy dune habitat in Oregon use rest structures that include squirrel nests in trees (most commonly), bare branches, and basal hollows from old overturned trees (FWS 2018c). Resting structures are used daily between foraging events. Denning habitat is used by female marten to give birth to kits (natal dens), and to care for kits after giving birth (maternal dens). The most common den structures used by martens are large diameter live and dead trees with cavities (Thompson et al. 2012).

Population Status

Reports by Zielinski (2001) and Moriarty et al. (2016) noted a relatively high incidence of road kills in the last 30 years (n=17) in the central coastal Oregon population, and it was assumed that martens were abundant. Linnell et al. (2018) used recent surveys to refine the extent of the central coastal Oregon population size of fewer than 87 adults divided into two subpopulations; however, there is no information at this time on long–term trends in population size. The 2018 SSA estimates that the two subpopulations contain approximately 30 adults each, separated by the Umpqua River, a relatively large barrier to movement and dispersal. Martens in this population occur in the highest densities reported for any North American marten subspecies (1.13 per km^2; FWS 2018c, Linnell et al. 2018). The southern coastal population area in Oregon is located over 40 miles to the south and would not be affected by the Project.

Critical Habitat

No critical habitat has been proposed for this species.

3.2.10.2 Environmental Baseline

Analysis Area

The marten analysis area extends as far as construction-related noise attenuates to ambient noise (maximum of 2,850 feet; see section 3.2.10.3) within the range of the coastal DPS of Pacific marten in Coos County. Figure 3.2.10-1 identifies the range of the marten in the vicinity of the Project. Figure 3.2.10-2 identifies Project facilities and vegetation associations of the location where the Project overlaps with the range of the coastal DPS of Pacific marten.

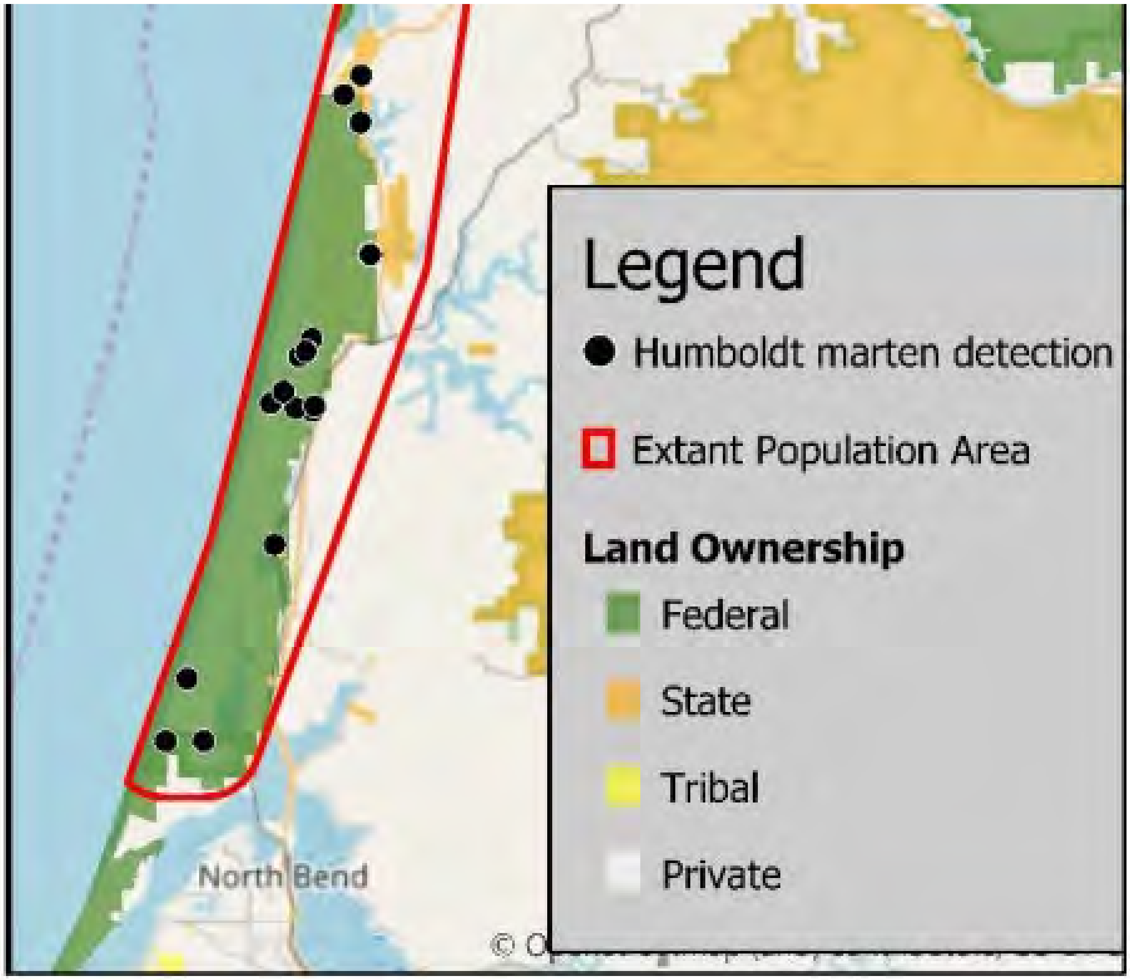


Figure 3.2.10-1 Marten Range in the Vicinity of the Project (from FWS 2018c)

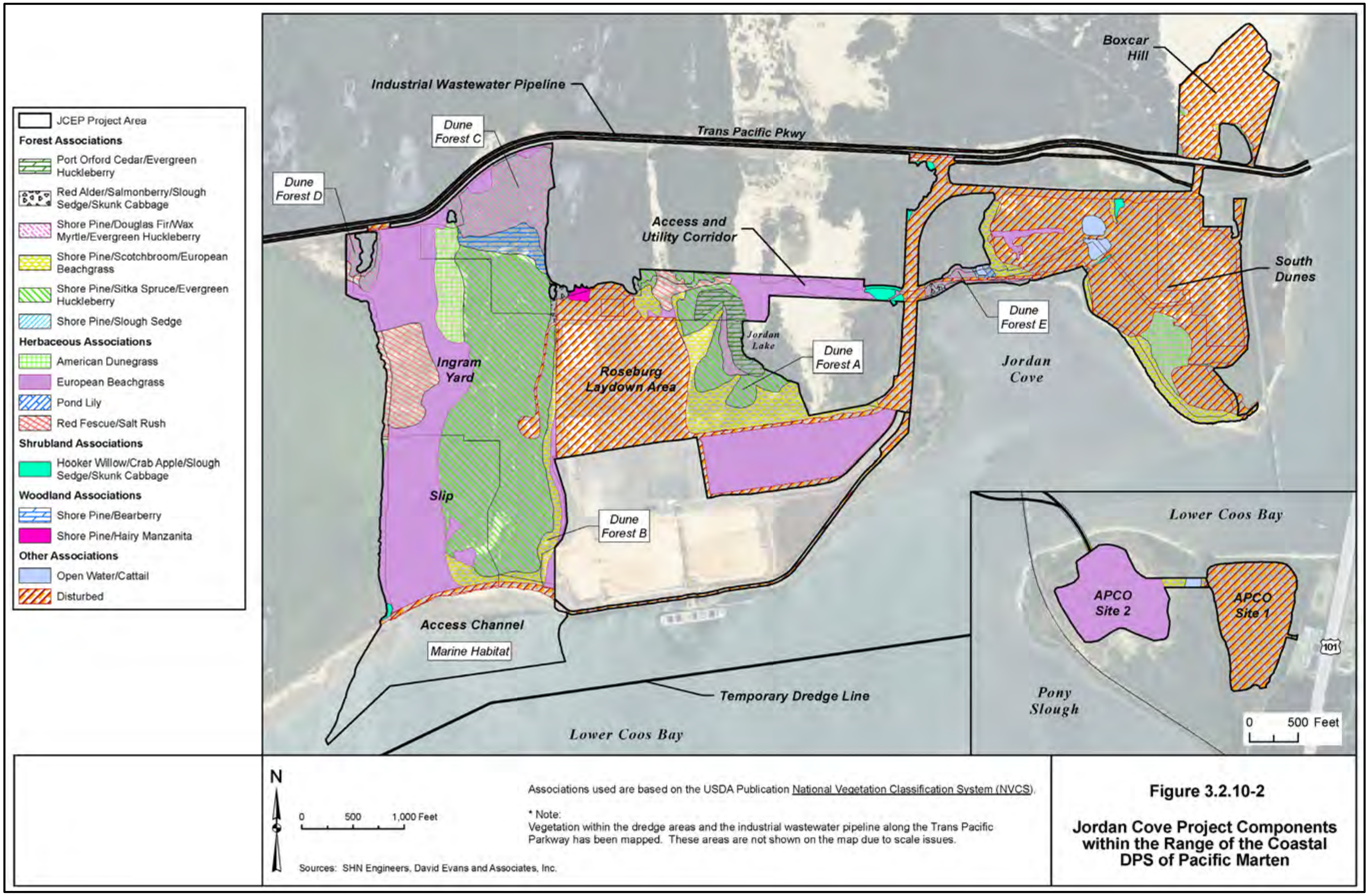


Figure 3.2.10-2

Jordan Cove Project Components within the Range of the Coastal DPS of Pacific Marten

Species Presence

The LNG Project area overlaps with the southern subpopulation of the central coastal Oregon extant population area of the coastal DPS of Pacific marten, in proximity to locations where marten have been detected. It is estimated that the southern subpopulation is occupied by approximately 30 adult marten. Wildlife surveys of the LNG Project area did not document marten, including four track plate stations placed in forested areas at the Project from September 2005 to April 2006 (LBJ 2006; SHN 2013a). Although there are no known occurrences of marten in the Jordan Cove Project area (ORBIC 2017a), marten have been documented on the North Spit (BLM 2005), indicating there is some potential for martens to occur within the LNG Project area. The pipeline portion of the Project does not cross any extant population areas for the coastal DPS of Pacific marten.

Habitat

Habitats within the LNG Project area includes coastal dune forest, riparian forest, shrubs, grasslands (herbaceous), and unvegetated sand dunes. Dominant overstory for the coastal dune forest at the Project includes Douglas-fir (*Pseudotsuga menziesii*), western hemlock (*Tsuga heterophylla)*, shore pine, Sitka spruce, and Port Orford cedar (*Chamaecyparis lawsoniana*), with an understory including evergreen huckleberry, salal, bearberry (*Arctostaphylos uva-ursi*), rhododendron, California wax myrtle (*Morella californica*), and manzanita (see figure 3.2.10-2). The forested habitats are consistent with the documented coastal forest used by Pacific martens in the central coastal Oregon population.

Critical Habitat

No critical habitat has been proposed for this species.

3.2.10.3 Effects of the Proposed Action

Direct and Indirect Effects

Given that the LNG Project is within the southern portion of the central coastal Oregon extant population area and coastal dune forest habitat would be removed, potential direct and indirect effects from construction and operation of the LNG Project include construction-related noise, vehicle-related mortality, locally concentrated human activities, and habitat removal. As the pipeline does not cross any extant population areas for the coastal DPS of Pacific marten, no effects are expected as a result of the pipeline portion of the Project.

<u>Project-related noise</u>

The FWS (2018c) does not include noise as a stressor (threat) to coastal martens. However, construction of the LNG Project could disturb martens potentially present if close enough to detect noise above ambient levels, estimated at 55 dBA because of breaking wave noise (see attachment BB). Based on the data presented in table 3.3.2-1 (see section 3.3.2, Western Snowy Plover), the noise produced by construction activities would attenuate to daytime ambient noise levels (55 dBA) within distances of 230 feet to 2,851 feet, depending on equipment/actions and hard site or soft site reduction ground surface conditions. The noise produced by sheet pile and pile installation activities would attenuate to daytime ambient noise levels within distances of approximately 4,200 feet (SRL 2017). Obscuring vegetation (tree cover), topography (interruption of line-of-sight), and atmospheric conditions (wind, air temperature, humidity) also affect noise reduction but can be highly variable between locations and over time and are generally not taken into account in estimates of noise attenuation over short distances (see appendix BB). Consequently, predictions of noise levels are likely to be higher than actual noise levels.

Similar to other wildlife responses to noise, marten exposed to Project-related noise may move out of the affected area and experience displacement. If adjacent marten habitats are at carrying capacity, displaced individuals would cause increased competition for resources, increased susceptibility to predation, or promote disease that may be facilitated by crowding. Martens in the central coastal Oregon population occur in the highest densities reported for any North American marten subspecies (1.13 per km^2; FWS 2018c), indicating that suitable but unoccupied habitat my not be available for displaced martens. Martens moving away from Project-related noise would also expend additional energy. This could result in lower fitness, which can affect predator elusion and avoidance, foraging, reproduction, and ability to fight off disease and infection (FWS 2018c).

Pacific marten's high incidence of road kill, especially in the central coastal Oregon population located adjacent to U.S. Highway 101, indicate that martens tolerate some anthropogenic noise as these individuals did not avoid this major highway that borders the east side of the extant population area (FWS 2015b, 2018c). However, studies of other species indicate that dispersing animals may be more vulnerable to road kill (Conard and Gipson 2006; FWS 2018c; Glista et al. 2007; Smith–Patten and Patten 2008), and several studies find that the majority of juvenile martens dispersed up to 15 km (9.3 miles; FWS 2018c). Thus, central coastal Oregon population martens dispersing from the narrow extant population area may be tolerating this noise as a tradeoff for the opportunity to find new habitat. Similarly, adult martens may be tolerating this noise as a tradeoff for finding prey during periods of low prey density (FWS 2018c; Thompson and Colgan 1987). Road kill mortalities on the Siuslaw National Forest (in or closest to the central coastal Oregon population) showed mortalities happening in all seasons, and four out of five fatalities reported by the Siuslaw National Forest were females. However, the sample size is too small to conclude a sex, age class, or seasonal predisposition to highway mortality (FWS 2018c). Therefore, more information is needed to determine if the high incidence of road kill is indicative of marten's toleration of noise, and if this tolerance is associated with a particular sex, age, or reproductive phase.

Similarly, martens have shown to not alter their use of occupied habitat during increases in OHV activity at established OHV recreation areas (Zielinski et al. 2008). Construction noise levels including pile driving would occur in the context of current anthropogenic noise produced by existing recreation activities at the Oregon Dunes National Recreation Area. Considering that OHV use occurs throughout the central coastal Oregon extant population area, additional noise from construction activities is unlikely to affect marten use of available habitat within the analysis area. Additionally, given that the LNG Project is at the southern edge of the population area near existing development, it is unlikely that denning females occur in this area and thus denning females are unlikely to be affected by construction noise.

Vehicle-Related Mortality

In Oregon, the most common verified mortality source has been vehicular strikes along U.S. Highway 101, and three road-killed martens (two adult females, one young male) were found during 2015–April 2016 in the central coast (Moriarty et al. 2016). FWS (2018c) identified roadkill as a stressor (threat) to coastal martens, and the central coastal Oregon population appears substantially more vulnerable to roadkill mortalities than the other three marten population areas. The LNG facility construction work force would use public roads and highways, which would increase traffic and increase the likelihood of vehicle-related mortality for marten. However, the majority of this traffic along U.S. Highway 101 would occur south of the Project, outside the central coastal Oregon extant population area.

Locally Concentrated Human Activities

Increased human presence during LNG Project construction could lead to increased predator presence (e.g., coyote) due to garbage being identified as a potential food source. To minimize this impact, trash would be removed daily to reduce the potential for attracting predator species. As result, effects from increased human activity are expected to be discountable.

Habitat Loss

Five forested and two woodland vegetation types occur within the LNG Project area that may be suitable habitat for marten and would be affected by the construction and operation of the LNG Project (figure 3.2.10-2). Approximately 76 acres of forested vegetation and 62 acres of woodland vegetation would be permanently cleared for the LNG facilities. Although martens were not detected during a track plate survey conducted at the LNG Project area in 2005 and 2006 (LBJ 2006), figure 3.2.10-1 indicates known marten use between the Trans-Pacific Parkway and Horsfall Beach Road, indicating that individuals could use the forest habitat proposed for disturbance at the LNG facility. A total of 138 acres of forest and woodland habitat would be removed within the approximately 100,000-acre (403 km^2) population area, which consists primarily of coastal forest that is less than 70 years old. FWS (2018c) identifies habitat loss and fragmentation as likely causes of marten population declines and continued low population levels.

Construction would remove forested habitat that might be used by martens for resting habitat during foraging events. Forest removal would also reduce available habitat for prey species. Martens have a relatively high energy demand as a result of their small body size, high metabolic rate, and spatial requirements three to four times larger than similar-sized carnivores (Sirén et al. 2016; FWS 2018c). This makes marten particularly sensitive to habitat loss and degradation which may increase travel distances to avoid openings and get to other suitable habitats (Andrén 1994; FWS 2018c). Removal of coastal dune forest during construction would also displace marten if present, resulting in the displacement effects described above under Project-related noise, including increased competition within remaining habitat and lowered body condition.

The habitat that would be removed during construction of the LNG Project is at the southern edge of the central coastal Oregon extant population area. Marten movements at the southern edge are already limited by Coos Bay (similar to the Umpqua River at the north edge of the subpopulation) and currently affected by proximity to industrial development in the Jordan Cove area of Coos Bay south of the Trans-Pacific Parkway. Given that the forest and woodland habitat potentially removed is at the southern edge of the population area near existing development, it is unlikely that denning females would be affected. However, removal of coastal dune forest during construction of the LNG terminal would result in the loss of potentially suitable habitat for the already isolated central coastal Oregon population, and thus is likely to adversely affect marten.

Critical Habitat

There is currently no critical habitat proposed for this species.

3.2.10.4 Conservation Measures

Avoidance, Minimization, and Rehabilitation / Restoration

No conservation measures have specifically been proposed for this species.

Mitigation

Upland habitat affected during the construction of the LNG terminal and related facilities would be mitigated through the Panhandle, Lagoon, and North Bank mitigation sites. The Panhandle site is within the range of the coastal DPS of Pacific marten and likely contains suitable habitat for this species. The Panhandle site is approximately 133 acres and is located north of Trans-Pacific Parkway. The Panhandle site is part of a larger natural area that extends north into the Oregon Dunes National Recreation Area. It contains coastal dune forest, herbaceous, shrub, unvegetated sand, wetlands, and open water habitat types. Jordan Cove has indicated Scotch broom (*Cytisus scoparius*) would be removed at this site to promote ecological uplift, which may benefit marten. Although ecological uplift activities may temporarily disturb marten if present, overall the uplift and conservation of the Panhandle site should benefit the coastal DPS of Pacific marten.

3.2.10.5 Determination of Effects

Species

The Project **may affect** the coastal DPS of Pacific marten because:

- martens have been documented within the southern portion of the central coastal Oregon extant population area, which overlaps with the LNG Project area;
- increased human presence associated with construction activities could affect marten behavior and movements, including the chance of collisions with vehicles; and
- the Project would remove potentially suitable habitat for the central coastal Oregon population.

If FWS lists the coastal DPS of Pacific marten prior to completion of the Project, the provisional determination **may affect, likely to adversely affect** would be warranted because:

- approximately 138 acres of forest and woodland habitat potentially suitable for the central coastal Oregon population of marten would be removed during construction of the LNG terminal, resulting in habitat loss that could affect marten predator elusion and avoidance, foraging, reproduction, and ability to fight off disease and infection.

Because marten are proposed for listing, the Project **would not likely jeopardize the continued existence** of the coastal DPS of Pacific marten because:

- increases in traffic from the LNG facility construction work force would be temporary, limited to the anticipated five year duration of LNG terminal construction; and
- the habitat that would be removed during construction of the LNG facility is at the southern edge of the central coastal Oregon extant population area, where marten movements are already constrained by Coos Bay and the habitat is currently affected by proximity to industrial activity in the Jordan Cove area of Coos Bay south of the Trans-Pacific Parkway.

Critical Habitat

No critical habitat has been proposed for the coastal DPS of Pacific marten.

3.2.11 Fisher

3.2.11.1 Species Account and Critical Habitat

Status

The FWS proposed to list the West Coast DPS of fisher as threatened under the ESA on October 7, 2014 (79 *Federal Register* 60419). The West Coast DPS of the fisher had previously been a candidate species under the ESA (FWS 2004a). In April 2016, the FWS determined that the fisher does not warrant listing under the ESA (81 *Federal Register* 22710). However, on September 21, 2018, the decision to deny the fisher protected status was vacated and the comment period for the proposed rule to list the West Coast DPS was reopened (84 *Federal Register* 644). The FWS is scheduled to prepare a new determination by September 21, 2019 (84 *Federal Register* 644). The West Coast DPS includes fishers in Washington, Oregon, and California. Fishers are known to occur in southwest Oregon, northwest California, and southern Sierra Nevada in California; counties where the fisher is currently known to occur in Oregon include Curry, Douglas, Jackson, Josephine, and Klamath (FWS 2014b).

Threats

FWS (2004a) identified the following reasons for the species' reduction in range: 1) overtrapping in the 1800s and early 1900s, 2) predation from bobcats and cougars, 3) pest control, and 4) alteration of forested habitats due to logging, fire, and farming (FWS 2004a). Other threats include non-target poisoning, collision with vehicles, and accidental trapping in manmade structures (FWS 2012b). Although historical trapping may have caused a severe population decline, trapping closures and other furbearer management methods that have been in place now for many decades have reduced, but not eliminated, the threat of deleterious population effects due to trapping (FWS 2012b).

Mortality from predation and exposure to rodenticides could pose an ongoing threat to fishers, especially fisher populations that are small and isolated and therefore have an increased vulnerability to small increases in mortality factors (FWS 2012b). Loss and fragmentation of habitat due to timber harvest and thinning, roads, urban development, recreation and wildfire are the main reasons for the decline of the fisher in the west (FWS 2018d). Habitat loss, modification, and fragmentation continue to occur as a result of forest management practices and stand replacing wildfire, and appear to pose a substantial threat to fishers (FWS 2012b). In addition to removing forage, rest, and den sites, fragmentation can increase predation risk, impede population-level movements, and affect prey species composition, abundance, and availability (FWS 2012b).

Species Recovery

FWS has not published a recovery plan for this proposed threatened species. However, the plans and efforts described below pertain to the recovery of the West Coast DPS of the fisher. In 2010, FWS developed a five-year action plan for the West Coast DPS of the fisher that included initiating programs needed to demonstrate expansion and establish new populations within the historical range of the fisher in the West Coast DPS (FWS 2012b). The action plan included the following four action categories:

A. Develop conservation strategies among federal, state, and local agencies as well as private land owners;

B. Develop a systematic survey and monitoring program for fishers throughout their historical range in the Pacific states and ensure that it has long-term institutional support;

C. Conduct research to assist in recovery and conservation planning; and

D. Augment existing populations or reintroduce extirpated populations in suitable habitat within the historical range of the fisher.

Additionally, the Forest Service, BLM, National Park Service, FWS, tribes, state wildlife agencies from Washington, Oregon, and California, and British Columbia Ministry of Environment completed a Conservation and Threat Assessment that provides foundational concepts for developing conservation strategies (Lofroth et al. 2010; Lofroth et al. 2011; Naney et al. 2012).

In 2006, the Washington Department of Fish and Wildlife (WDFW) developed a recovery plan for the fisher that identified three recovery areas in Washington (Olympics, Cascades, and Selkirk), and outlined recovery tasks that included the reintroduction of fishers in the Olympic and Cascades Recovery Areas (Hayes and Lewis 2006). WDFW, Olympic National Park, USGS, and Conservation Northwest reintroduced a population of 90 fishers from central British Columbia to the Olympic Peninsula between 2008 and 2010. In 2009, three females were documented as having kits (FWS 2014b). Monitoring of the reintroduced populations has continued although definite population numbers have not been published. WDFW, in partnership with the National Park Service, reintroduced 69 fishers from British Columbia into to the Cascades Recovery Area, including Mount Rainier and North Cascades National Parks (Lewis 2018); reintroduction occurred from December 2015 to November 2017 (Lewis 2018). To date, there have been 21 documented mortalities, and WDFW was encouraged by the relatively high survival rates for the fishers released in the first year (Lewis 2018).

In Oregon in 1961, and 1977 through 1981, a total of 54 fishers were translocated from British Columbia and Minnesota to create the southern Oregon Cascades population (Lofroth et al. 2010). The initial translocation in 1961 failed; however, the second effort has been successful. This population of 30 has been reported by Lofroth et al. (2010) to be persisting, although it is not expanding its range.

In 2009, the California Department of Fish and Wildlife, FWS, and Sierra Pacific Industries (SPI) prepared a translocation plan and started to translocate fishers from northwestern California to northern Sierra Nevada (Callas and Figura 2008). A total of 40 fishers were reintroduced over three years and will be monitored over seven years. An annual report for 2012 stated that, since reintroduction, 11 fishers have been found dead, and 12 females have given birth to 31 kits (Powell et al. 2013). Monitoring through early 2016 suggests the new population is stable or growing (CDFW 2018).

Life History, Habitat Requirements, and Distribution

The historical range of the fisher includes forests across North America, from southern Yukon in Canada, extending south into the United States along the Northern Rocky and Pacific Coast mountains, and encompassing the boundary of the West Coast DPS (figure 3.2.11-1).

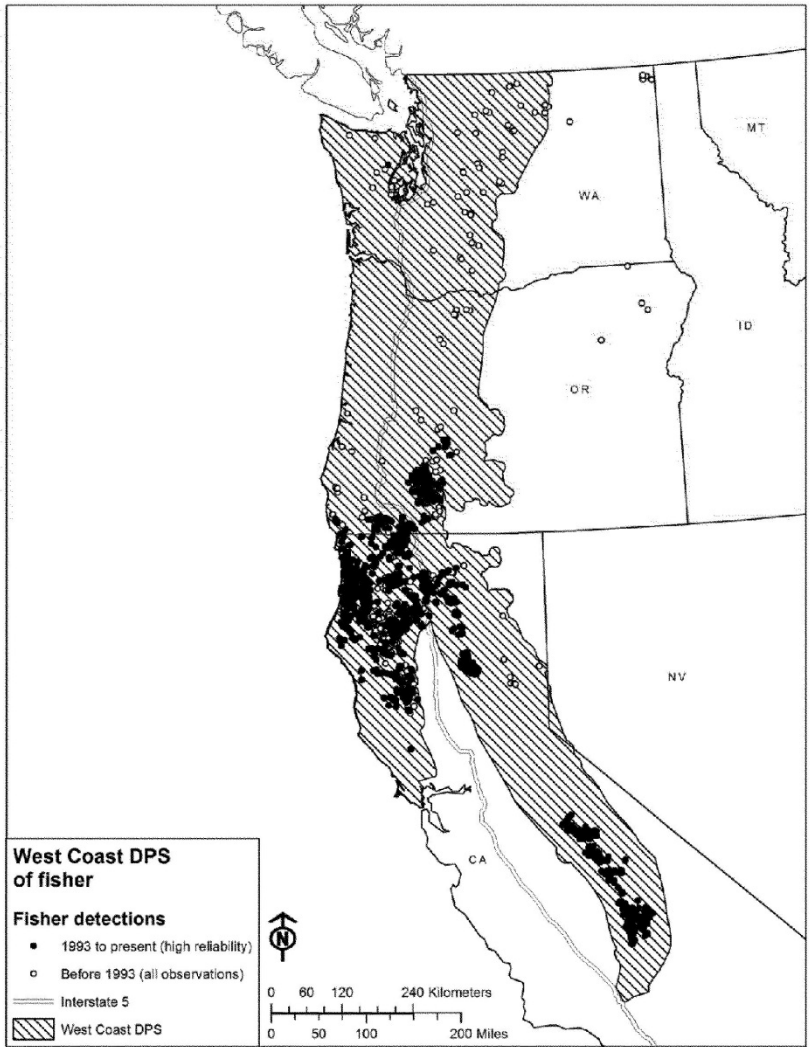


Figure 3.2.11-1 The Current Delineation of West Coast DPS for Fisher, Including the Species' Historical Range and Boundary in the 2004 Finding of Warranted but Precluded by FWS (from 79 *Federal Register* 60419)

Based on the 2012 FWS Assessment and Listing Priority Assignment Form (FWS 2012b), fishers occupy much of their historic range in British Columbia; however, populations in Washington are considered to be extirpated or reduced to scattered individuals. Currently, there are two documented populations of fisher in southern Oregon, one in the northern Siskiyou Mountains and one in the southern Cascade Range, that were believed to be genetically isolated from each other (FWS 2014b). However, recent research shows that the two populations may be interconnected by dispersing fishers (FWS 2014b; Barry et al. 2018). The population in the southern Cascade Range consists of descendants from British Columbia and Minnesota populations that were reintroduced from 1977 to 1981 (FWS 2012b). Based on a study conducted by Aubry and Raley (2006), the southern Cascade Range population is primarily located in the Upper Rogue River drainage basin on the west slope of the Cascade Range in southern Oregon, and also occurs in scattered areas on the east slope of the Cascade Range. FWS (2012b) describes this population as occurring in portions of Douglas, Jackson, and Klamath Counties with verified detections from near Lemolo Lake in the north, to Hyatt Reservoir in the south (FWS 2012b; Aubry and Raley 2006; Lofroth et al. 2010). The current distribution of the fisher in California includes populations in northern California and southern Sierra Nevada. The northern California/southwestern Oregon population occurs from east of Interstate 5 in California, west through the Klamath Mountains and Coast Ranges, and north into the Siskiyou Mountains and southernmost portion of the Rogue River watershed in southwestern Oregon (Lofroth et al. 2010; see figure 3.2.11-1).

Fishers are opportunistic predators that feed on a variety of wildlife, including birds, porcupines, snowshoe hare, squirrels, mice, shrews, voles, reptiles, insects, and carrion, and also on vegetation and fruit (FWS 2013n). Fishers are habitat specialists in the western United States, requiring middle to lower elevation (up to 8,200 feet) late-successional conifer and mixed conifer/hardwood forest with dense canopies and abundant large trees with cavities, snags and logs (NatureServe 2013). Fishers prefer large tracts of contiguous interior forest and typically avoid thinned or open forests, including areas where there is significant human disturbance. Fishers likely avoid open areas because the reduced hiding cover increases vulnerability to predators, and because in winter open areas have deeper snowpack, which can make travel and hunting inefficient (CBD 2000).

Fishers use fragmented patches of preferred forest types if those patches are connected by other forest types rather than separated by large open areas or clearcuts (Buskirk and Powell 1994). Fishers are negatively associated with clearcuts and forests that are nearly or completely surrounded by clearcuts, as well as with small forest patches less than 50 hectares (less than 124 acres; Rosenberg and Raphael 1986). A 5 percent increase of open habitat within potential fisher home range decreased the probability by 50 percent that the area would be occupied by fishers and an increase of open habitat by 25 percent would make the area unsuitable for occupancy (Weir and Corbould 2008). Fishers establish home ranges based on characteristics of the landscape whereas hunting for prey depends of prey abundance in patches but selection of rest sites depends on habitat characteristics within patches (Powell and Zielinski 1994). Fragmentation can increase predation risk by forcing fishers to traverse unsuitable habitat that lacks hiding cover and attracts predators associated with fragmented and early-seral habitats (Lofroth et al. 2010). Fragmentation can also increase energetic costs to fishers, which may result in nutritional stress that can reduce animal fitness, ultimately affecting survival, reproduction, and recruitment (Lofroth et al. 2010).

Fishers may use habitats near low-density housing, farms, and roads and have been reported denning under unoccupied structures (see Lewis and Stinson 1998). In Oregon, fishers' movements did not appear to be influenced by small rivers, creeks, or paved county roads but larger rivers (e.g., the Rogue River) and highways did influence fisher spatial use (Lewis and Stinson 1998; Aubry and Raley 2006). Resident females would occasionally cross such features; they were crossed regularly by adult males during breeding season, and did not limit dispersal movements of juveniles (Aubry and Raley 2006). Fishers depend on the presence of water, and occur in riparian areas, which are generally protected from logging practices and are more productive, therefore having denser canopies that are closed (CBD 2000).

Fishers are generally solitary animals except during breeding season (late February to the end of April). During breeding season, males move across greater areas of land and the home range of one male may overlap home ranges of several females (Aubry and Raley 2006). In southern Oregon Cascades, average home range sizes for females were approximately 25 km^2 (9.7 mi^2), 62 km^2 for males during the non-breeding season and 147 km^2 for males during the breeding season (from 24 to 57 mi^2), based on locations of radio telemetered study animals (Aubry and Raley 2006).

Reproduction rates are low for fishers and vary year to year because females may not give birth every year (FWS 2012b). In southwest Oregon, litter sizes ranged from 1 to 3 with an average of 1.9 kits/female (Aubry and Raley 2006). In the southern Oregon Cascades, fishers give birth from mid-March to early April. Natal dens are used until late May or beginning of June. When weaned, females move kits from natal dens to maternal dens, which are used for a few days to a few weeks; longer use appeared related to larger litter sizes. By late July-early August, kits are 4 months old and mobile, travelling with their mothers; by the end of October, kits are independent but may remain within the mother's home range until they disperse in late January-early February (Aubry and Raley 2006). Breeding occurs during April after females give birth; embryos become dormant and intrauterine implantation is delayed until the end of February in the next calendar year.

Fishers select large, live, decadent or dead trees for natal den sites, where females give birth to young and nurse until weaned when about 8 to 10 weeks old (Seglund 1995; Aubry and Raley 2006; Weir and Harestad 2003). Female fishers in southern Oregon were found to utilize cavities in snags that averaged 35 inches dbh (range of 24 to 54 inches) and 85 feet tall (range of 33 to 171 feet); live trees used for denning averaged somewhat larger in dbh and were taller (Aubry and Raley 2006). Access to hollows created by heartwood decay is often associated with holes excavated by pileated woodpeckers. A variety of large conifer tree species are used for denning, including Douglas-fir, incense cedar (*Calocedrus decurrens*), true fir (*Abies*), and western white pine (*Pinus monticola*; Aubry and Raley 2006). Availability of large den trees is likely a limiting factor for fishers in landscapes dominated by short-rotation forestry (less than 60 years) in which large snags are removed and forest succession is limited (Hayes and Lewis 2006).

Rest structures used by fishers include mistletoe and rust brooms, large lateral limbs and limb clusters in the canopies of live trees, rodent or raptor nests, cavities in snags or logs, ground burrows, or beneath piles of cull logs (Seglund 1995; Aubry and Raley 2006; Weir and Harestad 2003; Weir et al. 2004; Zielinski et al. 2004). Female fishers primarily utilize large, live Douglas-firs, and secondarily in Douglas-fir or white fir (*Abies concolor*)/grand fir (*Abies grandis*) snags as resting sites. Males also rest in live trees, but use western hemlock, Douglas-fir, and white/grand fir about equally with Douglas-fir snags used secondarily (Aubry and Raley 2006). Generally, fishers in western North America rest in the canopies of live trees in both winter and summer (Jones and Garton 1994; Buck et al. 1994; Seglund 1995).

Mature and old-growth forests with greater vertical layering of vegetation and greater conifer canopy cover provide a range of cooler and moister microclimates below the forest canopy (Hayes and Lewis 2006). Fishers' disproportionate use of riparian areas in more arid landscapes in some western states (Jones and Garton 1994; Seglund 1995) may be related to their association with cool, mesic forests (Buskirk and Powell 1994) although proximity to water does not appear to influence rest site selection in the cooler and moister forests in the Coast Range of the Pacific Northwest (Zielinski et al. 2004).

Population Status

Historical records indicate fisher populations had dramatically declined in Oregon's Cascade Range by the 1920s and the trapping season was closed in 1937 to protect remaining population (Aubry and Lewis 2003). Fishers were considered nearly extinct in Oregon in 1938 (Olterman

1972). Estimates of fisher abundance are difficult to obtain and as a result there are only a few estimates of fisher population densities for specific study areas in the Pacific states (FWS 2012b). For the northern California–southern Oregon population, there are estimates generated for individual study areas, and one for the entire population encompassing Oregon and California.

Matthews et al. (2010) reported densities on the Hoopla Valley Indian Reservation in Humboldt County, California in the Klamath Mountain Range for 1998 and 2005. This study reported a 73 percent decline from 52 fishers per 38.6 square miles in 1998 down to 14 fishers per 38.6 square miles in 2005. However, a study conducted by Diller on adjacent property over the same timeframe did not detect the same decline, concluding the Hoopla decline may have been localized (FWS 2012b). In 2008, 4,018 fishers were estimated to occur across the entire northern California southern Oregon population (Self et al. 2008). Population density estimates for the southern Sierra Nevada population have been modeled by a few studies. In 2000, Lamberson et al. (2000) estimated populations between 100 and 500 individuals. Another study in 2008 estimated the population size to be 160 to 360 individuals (Spencer et al. 2008). Self et al. (2008) estimated numbers of fishers in the southern Sierra Nevada populations to be 598 individuals.

Although precise empirical data on fisher numbers in the West Coast DPS are not available, the extant fisher populations appear to be relatively small compared to their historical distribution as evidenced by the lack of detections or sightings over much of its historical range, and apparent isolation from the main body of the species range (FWS 2012b, 2014b; see figure 3.2.11-1).

Critical Habitat

Critical habitat has not been proposed for the fisher.

3.2.11.2 Environmental Baseline

Analysis Area

The analysis area for the fisher extends as far as Pipeline construction-related noise attenuates to ambient noise, assumed to be 40 dB on both sides of the Pipeline construction right-of-way, in Klamath, Jackson, Douglas, and Coos Counties, where the fisher is currently and historically known to occur.

Species Presence

The southern Oregon Cascades population primarily occurs north of the Project, and was previously documented as close as approximately five miles from the Pipeline between about MP 110 to MP 175 (Aubry and Raley 2006; Lofroth et al. 2010). However, recent telemetry studies in the southern Oregon Cascades identified fisher home ranges that overlap with the Project on the Winema National Forest (Cummins 2018). Location databases show one observation within one mile and one observation within one to three miles of the Project on the Winema National Forest (ORBIC 2017b; Forest Service 2017). These observations, together with the availability of suitable habitat within the pipeline right-of-way, indicate that there is potential for fishers to be present within the analysis area.

Fishers from the southern Oregon Cascades population have been observed south of the proposed Pipeline route in Jackson and Klamath Counties (Lofroth et al. 2010; Cummins 2018). Fishers from the Northern California/Southern Oregon population occur in the northern Siskiyou Mountains in the Klamath-Siskiyou Bioregion of northern California (Del Norte County) and southwest Oregon (Curry and Josephine Counties) (Slauson and Zielinski 2004). Genetic analysis of fishers in the Siskiyou Mountains indicates that they represent the northern limit of fishers native to northwestern California (Aubry et al. 2004). The genetic evidence further indicates that fishers from the southern Oregon Cascades are geographically isolated from fishers in the northern Siskiyou Mountains (Aubry et al. 2004). However, limited evidence suggests that the two populations may be interconnected by dispersing fishers; a hair sample from a male fisher from the Northern California/Southern Oregon population was found east of I-5, 19 miles south of the southern Oregon Cascades population, indicating it had crossed the I-5 corridor (FWS 2014b; Barry et al. 2018).

Eleven fishers (five males, six females) were translocated from British Columbia and introduced at Buck Lake, Klamath County in 1961. A total of eight fishers (five males, three females), also from British Columbia, were introduced during two releases west of Crater Lake in 1977; a total of eight fishers (four males, four females) from British Columbia were introduced during three releases west of Crater Lake in 1978 and another male was released in 1980. Thirteen fishers (eight males, five females) were translocated from Minnesota and introduced northwest of Crater Lake in 1981 (Aubry and Lewis 2003). No monitoring of translocated fishers occurred, and there is no information about dispersion or persistence of released animals.

Fishers that had been incidentally captured, road-killed, or shot revealed that fishers had persisted after they were released, and genetic analysis of tissue from fishers surveyed in southern Oregon during the 1990s indicated common traits with fishers from British Columbia and Minnesota (Drew et al. 2003) but not with native Oregon or California fishers (Drew et al. 20003; Aubry and Lewis 2013; Aubry et al. 2004). These studies demonstrate the success of the several introductions between 1978 and 1981 in the southern Oregon Cascades and the persistence of fishers north of the Project.

Eighteen observations provided by the Forest Service and two provided by the Oregon Biodiversity Information Center (ORBIC) were ≤20 miles from Buck Lake, including two records from ORBIC (2012), five records from Rogue River-Siskiyou National Forest, and 11 records from Fremont-Winema National Forest. The ORBIC records include: 1) the introduction of five males and six females at Buck Lake in January 1961, and 2) multiple observations of from one to two fishers in the same vicinity 12.5 miles from the Pipeline in 1990, 1999, and 2010. The Rogue River-Siskiyou National Forest records include 1) one fisher 0.7 mile south of the route in 1978, 2) two records 12.8 miles north in 1990, 3) a sighting 10.5 mile north in 2012, and 4) a sighting 13.2 miles north in 2013. The Fremont-Winema National Forest records include 1) five fishers in the vicinity of Buck Lake (from 0.9 to 8.9 miles away following release in January 1961, 2) one sighting 18.2 miles north of the Pipeline in 1985, 3) one sighting 5.5 miles south in 1996, 4) one sighting 1.7 miles northeast in 1998, 5) one sighting 9.7 miles north in 1998, and 6) two detections by a remote camera set 15.9 miles north in 2011.

In addition to observations in the Buck Lake area, one record of a fisher was observed in the vicinity of the South Fork Coos River in Coos County in 1991 (ORBIC 2012), near the proposed pipeline route on land managed by the Coos Bay BLM District and a fisher skull was found in 1999, four miles south of the route west of I-5 on land within the Roseburg BLM District. Surveys for forest carnivores were conducted on Coos Bay BLM lands in 2005 using remote cameras but no fishers were detected (Bennett 2006). Likewise, surveys were conducted at 11 sites in Douglas County during 2008 but no fishers were detected (Hewitt Forest Resources 2009). Similarly, camera and track surveys did not detect fishers in the vicinity of Lake of the Woods on lands managed by BLM Lakeview District, Fremont-Winema National Forest, and Rogue River-Siskiyou National Forest (Roninger 2006). At its closest point, those surveys were about 1.2 miles north of the Pipeline route. Fishers were also searched for on the Dead Indian Memorial Plateau west of Lake of the Woods during 2008. The Plateau was identified as a critical gap in knowledge of the fisher distribution since it is located between the two populations in Oregon. The survey area included portions of the proposed pipeline route and vicinity but no fishers were detected (Clayton and von Kienast 2009).

Following an ecological study of fishers in the southern Oregon Cascades population, Aubry and Raley (2006) defined their fisher study area based on the geographic extent of telemetry locations of 19 fishers tracked between 1995 and 2001 (see Figure 1 in Aubry and Raley 2006). At its closest, the study area boundary is approximately 4.6 miles from the Project at MP 132, southwest of Lost Creek Lake. In addition, Aubry and Raley (2006) documented a juvenile male fisher dispersing 34.2 miles to establish a home range outside of their fisher study area. These observations were assumed to indicate that the southern Oregon Cascades population had not expanded much beyond the areas of fisher introductions in the vicinity of Crater Lake during the 1970s and 1980s. However, preliminary results of fisher monitoring south of the Project in Jackson and Klamath Counties indicate the presence of male and female fisher home ranges along and south of the Project in the southern Oregon Cascades (Cummins 2018). As a result, fishers could be present within the area crossed by the Pipeline right-of-way.

Habitat

The Pipeline right-of-way would cross potential fisher habitat, late successional and old-growth (LSOG) forest, for 39.3 miles, including Westside-Lowland-Conifer- Hardwood-Forest for 9.5 miles, Southwest Oregon Mixed Conifer-Hardwood Forest for 21.6 miles; Ponderosa Pine Forest and Woodland for 4.4 miles; Westside Oak and Dry Douglas-fir Forest and Woodlands for 2.2 miles; Western Juniper and Mountain Mahogany Woodlands for 0.2 mile; and Montane Mixed Conifer Forest for 1.4 miles (habitat categories follow Johnson and O'Neil 2001). LSOG forests are forests where the majority of trees are over 80 years of age, and contain snags and downed wood for denning and resting sites, both of which are essential for the fisher.

Pacific Connector prepared estimates of snag density (numbers of snags per acre) that would be affected within the construction right-of-way and TEWAs on each of the three national forests based upon timber reconnaissance conducted in 2006, 2007, and 2015 (Chapman 2017). Timber reconnaissance occurred prior to the 2015 Stout's Creek fire on the Umpqua National Forest. Snag density by size category (inches dbh) and decay class (hard or soft) are provided in table 3.2.11-1. Within the areas affected by construction, conifer snags less than 13 inches dbh are generally most dense on each forest although there are numerous hardwood snags in that size category on the Rogue River-Siskiyou National Forest. Most of the smaller snags (less than 13 inches dbh) were observed as hard wood, rather than softened due to decay. Because no other portions of the proposed route have been similarly examined, there is no information to indicate that snag densities on the portions of National Forests crossed are different from densities on lands under different management and ownership that would be crossed by the Project.

TABLE 3.2.11-1

Snag Density Estimates on NFS lands

National Forest (acres surveyed)	Tree Type	Decay Class	Estimates of Snag Density (Number per Acre) by Size Category (inches, dbh) <13	13-24	25-36	>36
Umpqua (147 acres)	conifer	Hard	5.7	0.7	1	0
		Soft	0.1	1	1	0.5
Rogue River (181 acres)	conifer	Hard	1.7	0.2	0.1	0
		Soft	0	0.5	0.2	0.1
	hardwood	Hard	1.7	0	0	0
		Soft	0	0.1	0	0
Winema (73 acres)	conifer	Hard	3.3	0.2	0.1	0
		Soft	0	0.4	0.1	0

Snag densities measured during the timber reconnaissance on the Pipeline right-of-way were considerably less than the lower 30 percent of densities of snags ≥50 cm dbh (≥19.7 inches dbh) measured on unharvested forest inventory plots, reported in DecAID (Mellen-McLean et al. 2012). Snag densities for larger trees (the vegetation condition selected in DecAID queries) in Westside Lowland Conifer-Hardwood Forests on the Oregon Coast, Westside Lowland Conifer-Hardwood Forests in the western Oregon Cascades, Southwest Oregon Mixed Conifer-Hardwood Forest, and Montane Mixed Conifer Forest were 4.4 snags per hectare (1.8 snags per acre) or greater in all unharvested forest plots, with and without measurable snags. However, there were no snags ≥19.7 inches dbh measured on at least half of all plots in unharvested tall Ponderosa Pine/Douglas-fir Forest. Each of these forest types are present within the fisher analysis area and snag density conditions along the proposed route fall within the lowest 30 percent or less of snag densities in unharvested forest plots with tall tree vegetation conditions that are expected to provide suitable denning and resting habitat for fishers.

To quantify current snag habitat, fire perimeters and documented tree mortality from the Region 6 Aerial Insect and Disease surveys (from 2000-2011) were counted as suitable snag habitat within the Umpqua National Forest (Chapman 2012). Snag habitat created by wildfire and insects totaled 175,102 acres in 2011 (table 3.2.11-2).

TABLE 3.2.11-2

Acres of Snag Patches Measured by the Region 6 Aerial Detection Surveys 2000-2011 and Wildfire Perimeters from 2000-2011 to Measure Current Functional Snag Habitat on the Umpqua National Forest

Insect and Disease Agent	Acres
Douglas-fir Beetle	15,874
Mountain Pine Beetle-Lodgepole	24,143
Mountain Pine Beetle-Ponderosa	139
Mountain Pine Beetle-Sugar Pine	1,331
Mountain Pine Beetle-Western White Pine	589
Western Pine Beetle	67
Total Acres of Snag Patches Created by Insect & Disease	**42,143**
Fire Year	
2002	87,379
2003	1,208
2008	34,783
2009	7,880
2011	1,708
Total Acres of Fire Perimeters	**132,958**
Total Acres of Snag Habitat 2000-2011	**175,102**

Source: Chapman 2012

However, the distributions of snag habitats from these sources is very limited in the southern portion of the Umpqua National Forest (Tiller Ranger District), in the vicinity of the Project, as opposed to amounts of snag habitat in the Diamond Lake Ranger District (see figure accompanying table in Chapman 2012) in the vicinity of most fisher observations on the Umpqua National Forest. The available data indicate that snag densities along the Pipeline route are less than densities in unharvested forests with large trees; snags within the size range (from 24 to 54 inches dbh) of those utilized by females for denning are limited along the Pipeline.

Critical Habitat

Critical habitat has not been proposed for the fisher.

3.2.11.3 Effects of the Proposed Action

Direct Effects

Habitat Removal During Breeding Season

As described above, fishers give birth from mid-March to early April, natal dens are used until late May or beginning of June, and maternal dens are used until late July-early August, when kits are 4 months old and mobile. Removal of habitat during the breeding season could result in the potential death of kits if natal or maternal den trees or snags are felled. However, timing restrictions for NSO and migratory birds would limit the potential for occupied den sites to be disturbed due to overlap in the habitats and areas used by these species and overlap in breeding seasons. Timber removal would be avoided within 0.25 mile of an NSO activity center between March 1 and September 30, and all timber would be removed outside of the primary migratory bird breeding season (April 1–July 15). As a result, occupied dens are unlikely to be removed during construction.

Construction Noise and Human Activity

Construction of the Project would result in noise that could affect fishers. Ambient sound levels in much of the Pipeline Project area probably would be similar to the Washington Fish and Wildlife Office's determination of 40 dB in the Olympic National Forest (FWS 2003a). Considering ambient sound as a base, noise levels associated with some common machines and activities which would be present during pipeline construction are included in table 3.2.9-1 (in section 3.2.9 [Gray Wolf]). Distances at which noise would attenuate to ambient levels would depend on local conditions such as tree cover and density, topography, weather (humidity), and wind, all of which can alter background noise conditions.

Project-related noise could disturb fisher potentially present if close enough to detect the noise above ambient levels, assumed to be 40 dB. For example, rock ditching (including use of a rock drill, pickup truck, dump truck, and mitigated blasting) is anticipated to attenuate to ambient levels at 11,670 feet assuming no intervening vegetation, or 7,352 feet assuming 100 feet of dense intervening vegetation.[26] On the other hand, noise from a pickup truck generating 70 dB while driving would attenuate to ambient levels about 800 feet away, assuming no intervening topography or vegetation and a noise reduction rate of 7.5 dB for every doubling of distance from the source.

[26] Noise attenuation assumes "soft site" (absorptive ground) conditions and point-source noise reduction of 7.5 dBA for every doubling of distance (WSDOT 2008).

Most construction-related noise would be inaudible above ambient levels within large proportions of fishers' home ranges. As described above, average home range sizes for females in the southern Oregon Cascades were approximately 25 km^2 (9.7 mi^2), while home range sizes for males was 62 km^2 during the non-breeding season and 147 km^2 during the breeding season (i.e., from 24 to 57 mi^2, Aubry and Raley 2006), for an overall average fisher home range size of 65.0 km^2 (25.1mi^2). Noise from a chainsaw (93 dB at 50 feet; see table 3.2.9-1) would attenuate to ambient forest noise 6,703 feet away with the same conditions described above and would be audible within a circular area of 141,166,235 square feet (3,241 acres). That area is 20 percent of the average fisher home range area if assumed to be circular and the chainsaw was operating in or near the center of the 25.1-square-mile home range. Noise generated above ambient levels (assumed to be 40 dB) during construction could disturb fishers if they are present within the analysis area. However, disturbance from noise would only be temporary, and habitat would become suitable once construction activities ceased. Due to this species' mobility, it should be able to temporarily relocate to portions of its home range that would not experience noise above ambient during construction, although this displacement could have energetic costs.

The response of fishers to Project-related noise would likely be similar to their response to other anthropogenic activities such as recreation, hunting, and logging that already occur within the area. In the absence of information specific to fisher's responses to existing anthropogenic noise, we summarize here fisher's response to other anthropogenic disturbance. Seglund (1995) found that rest sites were frequently greater than 328 feet (100 meters) from human disturbance, including recent timber harvest, houses, campground, and roads, indicating that anthropogenic disturbance could result in fisher displacement; this behavior modification could then result in reduced fitness (Naney et al. 2012). Other activities such as traveling or foraging appeared to be less susceptible to disturbance as these activities were documented closer to human disturbance (Seglund 1995; Lofroth et al. 2011). Disturbance of denning fishers is unlikely, as described above under *Habitat Removal during the Breeding Season*. However, construction of the Project could disturb fishers using rest structures within the fisher analysis area.

Vehicle-Related Mortality

Two out of 22 radio-telemetered fishers were killed by vehicles during a study in southwestern Oregon, and fishers have been killed by vehicles elsewhere in North America (Lofroth et al. 2010). During construction, there would be an increase of the number of vehicles traveling along public roadways in areas along the Pipeline and a minor increase in risk of vehicles colliding with fishers. However, the chance that a Project-related vehicle would kill or injure a fisher would be minimized through implementation of BMPs including speed limits, as described under section 3.2.11.4, Conservation Measures, below. During Pipeline operation, there would be no measurable increase in traffic above existing traffic volumes in the area. Vehicle-related mortality of a fisher due to Project construction and operation is possible but traffic accessing the Pipeline right-of-way on unpaved forest roads is not expected to increase risk of mortality to fishers.

Indirect Effects

Potential indirect effects from the construction and operation of the pipeline Project include habitat removal and modification, habitat fragmentation and edge effect, and loss of snags.

Habitat Loss

Construction of the pipeline would result in removal or modification of fisher habitat. Loss of habitat includes loss in forest complexity and structural elements, such as snags and downed logs, which the fisher depend on for denning and resting sites. Loss of structural elements negatively affects fishers (Lofroth et al. 2010). Removal of habitat could also increase predation by bobcats and cougars by reducing hiding cover (FWS 2012b).

Construction of the pipeline would impact approximately 773 acres of LSOG forests, including Westside-Lowland-Conifer-Hardwood-Forest (229.1 acres), Southwest Oregon Mixed Conifer-Hardwood Forest (406.3 acres); Ponderosa Pine Forest and Woodland (72.8 acres); Westside Oak and Dry Douglas-fir Forest and Woodlands (39.6 acres); Montane Mixed Conifer Forest (22.5 acres); and Western Juniper and Mountain Mahogany Woodlands (2.7 acres) (table 3.2.11-3; habitat categories follow Johnson and O'Neil 2001). The Pipeline Project would create a 95-foot-wide corridor through these LSOG forest-woodland types.

TABLE 3.2.11-3

Acres of Late-Successional Old Growth Forest Habitat Impacted by and Available within 5 Miles of the Project

Habitat Category (Johnson and O'Neil 2001)	Acres Impacted	Acres Available within 5 miles	Percent
Westside Lowland Conifer-Hardwood-Forest	229.1	52,485.1	0.4%
Montane Mixed Conifer Forest	22.5	15,121.0	0.1%
Southwest Oregon Mixed Conifer-Hardwood Forest	406.3	169,854.0	0.2%
Ponderosa Pine Forest and Woodlands	72.8	37,369.8	0.1%
Westside Oak and Dry Douglas-fir Forest and Woodlands	39.6	10,244.5	0.6%
Western Juniper and Mountain Mahogany Woodlands	2.7	2,854.3	0.0%
Other Forested-Woodland Habitat a/	0	38,360.5	0.0%
Total	**773.0**	**326,289.2**	**0.24%**

a/ Other Forest-Woodland Habitat: delineation and available GIS data sources indicate that the area is forested but Johnson and O'Neil (2001) GIS database identified the area as non-forested.

The acres of LSOG habitat available within five miles of the Pipeline were calculated using a combination of Johnson and O'Neil (2001) habitat types, Gap Analysis Project data, aerial photographs, and other available data, including LSOG coverage (BLM 2008a; ORNHIC and The Wetland Conservancy 2009; USGS 2011). LSOG habitat removed or modified by Project construction constitutes 0.24 percent of available habitat within five miles of the Project (table 3.2.11-3).

Habitat Fragmentation

In addition to removing suitable habitat, the pipeline would result in habitat fragmentation. Fragmentation can increase predation risk, migration/species movement, and affect prey species composition, abundance, and availability (FWS 2012b). Habitat fragmentation would degrade suitable habitat by creating a swath of less suitable habitat where fishers use of this habitat to forage or find rest and den sites would decrease as discussed above. This fragmentation could additionally increase predation risk by forcing fishers to traverse less suitable habitat that lacks hiding cover and attracts predators associated with fragmented and early-seral habitats (Lofroth et al. 2010). Fragmentation can also increase energetic costs to fishers, which may result in nutritional stress that can reduce overall fitness, ultimately affecting survival, reproduction, and recruitment (Lofroth et al. 2010).

Construction of the Pipeline would also result in edge effects to the habitat adjacent to the Pipeline right-of-way, especially interior LSOG habitat. The conversion of large tracts of old-growth forest to small, isolated forest patches with large edge areas can create changes in microclimate, vegetation species, and predator-prey dynamics. These changes in microclimate could affect fisher habitat adjacent to the cleared pipeline right-of-way by affecting prey species and reducing cover for resting and denning.

The cleared right-of-way also has the potential to act as a barrier to dispersal; however, the Pipeline is likely to be a porous or soft barrier because it would remain vegetated. Additionally, fishers have been documented crossing more extensive or hard barriers, including U.S. Highway 140 and I-5 (Barry et al. 2018; Cummins 2018).

Snags

Fishers depend on standing and coarse downed wood that provide cavities or hollows used for natal and maternal dens and for resting. Fishers in the southern Oregon Cascades use live trees and snags for resting structures, typically occupying cavities in hollows in large trees that had been subject to heartwood decay (Aubry and Raley 2006). Snag densities measured during the timber reconnaissance on the proposed right-of-way (see table 3.2.11-1) were considerably less than the lower 30 percent of densities of snags ≥50 cm dbh (≥19.7 inches dbh) measured on unharvested forest inventory plots as reported in DecAID (Mellen-McLean et al. 2012). Snag characteristics along the proposed route have limited similarity to characteristics of snags used by fishers in southern Oregon Cascades; females fishers utilized cavities in snags that averaged 35 inches in dbh (range of 24 to 54 inches dbh) and 85 feet tall (range of 33 to 171 feet) (Aubry and Raley 2006). Relatively few snags in the range of 24 to 54 inches dbh that might function as denning habitat were reported from the survey along the pipeline route crossing national forest lands (table 3.2.11-1).

Construction of the pipeline right-of-way within 773 acres of LSOG habitat (see table 3.2.11-3) could remove between 155 and 1,932 conifer snags using the densities provided in table 3.2.11-1, and extrapolating the total density of conifer snags greater than 25 inches by each National Forest to the total acres of LSOG habitat removed by the Project. If evenly distributed along the 39.3 miles of Project right-of-way that intersect LSOG habitat patches, there would be an estimated average of 3.9 to 49.2 snags per mile removed within affected LSOG forests. Those snags, ranging from 24 to 54 inches dbh, could provide denning and resting habitat for fishers. Snags are anticipated to be available outside the right-of-way in equal or greater densities and thus provide alternate rest and den sites for fisher within their home range. However, removal of snags during Project construction would result in loss of potential denning and resting habitat.

Critical Habitat

Critical habitat has not been proposed for the fisher.

3.2.11.4 Conservation Measures

No conservation measures have specifically been proposed for this species. However, the following conservation measures proposed by Pacific Connector including avoidance, minimization, and rehabilitation/restoration would reduce potential effects to this species.

Avoidance, Minimization, and Rehabilitation / Restoration

Conservation measures to minimize construction and operation impact to NSO habitat (see section 3.3.4) would also minimize impacts to fisher and LSOG habitat. Those measures have been compiled in table 2C in appendix N. Specific conservation measures that would benefit fishers include those that:

- Co-locate the proposed right-of-way adjacent to, but separated from, existing rights-of-way including powerlines, roads, and other pipelines for about 97.7 miles (43 percent), thus minimizing fragmentation to fisher habitat. TEWAs would be located in previously disturbed areas to minimize impacts to more pristine wildlife habitat when possible.
- Minimize removal of forest by incorporating UCSAs into the Project design.
- Flag large-diameter trees on edges of construction right-of-way or temporary work areas where feasible to save from clearing.
- Avoid removing timber within 0.25 mile of an NSO activity center between March 1 and September 30, and avoid removing all timber outside of the primary migratory bird breeding season (April 1 -July 15). Pipeline construction, including blasting and helicopter activity, would occur after the NSO critical breeding period (March 1 - July 15) within 0.25 mile of an NSO activity center. These seasonal restrictions would benefit any denning fisher in those areas.

Mitigation

The Forest Service has proposed a suite of mitigation projects to address the effects of the Pipeline Project on various resources on NFS lands and to ensure that construction and operation of the pipeline would be consistent with the objectives of the respective Forest Service LRMPs (appendix O.4). These mitigation actions would be a condition of the Forest Service letter of concurrence and would be included in the Right-of-Way Grant, if one were issued for this Project. Implementation and funding of these actions would be carried out through negotiated agreements between the Forest Service and Pacific Connector.

In general, the mitigation measures proposed for NFS land have the potential to result in short-term impacts to fishers, such as temporary disturbance from equipment and people, but would result in beneficial effects in the long term by improving habitat through, for example, fire risk reduction, and increased habitat connectivity. The Forest Service has proposed mitigation in the following mitigation categories to ensure consistency with the objectives of Forest Service LRMPs that may benefit fisher:

- habitat enhancement,
- fire suppression,
- fuels reduction,
- road decommissioning, and
- re-allocation matrix to late successional reserve (LSR).

Habitat enhancement projects would include silvicultural treatments to accelerate development of LSOG conditions, snag creation, and upland large wood (LW)[27] placement. These projects would

[27] Per standard industry terminology, large woody debris is referred to as LWD in our EIS, but it will be referred to as large wood, or LW, in this BA at the request of NMFS.

benefit fishers by creating habitat or improving existing habitat quality. Fire suppression and fuels reduction projects would reduce the future risk of fire and thus potential fisher habitat loss. Fire suppression projects would create noise from heavy equipment in the short term that could disturb fisher. Noise associated with these restoration activities, especially if they require helicopters, has the potential to disturb fisher. However, Project design features would focus disturbance outside the breeding season. Overall, the species is expected to benefit from these projects.

Road decommissioning would benefit many species of wildlife including the fisher through reduced disturbance from the elimination of road traffic and long-term benefits as decommissioned roads become reforested reducing fragmentation of habitat. Road decommissioning would create noise from heavy equipment in the short term that could disturb fisher. However, similar to the habitat enhancement and fire suppression activities described above, overall, the species is expected to benefit from these mitigation projects.

Re-allocation of Matrix to LSR would result in habitat creation for fisher as LSOG conditions develop. A summary of all Forest Service mitigation projects and their potential impacts to all relevant species and habitats is provided in table 2.1.5-1 in chapter 2 of our EIS (FERC 2019), and table 2.8-1 of this BA.

Currently, these projects lack the site-specific details needed for implementation; however, the Forest Service is seeking consultation at a programmatic level for these and other proposed Forest Service actions described in this BA. It is anticipated that these projects would require a secondary site-specific project-level ESA consultation prior to implementation.

3.2.11.5 Determination of Effects

Species

The Project **may affect** the fisher because:

- individuals from the southern Oregon Cascades population may occur within the analysis area and could be disturbed by construction of the Pipeline Project; and
- suitable habitat is available within the analysis area and would be impacted by construction of the Pipeline Project.

If FWS lists the fisher prior to completion of the Project, the provisional determination **may affect, likely to adversely affect** would be warranted because:

- fisher likely occur within the Project area, and there is suitable habitat within the pipeline right-of-way;
- the Project would remove large trees and snags that could be fisher habitat during the time of construction as well as over the lifetime of the Project;
- habitat would be fragmented during Project construction, which would increase impacts to fisher; and
- noise, equipment, and vehicles could disturb or injure fisher if present.

Because fishers are proposed for listing, the Project **would not likely jeopardize the continued existence** of the fisher for the following reasons:

- LSOG habitat removed or modified by Project construction constitutes only 0.24 percent of available habitat within 5 miles of the pipeline;

- the cleared right-of-way is not expected to pose a barrier to dispersal because it would remain vegetated and be considered a porous or soft barrier, and likely be less severe than hard barriers that fisher have been documented crossing such as U.S. Highway 140 and I-5; and
- observations of fishers within the analysis area have been limited, indicating few individuals would be disturbed by construction.

Critical Habitat

Critical habitat has not been proposed for the fisher.

3.3 BIRDS

3.3.1 Short-tailed Albatross

3.3.1.1 Species Account and Critical Habitat

Status

The short-tailed albatross was proposed for listing in the United States in 1980 under the ESA and was listed as endangered throughout its range in the United States on July 31, 2000 (FWS 2000b).

Threats

The primary threat leading to the species' decline and ultimate listing was over-harvest for their feathers in the early 1900s (FWS 2000b), but that threat is no longer present. Another major threat to the short-tailed albatross is their small population size and the existence of few breeding populations, one of which is threatened by volcanic activity on Torishima Island (i.e., an uninhabited Japanese island in the Pacific Ocean) as well as by mudslides and erosion (FWS 2005b, 2008a). Petroleum development occurs in many parts of the short-tailed albatross' marine range, and oil spills are a threat to conservation and recovery.

The possibility of volcanic eruption on Torishima Island remains the primary ongoing threat to short-tailed albatross because 80 to 85 percent of the breeding population nests there (FWS 2005b). Typhoons and monsoon rains generating mudslides and erosion threaten extant nesting colonies on a regular basis. Secondary threats include adverse effects related to environmental changes (oceanic circulation and patterns of upwelling), incidental take by commercial fisheries (longline fisheries trawl fishing in the North Pacific), ingestion of plastic debris (especially beverage bottle caps), contamination by oil and other pollutants (metals, pesticides, PCBs), vulnerability to predation by non-native species, and other human actions including collisions with airplanes (FWS 2005b). Also, when populations are small and confined to only a few locations such as the known breeding colonies for short-tailed albatrosses, there is a heightened risk of catastrophic loss from random or unpredictable events (environmental stochasticity).

Species Recovery

The FWS drafted a recovery plan for the short-tailed albatross in October 2005 (FWS 2005b), describing actions necessary to achieve conservation and survival of the species. Human harvest of the short-tailed albatross is no longer a threat to the species' existence, nor are human-related limitations. Therefore, focus for recovery is on the protection and creation of safe breeding colonies (i.e., without potential for volcanic eruption or massive erosion) on remote islands in the

Pacific Ocean (FWS 2008a). The goal of the plan is to recover the species to the point that protection under the ESA is no longer required. The plan listed the following recovery tasks:

- Support ongoing population monitoring and habitat management on Torishima.
- Monitor a second population in Japan (Senkaku population).
- Conduct telemetry studies.
- Establish one or more nesting colonies on non-volcanic islands.
- Continue research on impact from fisheries operations and mitigation measures.
- Conduct other research.
- Conduct other management-related activities.
- Conduct outreach and international negotiations as appropriate.
- Develop models and protocols for all aspects of recovery work.

Life History, Habitat Requirements, and Distribution

The short-tailed albatross nests on flat or sloped sites with sparse or full vegetation on isolated windswept offshore islands with limited human access (FWS 2000b). It requires remote islands for breeding (FWS 2005b). The only terrestrial area within U.S. jurisdiction where the short-tailed albatross is currently nesting is the Midway Atoll (FWS 2012c).

In the North Pacific, the coastal habitat for the short-tailed albatross is in high-productivity areas with expansive deep water beyond the continental shelf. Short-tailed albatrosses eat squid, fish, eggs of flying fish, shrimp, and other crustaceans (FWS 2000b). Short-tailed albatross foraging areas are closely associated with shelf-edge habitats where tidal currents and steep bottom topography generate strong vertical mixing of ocean waters. Areas are most prominent along the Aleutian Archipelago but also include several locations along the U.S. West Coast in the Santa Barbara Channel and Monterey Bay Canyon in California and the Juan de Fuca Canyon near Vancouver Island (Piatt et al. 2006).

Population Status

Prior to the publication of the final rule to list the birds, FWS (2000b) estimated a worldwide population of 600 breeding age birds and 600 immature birds (i.e., birds younger than 6 years in age) for a total of 1,200 individuals. In 2005-2006, there were an estimated 500 breeding pairs and approximately 2,000 individual short-tailed albatrosses (FWS 2005b). Population estimates in 2008-2009 indicate 418 breeding pairs (836 breeding adults) on Torishima with a total adult population of 1,045 and an estimated adult population on Minami-kojima of 200 during the 2008-2009 nesting season. The worldwide total adults of breeding age in 2008-2009 was 1,245 birds and 1,327 birds of sub-breeding age (under age 5 or 6) (FWS 2009a). The total population estimate for breeding age short-tailed albatrosses in the 2013-2014 nesting season was 1,928 individuals (FWS 2014b). Overall population size of 750 breeding pairs required for reclassification to threatened was estimated to have been met in 2013 and the delisting criteria of 1,000 breeding pairs is estimated to be met in 2017 (P. Sievert, pers. comm. 2010 as cited in FWS 2014b). More recent population data are not available.

Critical Habitat

Critical habitat has not been designated for the short-tailed albatross.

3.3.1.2 Environmental Baseline

Analysis Area

The analysis area within which the proposed action could affect the short-tailed albatross is the edge of the marine analysis area along the continental shelf. Within the analysis area, effects to the short-tailed albatross would be associated with LNG carriers, which are assumed to transect the marine analysis area perpendicularly (east and west) as they approach and depart from Coos Bay (see the discussion above under section 3.2.1.3).

Species Presence

The short-tailed albatross has not been documented within 25 miles of the LNG Project or Pipeline (ORBIC 2012), and the nearest known nesting population is within the Hawaiian Islands, on the Midway Atoll. Three percent of locations for sub-adult short-tailed albatrosses tagged with satellite transmitters in Alaskan waters were along the continental shelf margin, within 200 nmi of the U.S. West Coast (Suryan et al. 2007). The data is gridded on 1° lines making it unclear if albatrosses within the study area came within the marine analysis areas. Most recent records for the species in Oregon have been at sea in the vicinity of Perpetua Bank, which is 32 miles west of Yachats in Lincoln County (Marshall et al. 2006). Short-tailed albatrosses have also been observed at Heceta Bank (in 1961, 2000, and 2001; Audubon Society of Portland 2013), 15 to 30 miles off the central Oregon coast, which is part of the same seamount ridge formation as Perpetua Bank, promoting upwelling of ocean currents interacting with seafloor topography with concomitant primary production.

Habitat

Short-tailed albatrosses spend much of their time feeding in nutrient-rich areas of ocean upwelling which often occur at continental shelf breaks (FWS 2005b). In Oregon, the continental shelf extends from 10 miles off the coast at Cape Blanco to 46 miles from the Oregon central coast (Oregon Ocean-Coastal Management Program 2008). The Perpetua Bank and Heceta Bank are within the continental shelf break zone, and ocean upwelling presumably occurs in the vicinity to support foraging by short-tailed albatross. This habitat occurs on the edge of the marine analysis area, approximately 12 nmi to the outer continental shelf.

Critical Habitat

Critical habitat has not been designated for the short-tailed albatross.

3.3.1.3 Effects of the Proposed Action

Direct and Indirect Effects

None of the factors that have threatened the short-tailed albatross in the past or that are ongoing threats to the species would occur as a result of the proposed action.

Seabirds collide with fishing trawlers in the North Pacific although take of short-tailed albatross has not been reported (FWS 2009a). Collisions of seabirds with ships are possible, either by collisions of ships with birds on the ocean surface or collisions of birds in flight with ship structures although empirical data are limited (Wilson et al. 2007). Collisions between short-tailed albatrosses and LNG carriers are possible but not likely within the marine analysis area.

LNG carriers calling on the LNG Project would be required by the Coast Guard to have a vessel response plan in order to be adequately prepared for accidental spills. LNG carriers would also be required to obtain a vessel general permit from the EPA that would outline regulations for avoiding release of even small quantities of fuel or lubricants during normal operations such as washing the vessel deck. As a result, effects to short-tailed albatross from accidental spills are expected to be insignificant and discountable.

Critical Habitat

No critical habitat would be affected by the proposed action; none has been designated.

3.3.1.4 Conservation Measures

No measures have been included in the proposed action to specifically conserve short-tailed albatross.

3.3.1.5 Determination of Effects

Species

The Project **may affect** short-tailed albatross because:

- short-tailed albatross may occur within the marine analysis area during operation of the proposed action; and
- the Project would increase shipping traffic (e.g., LNG carriers) within the marine analysis area.

However, the Project is **not likely to adversely affect** short-tailed albatross because:

- other species of albatross have infrequently collided with airplanes in flight, but collisions of any albatross species with ships are unknown and are expected to be highly unlikely; and
- an increase of 120 LNG carrier trips per year to the LNG terminal is not expected to cause a measurable increase in potential ship strikes on short-tailed albatrosses.

Critical Habitat

No critical habitat has been designated or proposed for the short-tailed albatross.

3.3.2 Western Snowy Plover

3.3.2.1 Species Account and Critical Habitat

Status

The Pacific Coast population of western snowy plover has been listed as a threatened species under the ESA since March 5, 1993 (FWS 1993a). In March 2004, FWS issued an initial 90-day review in response to a petition to de-list the western snowy plover. However, in April 2006 after further review, the de-listing petition was found to be unwarranted (FWS 2006b).

Threats

Active nesting areas and breeding and wintering populations have declined due to habitat degradation caused by urban development (industrial, residential, recreational facilities including homes, parking lots, and commercial establishments), introduced beachgrasses used to stabilize sand dunes, expanding predator populations (particularly corvids and non-native red foxes), and human disturbance (e.g., beach walking and jogging, off-road vehicle (ORV) use, horseback riding, beach raking, pet walking [FWS 2007a]). Nesting from mid-March through mid-September corresponds with the period of intensive human use of beaches during summer, which has been documented to adversely affect adult survival as well as reproduction and fledging success.

Habitat destruction and degradation continue as the primary threats to western snowy plovers along the Pacific Coast (FWS 2007a). Beach stabilization efforts have continued with permanent habitat losses due to homes, resorts, parking lots, and increased human recreational use of beaches. Other human-related threats include sand mining, disposal of dredged materials that also alter beach habitat dynamics and increase recreational access to habitats, driftwood removal (for firewood, decoration), camping and campfires, reduction in sand delivery to beach by water diversions or waterbody impoundments, and maintenance of salt ponds (FWS 2007a). Non-native beachgrasses continue to degrade the landscape along the Oregon coast by changing patterns of dune stabilization, making beach habitats less suitable for nesting and brood-rearing snowy plovers (FWS 2007a).

Species Recovery

In 2007, the FWS issued a recovery plan for the western snowy plover, Pacific Coast population, with the primary objectives to increase the numbers and productivity of breeding adults throughout the Pacific Coast and to provide for long-term protection of breeding and winter plovers and their habitat. The recovery plan provides management goals for six recovery units established within the breeding range of the Pacific Coast population in Washington, Oregon, and California. Recovery Unit 1, specifically population OR-13 (Coos Bay North Spit), is near the Project. The management goal for recovery unit OR-13 is 54 breeding plovers (FWS 2007a). The 2007 recovery plan's primary objective is to remove the species from the List of Endangered and Threatened Wildlife and Plants by:

- increasing population numbers distributed across the range of the Pacific Coast population;
- conducting intensive ongoing management for the species and its habitat and developing management mechanisms; and
- monitoring western snowy plover populations and threats to determine success and refine management actions.

The recovery plan lists the following necessary actions:

- Monitor breeding and wintering populations and habitats of the Pacific Coast population of the western snowy plover to determine progress of recovery actions to maximize survival and productivity.
- Manage breeding and wintering habitat of the Pacific Coast population of the western snowy plover to ameliorate or eliminate threats and maximize survival and productivity.

- Develop mechanisms for long-term management and protection of western snowy plovers and their breeding and wintering habitat.
- Conduct scientific investigations that facilitate the recovery of the western snowy plover.
- Conduct public information and education programs about the western snowy plover.
- Review progress towards recovery of the western snowy plover and revise recovery efforts, as appropriate.
- Dedicate FWS staff to allow the Arcata Fish and Wildlife Office to coordinate western snowy plover recovery implementation.
- Establish an international conservation program with the government of Mexico to protect western snowy plovers and their breeding and wintering locations in Mexico.
- Coordinate with other survey, assessment, and recovery efforts for the western snowy plover throughout North America (FWS 2007a).

The BLM administers the bulk of the lands on the Coos Bay North Spit (about 1,864 acres) with other federal and state agencies having jurisdiction over various portions of the North Spit; privately owned lands are also scattered throughout the area (COE 2016a). Snowy plover habitat on the North Spit is currently owned by the BLM and COE and managed by the BLM, Forest Service, and Oregon Parks and Recreation Department (OPRD). The COE developed a site management plan to protect habitat for western snowy plovers on lands under their jurisdiction on the Coos Bay North Spit (COE 2016b). The plan includes habitat management and restoration, seasonal and area restrictions, access and public use, predator management, and population and productivity monitoring. Additionally, the BLM management plan (BLM 2016a) contains directives to avoid road or trail development within designated critical habitat and restricts timing and location of beach activities to avoid disrupting nesting behaviors. A Habitat Conservation Plan was prepared, as part of OPRD application for an incidental take permit, to implement OPRD management and regulatory activities along the Oregon Coast that could affect the snowy plover (ICF 2010). OPRD would implement potential recreation restrictions and beach management activities within covered lands.

Life History, Habitat Requirements, and Distribution

The Pacific Coast breeding population of the western snowy plover extends from Mexico to mid-way up the Washington coast. Coastal populations, including those in Oregon, typically consist of both resident and migratory birds. Large concentrations of migratory snowy plovers winter primarily in coastal California, Baja California, and along the coastal mainland of Mexico (FWS 1993a). The Pacific Coast population of the western snowy plover includes the birds that nest adjacent to tidal waters, including all nesting birds on the mainland coast, peninsulas, offshore islands, adjacent bays, estuaries, and coastal rivers (FWS 1993a). They breed on coastal beaches from southern Washington to southern Baja California, Mexico, from early March through late September (FWS 1993a and 2001). Coastal beach breeding habitat is often dynamic because of unconsolidated soils, high winds, storms, wave action, and colonization by plants. Preferred nesting sites include sand spits, dune-backed beaches, beaches at creek and river mouths, and salt pans at lagoons and estuaries (Wilson 1980; Stenzel et al. 1981). Less frequently, western snowy plovers nest on bluff-backed beaches, dredged material disposal sites, salt pond levees, dry salt ponds, and river bars (FWS 2001).

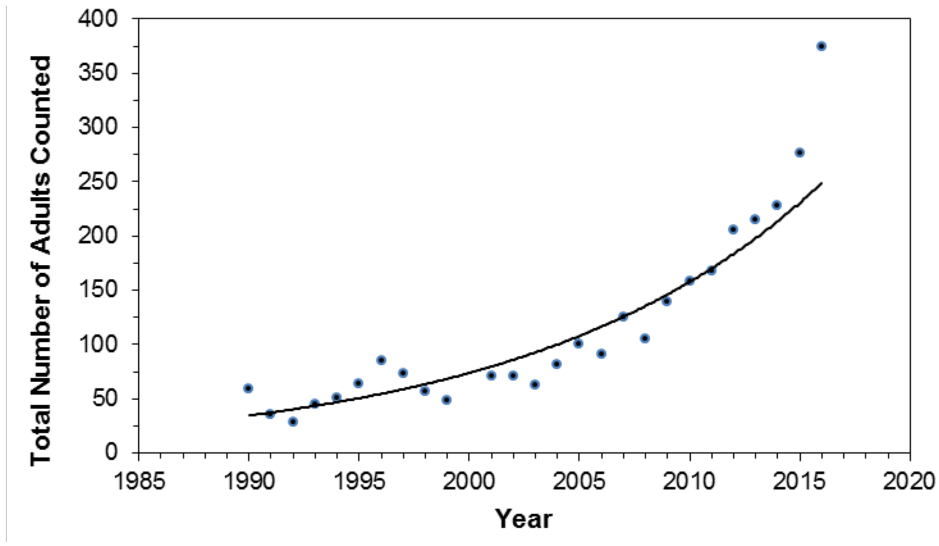
Nesting in Oregon may occur as early as mid-March but peak nest initiation occurs from mid-April through mid-July (Wilson-Jacobs and Meslow 1984). Nests typically occur in flat, open areas with sandy or saline substrates; vegetation and driftwood are usually sparse or absent (Wilson 1980). Nests consist of a shallow scrape or depression lined with beach debris (e.g., small pebbles, shell fragments, plant debris, and mud chips); nest lining progresses as incubation progresses.

Usual clutch size is three eggs but can vary from two to six. Both males and females incubate the eggs. After losing a clutch or brood (i.e., group of chicks) or successfully hatching a nest, western snowy plovers may re-nest at the same site or move substantial distances to nest at other sites (Wilson 1980; Warriner et al. 1986).

Eggs hatch within 30 days. Young are very precocial and ready to leave the nest within 1 to 3 hours of emergence at which point the attending parent would lead them to suitable feeding grounds. Broods rarely remain in the nesting area and have been observed on the North Spit as far as three miles north of the jetty at the mouth of the bay (Todd 2007). Chicks are able to fly approximately one month after hatching (FWS 2007a). Plovers feed on small invertebrates in wet sand areas of the intertidal zone, along the wrack line, in dry sandy areas above the high tide line, and along surf-cast driftwood and kelp.

Population Status

Historical records indicate that western snowy plovers nested in at least 29 locations along the Oregon coast (FWS 2009b). At the time of the species' listing, there were only six known nesting locations (FWS 1993a). The breeding population in Oregon declined from 139 adults in 1983 to 30 adults in 1992. Similar declines within wintering habitats were also reported in southern California (FWS 1993a). Along the Oregon coast, there are nine main nesting areas, though several other areas may be utilized in some years (FWS 2007a). The lowest population estimates for nesting plovers on the Oregon coast averaged 33 individuals annually between 1991 and 1993. From 1993 to 2016, the Oregon coast population of adults has increased to 375 birds following an exponential trend (see figure 3.3.2-1). In 2016, nesting success for those breeding sites was the highest recorded since monitoring began in 1990, with 339 birds fledging in 2016 compared to only six birds that fledged in 1991 (Lauten et al. 2016). The plover population exceeded recovery goals in 2016 (Lauten et al. 2016).



Source: Lauten et al. 2016

Figure 3.3.2-1 Number of Adult Western Snowy Plovers Observed During the Breeding Season on the Oregon Coast, 1990 to 2016. The exponential relationship is significant (r^2 = 0.87, P<0.001).

The 2016 estimate of resident snowy plovers on the Oregon coast was 518 individuals, the highest estimate recorded since monitoring began in 1990. This estimate was attained using the 10-day interval method by comparing minimum numbers of unbanded individuals against the number of banded individuals (Lauten et al. 2016).

Critical Habitat

Critical habitat for the western snowy plover was designated on January 6, 2000 (FWS 1999a), including 278 acres in proximity to Coos Bay, and re-designated in 2005 (FWS 2005c). The most recent revised designation of critical habitat for the western snowy plover was in June 2012 (FWS 2012d). The closest critical habitat to the Project is Unit OR-10, which occupies 273 acres on the Coos Bay North Spit, approximately 2.6 miles southwest of the LNG Terminal site. A second critical habitat Unit OR-9, at the mouth of Tenmile Creek on the Siuslaw National Forest, is 7.7 miles northwest of the LNG Terminal site at its closest location to the Project. Both CHUs were occupied by western snowy plovers at the time of listing (1993) and in 2016. Approximately 55 breeding resident males with 42 fledglings occupied Unit OR-9 in 2016, while 83 breeding male snowy plovers with 43 fledglings were documented with Unit OR-10 on the North Spit in 2016 (Lauten et al. 2016).

Based on the Pacific Coast western snowy plover's requirements for reproduction, feeding, forage, and shelter, the FWS (2012d) identified the following essential physical and biological features and specific primary constituent elements (PCE)[28] of designated critical habitat: 1) sparsely vegetated areas above daily high tides that are relatively undisturbed by the presence of humans, pets, vehicles or human-attracted predators; 2) sparsely vegetated sandy beach, mud flats, gravel bars or artificial salt ponds subject to daily tidal inundation, but not under water, that support small

[28] The designations of critical habitat for species included in this BA use the terms "primary constituent element" (PCE) or "essential features." The new critical habitat regulations (81 *Federal Register* 7414) replace this term with physical or biological features (PBFs). In this BA, we use the term PCE to mean PBF or essential feature, as appropriate for the specific critical habitat.

invertebrates; and, 3) surf or tide-cast organic debris such as seaweed or driftwood located on open substrates. Critical habitat in the vicinity of the Project area (Unit 10 Coos Bay North Spit), contains expansive, sparsely vegetated interdune flats, areas of sandy beach above and below the high tide line with occasional surf-cast wrack supporting small invertebrates, and close proximity to tidally influenced estuarine areas (FWS 2012d).

Threats that may require special management in this unit are introduced European beachgrass that encroaches on the available nesting and foraging habitat; disturbance from humans, dogs, and OHVs in important foraging and nesting areas; and predators such as the American crow and common raven (FWS 2005c).

3.3.2.2 Environmental Baseline

Analysis Area

The LNG Project analysis area extends for 1.5 miles beyond the perimeter of the LNG Terminal site (see figure 3.3.2-2) to include Project components on the North Spit and APCO Site, which historically provided western snowy plover nesting habitat. The only portion of the Pipeline that occurs within this analysis area either overlaps the LNG Terminal site, APCO site, or is submerged across Coos Bay. The LNG carrier transit route and marine waterway modifications are included in the estuarine analysis area with Dredge Area 1 located within 0.25 mile of critical habitat (see figure 2.1.1-2). Therefore, the only Project facilities addressed within this analysis area are the LNG Terminal facilities, APCO Site, Port Laydown Site, Dredge Area 1, Meteorological Station, the Pacific Connector Jordan Cove Meter Station, and the pipeline HDD entry and exit locations.

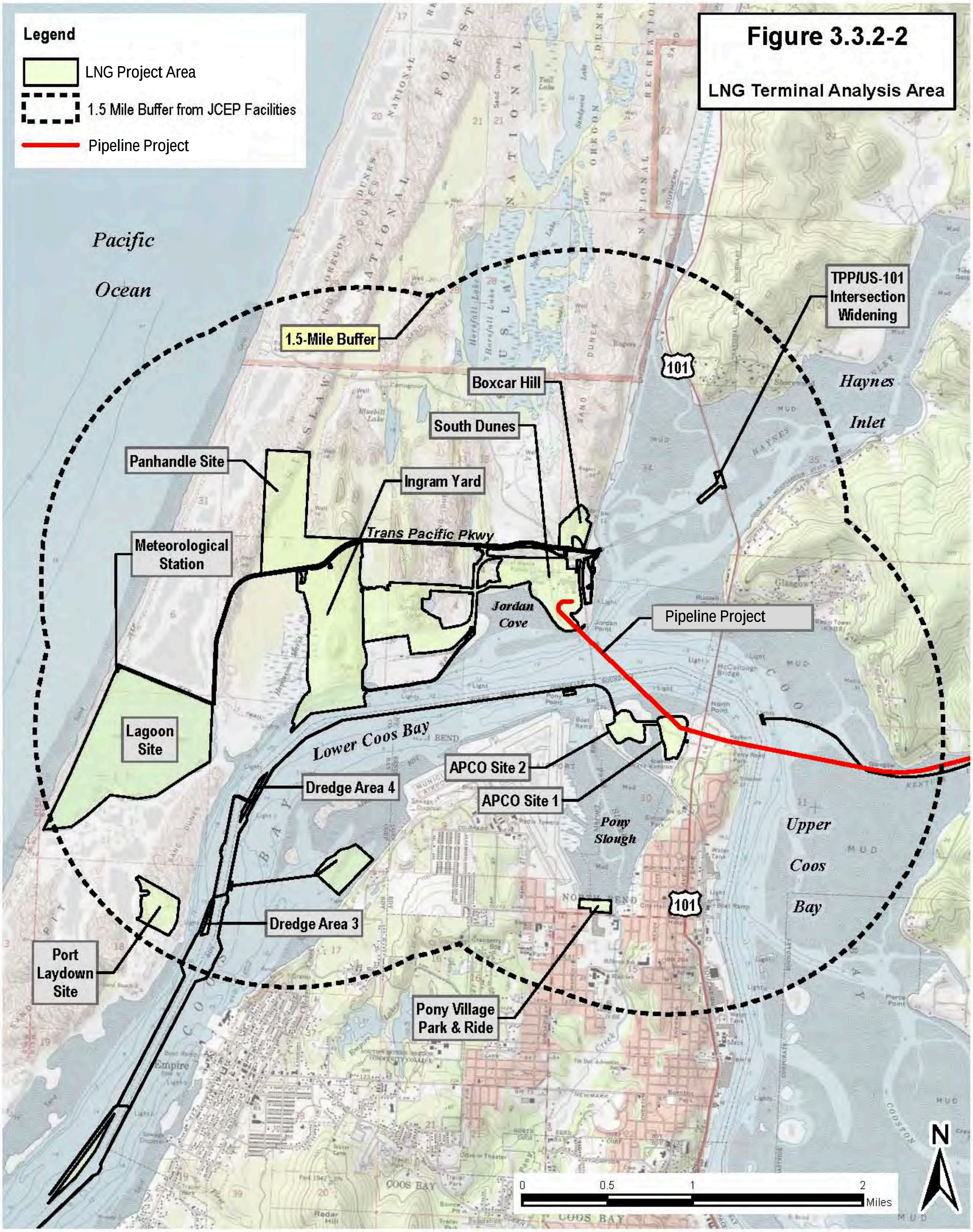
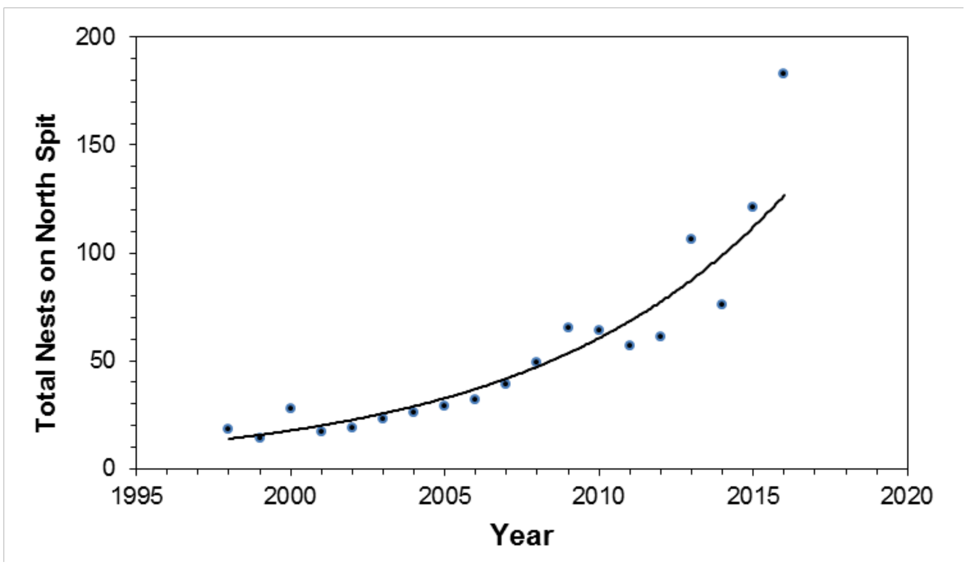


Figure 3.3.2-2
LNG Terminal Analysis Area
Legend
LNG Project Area
1.5 Mile Buffer from JCEP Facilities
Pipeline Project
Pacific
Ocean
1.5-Mile Buffer
Boxcar Hill
South Dunes
Panhandle Site
Ingram Yard
Trans Pacific Pkwy
Meteorological
Station
Jordan
Cove
Pipeline Project
TPP/US-101
Intersection
Widening
Haynes
Inlet
Lagoon
Site
Lower Coos Bay
APCO Site 2
APCO Site 1
Dredge Area 4
Dredge Area 3
Pony
Slough
Upper
Coos
Bay
Port
Laydown
Site
Pony Village
Park & Ride
101
0
0.5
1
2
Miles
N

Species Presence

Western snowy plovers have been recorded on the National Audubon Society's Christmas Bird Counts (CBC) in the Coos Bay count circle most years since 2000, and sporadically in earlier surveys. There are no CBC data for the Coos Bay count circle for 2010 and 2014, and no plovers were counted in 2002 and 2007. For the years with data between 2000-2016, an average of 9.9 snowy plovers have been counted per year; the most reported in any annual survey were 32 counted during 130 observation hours in 2011 (National Audubon Society 2016). Western snowy plovers are known to nest at the upper edge of the beach below the foredunes, on bare spits at small estuary mouths and on old dredge spoils (Marshall et al. 2006). No western snowy plovers were detected during field surveys of the LNG Terminal site (LBJ Enterprises 2006).

In the summer of 2012, 16 adults (8 males, 8 females) were documented by the Forest Service on the Tenmile Creek Unit OR-9, and 52 adults (35 males, 17 females) were documented by personnel with BLM and COE on the Coos Bay North Spit, CHU OR-10. In 2012, the nest success rate on the North Spit was 87 percent, similar to 2011, and the highest rate on the Oregon Coast since predator management was implemented in 2002 (Lauten et al. 2012). Nesting success at the Tenmile Creek unit has been very poor; only 13 percent of nests were successful in 2012, mostly due to depredations by corvids (common ravens) and great horned owls (Lauten et al. 2012). The total number of nests documented on the North Spit has increased most years between 2006 and 2016 (see figure 3.3.2-3).



Source: Lauten et al. 2016

Figure 3.3.2-3 Total Number of Western Snowy Plover Nests Observed on the Coos Bay North Spit from 1998 to 2016. The increasing exponential trend is significant ($r^2 = 0.92$, $P<0.001$)

However, overall nest success at the North Spit in 2016 was the lowest since monitoring began and over 40 percentage points lower than 2015 (Lauten et al. 2015; Lauten et al. 2016). In 2016, combined nest success at the three sites measured at the North Spit was 35 out of 183, or 19 percent. Although 100 more eggs were laid at the North Spit in 2016 than in 2015, more than 100 fewer eggs hatched, yielding the lowest recorded hatch rate for this site (Lauten et al. 2016). The mean fledglings per male was 0.6, the lowest rate in the 13-years of study, considerably lower than the average of 1.34 +/- 0.33 over that time (Lauten et al. 2016). Lauten et al. state that "the low number of fledglings per resident male was due to many males never successfully hatching nests, and thus having no productivity in 2016." In 2016, a total of 149 adult plovers were determined to be present at the North Spit, all of which were residents. This is the largest plover population of the nine study areas (Lauten et al. 2016). Western snowy plovers may be encountered in the LNG carrier transit route from nearshore coastal waters to the LNG Project.

In the 2016/2017 winter window survey, 91 western snowy plovers were observed at the Coos Bay North Spit on COE and BLM lands. No plovers were documented on the Horsfall Beach – North Jetty Coos Bay area (Forest Service, County and Department of State Lands). There has been an increase in the number of wintering birds observed in this area beginning in the 2015/2016 counts (85 birds) compared to the previous six year counts, which ranged from 10 to 37 birds (FWS 2018e).

Habitat

The northern end of critical habitat on the North Spit is approximately 2.6 miles from the LNG Terminal site. Nesting habitat, reported by ORBIC (2017a), extends north of the North Spit designated critical habitat for nearly 2 miles along the beach. The 2016 surveys on the North Spit indicated that the closest active nest to the Project was approximately 1 mile from the LNG Terminal site, which is approximately 0.5 mile south of Horsfall Beach (Lauten et al. 2016). The Meteorological Station is located approximately 100 feet east of the northern extent of known nesting sites (ORBIC 2017a). In 1990, one western snowy plover nest was documented at Menasha Spoils at the mouth and along the east side of Pony Slough at its confluence with Coos Bay (ORBIC 2017a), approximately 0.2 mile west of MP 1.08 where the HDD exits at North Point from crossing beneath Coos Bay. Since 1990, vegetation has invaded the Menasha Spoils site, and the site may no longer be suitable as snowy plover nesting habitat because it is no longer an expanse of sparsely vegetated interdune flats. The nest was unsuccessful and there have been no nest sites documented within the Coos Bay estuary since 1990.

The existing land use of the LNG Terminal site is industrial. It has been disturbed by past and present activities. The site area has been filled in the past as evidenced by deposits of clamshells and wood chips and it is a licensed landfill facility. Elevation ranges from near sea level to an approximate elevation of 67 feet. Topography is variable, ranging from low lying deflation basins to semi-stable dunes. Existing vegetation comprises upland coniferous dune forests and upland herbaceous dominated areas.

There is no suitable habitat for western snowy plover within the LNG Project area.

Critical Habitat

No designated critical habitat for western snowy plover is present in the Project's analysis area. The northern end of critical habitat (OR-10) on the North Spit is located approximately 2.6 miles from the LNG Terminal site, and less than 1 mile from the Port Laydown site. CHU OR-10 is approximately 0.25 mile from Dredge Area 1, within the estuarine analysis area.

3.3.2.3 Effects of the Proposed Action

Direct Effects

Noise

The 2007 western snowy plover recovery plan states that: "sources of noise that would disturb snowy plovers should be avoided," but the levels of noise likely to disturb plovers are not provided. The recovery plan identifies noise associated with dredging as having a potentially negative effect on breeding and wintering western snowy plovers; noise associated with driftwood removal, especially if chainsaws and vehicles are used, can disrupt nesting; noise from beach cleaning machinery, from beach pyrotechnics, and from aircraft overflights (especially helicopters) can also cause adverse effects (FWS 2007a).

Ambient noise levels in the vicinity of the LNG Terminal were measured continuously for 24 hours between August 31 and September 1, 2005 at two residences (noise sensitive areas [NSA]), one of which was 1.4 miles south of the LNG Terminal and the other 2.3 miles east. A new sound level survey was performed in May 2017. Ambient noise levels were not reported directly at the LNG Terminal site or on the Coos Bay North Spit (see appendix BB). Average noise levels from these studies of 52.7 A-weighted decibels (dBA) at NSA 1, south of the LNG Terminal site, and 65.2 dBA at NSA 2, east of the site. At REC 1, the recreation area west and northwest of the LNG Terminal site, ocean surf sounds are a significant and continuous source of ambient sounds. Occasional aircraft could be heard at the Southwest Oregon Regional Airport just across the bay from the site. NSA 3, the Horsfall campground northeast of the LNG Terminal, and REC 1 were added to the 2017 noise study. The ambient noise results at these sites was 56.3 dBA at NSA 3 and 55.2 dBA at REC 1 (see appendix BB). Local conditions such as aircraft, vehicle traffic, vegetation, topography, breaking waves, and winds characteristic of the location can alter background noise conditions. Noise levels at existing NSAs nearest the LNG Terminal site are controlled primarily by vehicular traffic. Noise levels experienced at the NSAs are similar in level to those in suburban areas where traffic is the primary source of noise (see appendix BB). Sound levels (dB) at outdoor rural residential locations of about 40 dB, averaged for day and night periods (see for example, EPA 1974) have been accepted as standard. More than likely, ambient noise levels on the North Spit, near breaking waves, would be higher than 40 dB; noise generated by breaking wavecrests in the surf zone can be 15 dB higher than background levels (Dean 1999). Daytime ambient noise is typically 10 dB higher that night levels (EPA 1974).

Construction – LNG Terminal Facilities

Construction of the LNG Terminal site would result in additional noise within the analysis area. Noise levels 50 feet away from typical construction equipment that might be used during LNG Terminal construction are provided in table 3.3.2-1.

TABLE 3.3.2-1

Average Maximum Noise (L_{max}) at 50 feet from Construction Equipment and Estimated Distance to Attenuate to Ambient Levels near the Surf Zone on the North Spit a/

Construction Activity	Equipment	Noise dBA (Lmax measured at 50 feet) b/	Distance (feet) to Attenuate to Assumed Ambient Noise Level of 55 dBA a/	
			Soft Site Reduction at 7.5 dBA per double of distance	Hard Site Reduction at 6 dBA per double of distance
Clearing and Grading	Grader	85	800	1,600
	Scraper	84	729	1,425
	Warning Horn	83	665	1,270
	Dozer	82	606	1,131
	Excavator	81	553	1,008
	Backhoe	78	419	713
	Pickup Truck	75	317	504
	Flatbed Truck	74	289	449
Rock Excavation	Mounted Impact Hammer	90	1,270	2,851
	Auger Drill Rig	84	729	1,425
	Rock Drill	81	553	1,008
Stationary Equipment	Concrete Saw	90	1,270	2,851
	Pneumatic Tools	85	800	1,600
	Generator	81	553	1,008
	Air Compressor	78	419	713
	Welder Torch	74	289	449

a/ WSDOT 2019
b/ FHWA 2006

The standard for noise reduction from point sources such as construction machinery is 6 dBA per doubling of distance under hard site conditions (over calm water, or hard, smooth ground surface) and 7.5 dBA per doubling of distance under soft site conditions (because of roughened ground and/or vegetation cover; WSDOT 2019). Based on the data in table 3.3.2-1, the noise produced by construction activities would attenuate to daytime ambient noise levels (estimated at 55 dBA because of breaking wave noise) within distances of 230 feet to 2,850 feet, depending on equipment/actions and hard site or soft site reduction ground surface conditions. Obscuring vegetation (tree cover), topography (interruption of line-of-sight), and atmospheric conditions (wind, air temperature, humidity) also affect noise reduction but can be highly variable between locations and over time and are generally not taken into account in estimates of noise attenuation over short distances. Consequently, predicted noise levels are likely to be higher than actual noise levels. Based on this information, general construction noise would not affect nesting or wintering western snowy plover located approximately 1 mile from the LNG Project.

Construction of the LNG terminal and slip is expected to take 60 months. Prior to the excavation work starting for the LNG carrier slip, an open cell sheet pile bulkhead and retaining wall would be installed. Sheet piling is typically installed with a vibratory pile driver. Pile-driving activities would take place over approximately an 24-month period and are expected to occur on a schedule of two shifts, 6 days per week. Sheet pile driving would occur initially followed by the on-shore berthing structures as the marine foundation work begins. Sheet piling could be installed during the snowy plover breeding, nesting or rearing periods. The cumulative long term average airborne sound level created by pile driving activities for 14 impact pile driving rigs and 6 vibratory pile driving rigs in operation, simultaneously, was used to calculate the day and night sound levels (L_{nd}) (see appendix BB). The same analysis model was used to calculate the pile driving daytime average (L_d or L_{eq} daytime) to determine potential impacts to nesting and wintering snowy plovers.

The noise produced by sheet pile and pile installation activities would attenuate to daytime ambient noise levels (estimated at 55 dBA because of breaking wave noise) within distances of approximately 4,200 feet (SRL 2017). Based on the distance of construction from western snowy plover critical habitat (2.6 miles) and potential nesting sites (1 mile) on the North Spit, acoustic disturbances from the proposed action are not expected to affect western snowy plover wintering, breeding, nesting, or rearing activities.

A meteorological station would be installed on the west side of the Lagoon adjacent to the northern extent of the snowy plover nesting area (ORBIC 2017a). In reviewing the Western Snowy Plover Annual Reports from 2010 to 2017, the number of documented nests at the north end of Coos Bay North Spit is low and no nests have been documented immediately adjacent to the proposed location for the meteorological station. The annual reports documented one nest located about 1.8 miles north of the station in 2016 and 2017 and one to three nests per year located 1.3 to 3 miles south of the station during this eight-year period (FWS 2018e). Although western snowy plovers were not observed during the winter window surveys, they could occur on the beach adjacent to the station but this area is not documented as being used in the winter. Based on this information, the use of the beach by snowy plovers immediately adjacent to the meteorological station is likely low. The Meteorological Station would be constructed outside the nesting season (March 15 to September 15) to avoid disturbance to snowy plovers. The station would be mounted on an approximately 30 to 40-foot-high lattice tower. If guy wires are required during final design, bird deterrent measures would be added to the wire to reduce the likelihood of bird collisions. Deterrent measures such as cones or other anti-perching/anti-nesting devices would also be installed on any surface that could provide potential perching/nesting habitat for predatory species. Security lighting would be installed at the station and would be shielded in order to minimize glare while meeting safety requirements.

Additional construction staging and temporary laydown of equipment would occur during construction of the LNG Terminal at the Port Laydown site. This site is located on the North Spit over 3,500 feet from the northern extent of the snowy plover nesting area (ORBIC 2017a). Based on the data in table 3.3.2-1, noise produced by construction activities would attenuate to below daytime ambient noise levels in the vicinity of western snowy plover nests.

The marine waterway modifications would occur in four locations along the edge of the Federal Navigation Channel. Access to the marine waterway modifications would be by marine transport. No land-based access near primary snowy plover habitat is planned for pedestrians or vehicles. Dredge Area 1 is located approximately 0.25 mile from known nesting habitat and designated Critical Habitat OR-10. Dredging operations would take place within the ODFW in-water work window, which is outside of the nesting period for western snowy plovers but wintering birds may forage on the bay side of the North Spit. An airborne noise analysis for dredging determined that the 55 dBA contour, which is the estimated ambient noise level, would extend to the nearshore area of the bay where plovers may forage. Airborne noise from dredging within critical habitat was determined to be 40 to 45 dBA (see appendix BB). Because these levels are below estimated ambient noise levels, dredging is not anticipated to impact wintering plovers. The remaining dredge areas are located over one mile from known nesting habitat and are not expected to impact snowy plovers during winter or nesting seasons.

While noise levels from dredging activities are anticipated to be at or below ambient noise levels, temporary mooring piles to support the dredging equipment may need to be set with an impact hammer. Impact hammers could be used between 0.25 mile and about 1 mile from known snowy plover habitat. As noted above in table 3.3.2-1, mounted impact hammers attenuate to 55 dBA at 2,851 feet over hard site conditions and 1,270 feet over soft site conditions. The areas between the dredge areas and snowy plover habitat are a mix of hard and soft site conditions; the distance varies based on the roughness of the water and other environmental conditions on a given day. These distances are within the range of snowy plover habitat along the eastern edge of primary nesting area at 0.25 mile (1,370 feet) away from Dredge Area 1. If present, noise from an impact hammer could temporarily disturb snowy plovers wintering within this area on the North Spit.

The marine waterway modifications disposal site is located at the APCO site. Placement of dredge spoils could create nesting habitat for western snowy plover. Creation of nesting habitat for plovers is considered undesirable because it could result in dispersal of existing breeding populations on the North Spit to an area where they could be more susceptible to nest predations. Additionally, any habitat created would be temporary, as opposed to the permanent habitat available on the North Spit. To prevent plover use of the area, it is recommended to plant American dune grass (FWS 2017b).

Construction - Pipeline

Construction of the Pipeline across Coos Bay may occur between January 1 and August 31, which is within the nesting and fledgling season for this species on the Oregon coast (early April through August; FWS 2001). It is not possible to anticipate any local occurrence of western snowy plover in the Project area at the time of construction, although habitat near the HDD activity does not currently provide suitable nesting habitat, even though an historic snowy plover nest was documented at Menasha Spoils in 1990, approximately 0.2 mile from HDD activity.

Construction of the Jordan Cove Meter Station and the HDD beneath Coos Bay would require surface disturbance of 13.63 acres of previously developed industrial land on the Jordan Cove side and 2.87 acres of industrial land on the North Point side 0.2 mile from Menasha Spoils at the mouth and along the east side of Pony Slough at its confluence with Coos Bay. Neither site currently provides suitable nesting habitat.

Operation

The following major noise-producing equipment would normally be in operation at the LNG Project:

- five (5) refrigerant compressors, combustion turbines, heat recovery steam generators (HRSGs), and associated piping;
- refrigerant compressor interstage and discharge aerial coolers;
- three (3) steam turbines and their associated air-cooled condensers;
- two (2) boil-off gas compressors with interstage and discharge aerial coolers; and
- various other condensers, coolers, pumps and valves.

The above equipment packages have been specified to meet sound level requirements appropriate to support an overall far-field sound level that does not exceed the applicable FERC regulatory limits (see appendix BB). A constant sound level of less than 48 dBA would ensure compliance with all applicable regulations, including the FERC requirement limiting the average day/night noise level at the nearest residential NSAs to ≤55 dBA. With that restriction, noise generated by equipment at the LNG Project would not exceed 55 dBA at western snowy plover breeding, nesting or rearing habitat on the North Spit. Therefore, noise from operations at the LNG Project would have not affect the snowy plover.

Operational activities at the Meteorological Station would be limited to maintenance only. Planned maintenance activities that would generate noise levels above ambient conditions would be scheduled outside of nesting season to minimize potential disruption to western snowy plover. Other activities would be limited to existing pathways and inside fence lines.

During operations of the Pipeline, aerial inspections would occur over the permanent right-of-way. Nesting snowy plovers are not expected to be affected because the closest nesting population is more than 4 miles from proposed aerial inspections and air traffic is a constant disturbance with the existing North Bend Municipal Airport within less than 3 miles of the nesting habitat on North Spit.

Indirect Effects

Potential indirect effects to western snowy plovers could be caused by an increased human population base, whether as a result of the requirements of the action itself (the workforce needed to construct or operate the Project) or as a consequence of the action (need for ancillary goods, services, opportunities resulting from the Project). Potential indirect or secondary effects include increased recreation demand (including OHV use), increased habitat conversion, habitat degradation by human encroachment, and increased illegal harvest (Comer 1982). Potential indirect effects of the proposed action on western snowy plovers could occur: 1) increased human presence at the LNG Terminal site, and 2) increased predation of western snowy plovers by crows and ravens due to increased human presence. In addition, increased human presence may lead to destruction of nests and/or disturbance of plovers from the following activities: OHV usage, visitors or their dogs, predators such as crows and ravens (that are attracted to areas with humans and their garbage), beach walking or jogging, horseback riding, and beach raking.

<u>Human Presence</u>

The Coos Bay North Spit is currently utilized by a variety of recreational users for OHV driving, beach combing, boating, bay-shore clamming and crabbing, day hiking, picnicking, kayaking, surfing, and fishing (Natural Resource Trustees 2006). In addition, the North Spit has become one of the most popular horseback riding areas in the region (BLM 2005). Snowy plover habitat on the North Spit is currently owned by the BLM and COE and managed by the BLM, Forest Service, and OPRD. This area is known as the Coos Bay North Spit Recreation Management Area (CBNS RMA) and extends about 3.4 miles north from the southern tip of the North Spit along the ocean-side shoreline, encompassing some, but not all, of the Snowy Plover Critical Habitat on the North Spit.

According to the OPRD 2007 Plover Habitat Conservation Plan, the peak number of visitors to the 15.6 miles of beach from Tenmile Creek to Coos Bay (the beach segment including the CBNS RMA) was 3.8 people per mile (OPRD 2005 and 2007), and the distribution of these visitors was described as "dispersed." The number of visitors per mile at the eight recreational management areas currently utilized by nesting plovers ranged from 3.5 to 13.2 (OPRD 2007). The Habitat Conservation Plan for Western Snowy Plovers published by the OPRD in September 2007 states (with regard to the CBNS RMA), "This beach is open to street legal vehicle driving only, but is closed during the breeding season. There is illegal ATV [all-terrain vehicle] use on this beach.

Recreation use here is low, but higher than other RMAs due to its close proximity to Coos Bay/North Bend/Charleston. The area is a popular surfing site."

The primary reasons that the public accessed the North Spit beach were to walk/run (16 percent) or to relax (21 percent). Of those surveyed, 4 percent reported bringing dogs to the beach (OPRD 2007). The percentage of people with dogs was significantly lower than the statewide average of 35 percent. All of the human-caused disturbances listed above can result in destruction of nests (by dogs or through inadvertent trampling and deliberate vandalism) and in diverse plover responses to human presence, including: flushing from and abandonment of nests, separation from broods, shifting to marginal habitat, cessation of foraging and adoption of vigilant or cryptic behaviors (FWS 2007a).

The number of people employed on the North Spit in 2007 was approximately 110 (Southport Lumber Products – 70, Roseburg Forest Products – 20, DB Western Marine Division – 20). The Project would result in a large but temporary increase in people employed on the North Spit during construction and a much smaller long-term increase of operations staff. Construction would take approximately 60 months, and the number of construction personnel would peak at 1,996 workers.

An increase in workers supporting the Jordan Cove Project could result in an increase in recreational activities in the area, during both construction and operation. Recreation on the beach has been shown to cause a reduction in plover productivity. In total, it was estimated that between 2000 and 2006, recreational activities on the Oregon Coast resulted in the loss of 30 hatchlings and 11 fledglings per year, which equated to an annual loss of 5 adult equivalents (Jones and Stokes 2007). It is difficult to predict how the increase in short-term and long-term employment due to the LNG Terminal site on the North Spit would translate into increased recreational use of areas near snowy plover habitat. However, it is reasonable to assume that the LNG Project operations staff, their family and friends would be introduced to the area, and some minor increases in recreational use could occur. This increase in recreational use could result in increased plover disturbance. However, mitigation measures to educate construction and operations employees on recreational use restrictions would be employed to minimize any such effect. The measures are discussed below in Conservation Measures, section 3.3.2.4.

Predators

Predation of snowy plovers along the Oregon coast has been attributed to the low nest success in 2016. Northern harriers (*Circus cyaneus*) supplanted corvids as the most frequently identified nest predator along the Oregon coast. Harriers-caused nest failure was far more prevalent at the North Spit than the other eight sites included in the study, accounting for 74 percent of total harrier depredation along the coast (45 of 61 nests; Lauten et al. 2016).

Corvids caused nine nests to be lost at the North Spit in 2016, where no corvid depredations had been recorded since 2005 (Lauten et al. 2016). Increased foot traffic through snowy plover nesting has been shown to increase scavenger predation (Buick and Paton 1989; Castelein 2008). Therefore increased recreational use of the North Spit ocean beaches by off duty employees could create additional predation pressure and could be detrimental to the recovery of snowy plover populations; however, mitigation measures would be employed to minimize any such effect. The measures are discussed below in Conservation Measures, section 3.3.2.4.

Critical Habitat

The northern end of critical habitat on the North Spit, OR-10, is located approximately 2.6 miles from the LNG Project. CHU OR-10 is less than 1 mile from the Port Laydown site, and 0.25 mile from Dredge Area 1. Noise and increased human presence from the LNG terminal construction and operation may affect PCE 1 (sparsely vegetated areas above daily high tides that are relatively undisturbed by the presence of humans, pets, vehicles or human-attracted predators) as described above under direct and indirect effects to the species. However, implementation of the conservation measures described below would limit these potential effects.

3.3.2.4 Conservation Measures

No Project-specific conservation measures have been proposed for the western snowy plover. However, as part of its application to FERC Jordan Cove has committed to assisting with ongoing management activities for the species. Current management activities and use restrictions within the Coos Bay North Spit Recreation Management Area include:

- predator management (i.e., nest exclosures, lethal and non-lethal predator removal and hazing);
- symbolic fencing (ropes and signs installed around nesting areas);
- habitat restoration (removal of European beachgrass, placement of shell hash, maintenance of gaps through the dunes);
- public outreach and education provided by BLM staff;
- monitoring of snowy plover populations;
- recreational use restrictions in place from March 15 – September 15 each year, including:
  - seasonal re-routing of the foredune road;
  - vehicles, camping, and dogs are prohibited;
  - kite flying would be prohibited under the draft conservation plan; and
- non-prohibited recreational use (i.e., jogging, beach combing, horseback riding) is restricted to the wet sand outside of roped and signed breeding areas.

Jordan Cove would work with the agencies to assist with ongoing management activities and recreation use restrictions on the North Spit. Management activities may include fencing, signage, application of shell hash, tree removal, beach grass elimination, and maintenance.

Jordan Cove would mitigate potential impacts to western snowy plovers, including from increased predator density and increased human presence, through implementation of 1) BMPs, and 2) education and outreach programs.

Best Management Practices

Structures associated with the LNG Project would be monitored to discourage use by avian predator species, including construction of nests.

During construction and operation, the LNG Terminal site would be kept clear of construction debris and food wastes that could attract predators of the western snowy plover. Covered, animal-resistant receptacles would be provided in eating and break areas, parking lots, and at appropriate locations around the construction site. During construction, the site would be monitored on a daily basis to remove any food or other debris left by construction workers. During operations, the facility and grounds would be regularly inspected to ensure that no garbage is allowed to accumulate.

The dredged material placement areas would be regularly monitored to ensure that no predator denning is occurring in the hillocks. The proposed placement areas would be located near construction activities that would discourage use by individual birds. If necessary, nylon mesh or other exclusion fencing would be installed around the perimeter of the placement areas to prevent the establishment of coyote or skunk dens until the slopes are stabilized or constructed upon.

To prevent plover use of the APCO dredge disposal site, it would be stabilized using American dune grass or other appropriate measures in consultation with the FWS.

Access to marine waterway modifications dredging areas would be by marine transport. No land-based access near primary snowy plover habitat is planned for pedestrians or vehicles.

The Meteorological Station would be constructed outside the nesting season (March 15 to September 15) to avoid disturbance to snowy plovers. If guy wires are required during final design, bird deterrent measures would be added to the wire to reduce the likelihood of bird collisions. Deterrent measures would also be installed if the final design provides any potential perching habitat for predatory species. Security lighting would be shielded in order to minimize glare while meeting safety requirements. Planned maintenance activities at the Meteorological Station that would generate noise levels above ambient conditions would be scheduled outside of nesting season to minimize potential disruption to western snowy plover. Unplanned activities would be limited to existing pathways and inside fence lines.

Education and Outreach

Surveys conducted in 2002 indicated that 76 percent of beach visitors were unaware of restrictions associated with snowy plovers (OPRD 2007) , indicating that increased education could have a substantial impact on public awareness and implementation of use restrictions for snowy plovers. The Forest Service at the Oregon Dunes National Recreation Area and the BLM staff have also reported that the majority of contacted individuals are more willing to comply with beach-use restrictions after better understanding the reasons for them (FWS 2007a).

With this in mind, Jordan Cove would train all construction and operations staff on the need for snowy plover conservation; current snowy plover regulations and recreational use restrictions; and the importance of conservation measures, including: litter control, avoidance of nesting and foraging areas, keeping pets on-leash, and remaining on established roads and trails in designated critical habitat. The training program would be developed based on guidance provided in appendix K of the 2007 Plover Recovery Plan (OPRD 2007). Jordan Cove would consult with agencies prior to implementation of this training.

3.3.2.5 Determination of Effects

Species

The Project **may affect** western snowy plovers because:

- the closest western snowy plover nesting habitat to the Project is on the North Spit approximately one mile from LNG terminal site, and contained active nests during 2016 surveys;
- temporary construction activities would occur at the Port Laydown site, which is less than one mile from known nesting sites;
- the meteorological station is located east of the foredune, approximately 100 feet from the northern extent of known nesting sites;
- impact hammer noise associated with the marine waterway modifications temporary facilities is expected to be above ambient levels, and may disturb wintering western snowy plovers if present along the eastern edge of the primary nesting area on the North Spit, which is within 0.25 mile of Dredge Area 1; and
- Jordan Cove terminal construction and operations personnel would likely use the North Spit for recreational purposes and increased recreational use could result in increased plover disturbance including destruction of nests by dogs, off-road vehicle traffic, inadvertent trampling, or increased predation if scavengers and predators (corvids, coyotes, striped skunk, feral cats) are attracted to nesting areas due to the presence of trash and food remains.

However, the Project is **not likely to adversely affect** western snowy plover because:

- Jordan Cove LNG Project construction noise at active nest sites (approximately 1 mile) and critical habitat (approximately 2.6 miles) is not expected be above ambient levels.
- Dredging operations would take place within the ODFW in-water work window, which is outside of the nesting period for western snowy plovers and dredging noise level is unlikely to affect wintering plovers approximately 0.25 mile away. Access to dredging areas would be by marine transport with no land-based access near primary snowy plover habitat.
- The meteorological station would be constructed outside the nesting season (March 15 to September 15) to avoid disturbance to snowy plovers and would include spikes or other deterrent measures on any potential perching surface, bird deterrent measures if guy-lines are required, and shielded security lighting to minimize glare. Operational activities would be maintenance-related and would be scheduled outside of the nesting season.
- Jordan Cove would minimize disturbance by humans, pets, vehicles, or human-attracted predators through implementation of 1) BMPs to minimize predator density related to increased human presence and habitat removal, and 2) education and outreach programs intended to train all construction and operations staff on the need for snowy plover conservation; current snowy plover regulations and recreational use restrictions; and the importance of conservation measures, including litter control, avoidance of nesting and foraging areas, keeping pets on leash, and remaining on established roads and trails.

Critical Habitat

The Project **may affect** designated critical habitat for the western snowy plover even though the northern end of critical habitat OR-10 on the North Spit is located approximately 2.6 miles from the LNG Project because:

- temporary construction activities would occur at the Port Laydown site, which is approximately 1 mile from critical habitat;
- the marine waterway modifications Dredge Area 1 is approximately 0.25 mile from critical habitat; and
- the Project would result in a large but temporary increase in people employed on the North Spit during construction, and a much smaller long-term increase of operations staff. The additional human presence could increase use of the North Spit with concomitant potential increase of pets, vehicles, and/or human-attracted predators.

However, the Project is **not likely to adversely affect** designated critical habitat for the western snowy plover because:

- dredging noise level is unlikely to affect PCEs at CHU OR-10 which is located approximately 0.25 mile away; and
- Jordan Cove would minimize potential secondary effects on the critical habitat PCE that identifies disturbance by humans, pets, vehicles, or human-attracted predators through implementation of 1) BMPs to minimize predator density related to increased human presence and habitat removal, and 2) education and outreach programs intended to train all construction and operations staff on the need for snowy plover conservation; current snowy plover regulations and recreational use restrictions; and the importance of conservation measures, including litter control, avoidance of nesting and foraging areas, keeping pets on leash, and remaining on established roads and trails.

3.3.3 Marbled Murrelet

3.3.3.1 Species Account and Critical Habitat

Status

MAMU in Washington, Oregon, and California were listed as threatened under the ESA on October 1, 1992 (FWS 1992a), and were subsequently listed as threatened by the State of Oregon under the Oregon Endangered Species Act in 1992. The final rule listing the MAMU cited loss and modification of forest nesting habitats, mostly by commercial timber harvest of LSOG forests, as the principal threat to the species, along with effects of coastal oil spills and gill-net fishing operations off the Washington coast (FWS 1992a).

Threats

Threats to MAMUs include loss of habitat, predation, effects of gill-net fishing, effects of offshore oil spills, and other factors. There are two components of MAMU habitat that are biologically important: 1) terrestrial nesting habitat and associated stands, and 2) marine foraging habitat, including prey spawning and concentration areas. Threats to MAMU can be found in both the terrestrial nesting environment and the marine foraging environment. Extensive harvest of LSOG was the primary reason for listing the MAMU as threatened in 1992 (FWS 1992a). In 1992, the amount of old-growth forest in western Oregon and Washington had been reduced by about 82.5 percent from pre-harvest levels. Because MAMUs utilize old-growth forests for nesting, this dramatic loss of older forested habitats is a serious threat to these birds. Harvesting within previously contiguous areas of old-growth forest causes habitat fragmentation on large and small scales. As forest fragmentation increases, the threat of habitat loss due to windthrow is likely to increase. Fire has also affected older coastal forests; however, unlike clearcut timber harvest, fire often allows diverse structural characteristics to develop in regenerating forests, such as scattered surviving old-growth trees that can be utilized by MAMUs for nesting (FWS 1992a).

Predation is expected to be the principal factor limiting MAMU reproductive success and nest site selection (Ralph et al. 1995; Nelson and Hamer 1995). Known predators of MAMU adults, chicks, and eggs in the terrestrial environment include great horned owls, peregrine falcon, sharp-shinned hawk, northern goshawk, bald eagle, Steller's jays, and ravens as well as other corvids. Common ravens account for the majority of egg depredation (Nelson and Hamer 1995). Predation rates are influenced mainly by habitat stand size, habitat quality, nest placement (on the edge of a stand versus the interior of a stand), and proximity of the stand to human activity centers. Fragmentation of forested stands by timber harvest increases the potential for avian predation (FWS 1992a). An increase in susceptibility of adults to predation can have greater impacts on MAMU populations than predation on eggs or young, as demographic modeling for MAMUs demonstrates (McShane et al. 2004).

Because MAMUs feed offshore, gill-net fisheries, especially for salmon, was a significant mortality factor in 1992, primarily in Washington and British Columbia. New gill-netting regulations in northern California and Washington have reduced the threat to MAMUs (McShane et al. 2004). Offshore oil spills, such as the *Exxon Valdez,* have also adversely affected MAMUs by causing direct mortality (FWS 1992a). The 1999 oil spill associated with the grounding and wreck of the *New Carissa* on the Oregon coast near Coos Bay killed 252 MAMUs, the highest mortality for any spill during the 1993 to 2003 period (McShane et al. 2004). Oil spills and related mortality of MAMUs are believed to have remained constant since the species was listed. Although there has been a moratorium on offshore oil drilling off the California, Oregon, and Washington coastlines, there has been increased shipping traffic, including oil tankers, carrying the risk of future spills (McShane et al. 2004).

Other factors contributing to demographic threats and population viability include: 1) loss of genetic variation as a result of low population numbers and low immigration rates, 2) low potential for recolonization or recovery from local disturbances due to low immigration rates, and 3) bacterial, fungal, parasitic, and viral diseases, including potentially West Nile Virus (McShane et al. 2004).

The 2004 MAMU 5-year review (FWS 2004b) and the 2009 MAMU 5-year review (FWS 2009c) continue to consider habitat loss, high predation rates, mortality from oil spills, or entanglement in fishing nets as the primary threats to MAMU. Additionally, the 2009 5-year review identified environmental and anthropogenic factors in the marine environment as new threats to MAMU. Another 5-year review was initiated in April 2017 (FWS 2017c).

Species Recovery

FWS published a recovery plan for the MAMU in 1997 for Washington, Oregon, and California (FWS 1997b). The objective of the recovery plan is to stabilize population size at or near current levels by increasing population productivity and removing and/or minimizing threats to survivorship. In the short-term, specific actions identified as necessary to stabilize the population included maintaining occupied habitat, maintaining large blocks of suitable habitat, maintaining and enhancing buffer habitat, decreasing risks of nesting habitat loss due to fire and windthrow, reducing predation, and minimizing disturbance. Long-term conservation actions included increasing productivity and population size, increasing the amount, quality, and distribution of suitable nesting habitat, protecting and improving the quality of the marine environment, reducing or eliminating threats to survivorship, reducing predation in the terrestrial environment, and reducing anthropogenic sources of mortality at sea (FWS 1997b).

The recovery plan divided the range of the Washington, Oregon, and California MAMU population into six Conservation Zones that extend inland a distance of up to 35 miles, coinciding with the “Inland Zone 1” boundary line described by the Forest Ecosystem Management Assessment Team (FEMAT) for the NWFP: Puget Sound (Conservation Zone 1), Western Washington Coast Range (Conservation Zone 2), Oregon Coast Range (Conservation Zone 3), Siskiyou Coast Range (Conservation Zone 4), Mendocino (Conservation Zone 5), and Santa Cruz Mountains (Conservation Zone 6). FEMAT Inland Zone 1 contains large blocks of suitable habitat critical to the recovery of the MAMU within California, Oregon, and Washington. The proposed action occurs within the highest density zones along Oregon’s coast (Conservation Zones 3 and 4), although the largest populations of MAMUs are found in Puget Sound and Strait of Juan de Fuca of Washington – Zone 1 (Huff et al. 2006). Management for Conservation Zones 3 and 4 recommend the following: maintain designated occupied sites, minimize loss of unoccupied but suitable habitat, and decrease the time for development of new habitat. The recovery plan also recommended that specific recovery efforts should focus on maintenance of suitable and occupied MAMU nesting habitat in BLM-administered forests (FWS 1997b).

FWS (2006c) concluded that the maintenance and/or increase of suitable nesting MAMU habitat in relatively large, contiguous blocks, whether occupied or unoccupied, would be needed to recover the MAMU, since unoccupied suitable habitat in proximity to occupied habitat could be used by dispersing MAMUs. Despite the above protection measures, an approximately 12.1 percent decline (2 percent decline on federal, 27 percent decline on nonfederal lands) in the amount of available, higher suitable nesting habitat has been observed since the NWFP was implemented (1994 to 2012; Raphael et al. 2016). On federal lands, stand-replacing fires are the major cause of habitat loss, but also timber harvest and insect damage or disease have also caused losses; habitat loss on nonfederal lands is primarily the result of timber harvest (Raphael et al. 2011 and 2016). Together wildfire and timber harvest have been identified as the primary causes of habitat loss since the NWFP was implemented in 1994 (Falxa and Raphael 2016). Based on Maxtent habitat suitability modeling using updated gradient nearest neighbor (GNN) 2012 habitat data and analyses approach, Raphael et al. (2016) estimated that there are approximately 2.2 million acres of moderately high to highly suitable habitat available within the following states: Washington (1.3 million acres), California (108,900 acres), and Oregon (774,700 acres).

Life History, Habitat Requirements, and Distribution

The MAMU is a long-lived, small seabird that spends most of its life in the marine environment, but utilizes a distinct nesting habitat type from other Alcidae (guillemots, puffins, auklets and murres), nesting primarily in coastal, old growth forests characterized by large trees, multi-storied stands, and moderate-to-high canopy coverage from Alaska to Monterey Bay, California (FWS

2006c). They are also known to nest in mature forests with old-growth characteristics. Trees must have large branches or deformities such as high, moss-covered branches or branches with growths of dwarf mistletoe, which serve as nest platforms (Binford et al. 1975; Marshall 1988a; Naslund 1993; FWS 1997b). Old-growth conifers generally provide the following requisite conditions for MAMU nesting: 1) openings in forest canopies for nest access, 2) nest platforms on large branches or tree deformities, 3) substrate (mosses or epiphytes) for a nest cup, 4) horizontal and vertical cover at the nest site, and 5) enough height above ground to allow for "drop take-offs" and "stalled drop-in" landings (McShane et al. 2004). Generally, forests that provide suitable nesting habitat and nest trees require 200 to 250 years to develop (FWS 2006c).

The distance inland that MAMUs breed is variable and influenced by a number of factors such as habitat availability, climate suitability, foraging range, and predation rates (McShane et al. 2004). In Oregon, MAMU nest sites and occupied stands are located as far as 30 to 40 miles from salt water (Mack et al. 2003), although most often sites are found within 12 miles of the ocean (FWS 1996). Social interactions may also play an important role in determining nesting location, since research has indicated that MAMUs in California and southern Oregon were less likely to occupy old-growth habitat if it was isolated from other nesting MAMUs by more than 3 miles (Meyer et al. 2002).

Murrelets do not form dense colonies, which is atypical for most seabirds; this is most likely to avoid detection by predators (Ralph et al. 1995). Also, in Oregon, MAMU occupied stands and nest sites are generally located away from high-contrast edge created by certain timber harvest practices and adjacent immature forests, most likely to reduce predation risk on eggs and juvenile MAMUs (Ripple et al. 2003), although many MAMU stands on BLM lands are located in highly fragmented landscapes (BLM 2014). Meyer et al. (2002) found at least a few years passed before birds abandoned fragmented forests. In northern California and southern Oregon, Meyer and Miller (2002) concluded that MAMU occupancy was most related to availability of low elevation, unfragmented old-growth forests within the fog zone that were close to highly productive marine areas. Federal lands account for the majority of suitable MAMU habitat in California, Oregon, and Washington (McShane et al. 2004).

These small seabirds spend most of their lives in the marine environment where they forage in shallow off-shore and inland saltwater areas on a variety of small fish and invertebrates, and large pelagic invertebrates (Marshall 1988a, 1988b, and 1989; Becker 2001). MAMUs forage by diving in relatively shallow waters (generally between 20 and 80 meters [65 to 262 feet]), averaging about 16 seconds in the water column per dive (Strachan et al 1995; Burkett 1995). In Oregon and Washington, anchovy, sand lance, and smelt appear to be the major prey types provided to chicks (McShane et al. 2004). MAMUs generally forage within 3 miles of shore in western North America, although during the breeding season they stay closer to the coast, e.g., within 1.2 miles in Oregon (McShane et al. 2004). Courtship, loafing, molting, and preening also occur in near-shore marine waters (Nelson 1997). The largest populations of MAMUs are in the Puget Sound and Strait of Juan de Fuca of Washington (Huff et al. 2006).

MAMUs are usually present year-round in California, Oregon, and Washington, whereas farther north in their breeding range, seasonal migration is common. MAMUs migrate back to breeding grounds in the north in early to mid-April (McShane et al. 2004). Research suggests that MAMUs demonstrate site fidelity (Huff et al. 2006).

Breeding is asynchronous in the MAMU, varying regionally, although generally occurring between April and September (McShane et al. 2004; Huff et al. 2006). Both sexes share the incubation and foraging duties, usually with duty exchanges occurring at dawn. One to two days after hatching, the chick will be left alone while both parents forage at sea. The chick will receive 1 to 8 meals per day, with the majority of the meals delivered in the morning, usually before sunrise. Additional meals are delivered at dusk and occasionally throughout the day. Murrelet chicks fledge from the nest 27 to 40 days after hatching, usually at dusk (McShane et al. 2004). Existing data do not provide information on how far or where fledglings disperse.

Sex ratios of juveniles and adults are equal and breeding begins when birds are 2 to 5 years old; only 1 egg is laid per breeding season (McShane et al. 2004). A substantial proportion of nests is known to fail (Nelson and Hamer 1995); breeding success has been documented as high as 0.46 chicks per breeding pair in southern British Columbia but lower in northern California where telemetry studies documented between 0.135 and 0.324 chick per pair (McShane et al. 2004). Such low breeding success is not expected to sustain populations in which adult survivorship ranges from 0.83 to 0.93. The mean lifespan of MAMUs is 10 years (McShane et al. 2004).

Population Status

The exact population size of MAMUs is not known; however, the North American population is currently thought to be about 24,100 birds (with 95 percent confidence between 19,700 and 28,600 birds), based on counts at sea (Lynch et al. 2017). Within the Pipeline Project area (Conservation Zones 3 and 4), the marbled murrelet population is estimated to be 15,556 birds in 2016 (with 95 percent confidence between 12,798 and 21,946 birds): 6,813 birds in Conservation Zone 3 (with 95 percent confidence between 5,389 and 8,821 birds) and 8,743 birds in Conservation Zone 4 (with 95 percent confidence between 7,409 and 13,125 birds).

In the early 1990s, MAMU abundance in Washington, Oregon, and California had been estimated at 18,550 to 32,000 (Ralph et al. 1995). In the late 1990s, population survey protocols were established to provide a consistent methodology for estimating MAMU population and population trends. Using the data and trends provided in Lynch et al. (2017), the trend in murrelet densities off-shore in Conservation Zones 3 and 4 has increased significantly ($P<0.05$) between 2000 and 2016. While this research indicates a positive trend, this positive trend in Conservation Zone 3 is uncertain (lower confidence interval overlaps zero). Using that trend, the predicted estimate of marbled murrelet densities within Conservation Zones 3 and 4 by 2022 is 5.77 birds per km^2 but could range from 3.30 to 8.24 birds per km^2 using the 95 percent prediction intervals (see table 3.3.3-0). Figure 3.3.3-1 shows the increasing population trend from 2000 to 2016 in Conservation Zones 3 and 4, combined, as well as projections of murrelet populations through 2022[29], using data from Lynch et al. (2017) which also shows an increasing trend in marbled murrelet density from 2000 to 2016 for all of Oregon (see Figure 4 in Lynch et al. 2017).

[29] The date of 2022 was used as a targeted projection and basis for the analysis due to the original date of operation estimated by the applicant in their September 2017 application; however, even if the Project is approved, the exact date of operation would still be unknown at this time.

TABLE 3.3.3-0

Estimated (2000-2016) and Predicted (2017-2022) Marbled Murrelet Densities (birds/km^2) in Conservation Zones 3 and 4 a/

Year	Birds	Area (km^2)	Density (birds/km^2)	Regression (Density vs Year)	Prediction (Density)	Lower 95PI	Upper 95PI
2000	11,604	2755	4.21	3.48	N/A	1.28	5.67
2001	11,389	2755	4.14	3.58	N/A	1.41	5.74
2002	11,087	2755	4.03	3.69	N/A	1.55	5.81
2003	10,361	2755	3.76	3.79	N/A	1.68	5.89
2004	11,950	2755	4.34	3.90	N/A	1.80	5.97
2005	9,485	2755	3.44	4.00	N/A	1.92	6.06
2006	10,343	2755	3.76	4.11	N/A	2.04	6.16
2007	7,787	2755	2.83	4.21	N/A	2.15	6.25
2008	11,026	2755	4.00	4.31	N/A	2.26	6.35
2009	10,741	2755	3.90	4.42	N/A	2.36	6.46
2010	10,891	2755	3.95	4.52	N/A	2.46	6.57
2011	13,459	2755	4.89	4.63	N/A	2.55	6.69
2012	9,773	2755	3.55	4.73	N/A	2.64	6.81
2013	13,926	2755	5.06	4.84	N/A	2.72	6.93
2014	8,841 a/	1595	5.54	4.94	N/A	2.80	7.06
2015	8,743 b/	1159	7.54	5.04	N/A	2.87	7.20
2016	6,813 a/	1595	4.27	5.15	N/A	2.95	7.34
2017	N/A	N/A	N/A	N/A	5.25	3.01	7.48
2018	N/A	N/A	N/A	N/A	5.36	3.08	7.62
2019	N/A	N/A	N/A	N/A	5.46	3.14	7.77
2020	N/A	N/A	N/A	N/A	5.57	3.19	7.92
2021	N/A	N/A	N/A	N/A	5.67	3.25	8.08
2022	N/A	N/A	N/A	N/A	5.77	3.30	8.24

Notes :
a/ Zone 4 not surveyed in 2014 and 2016
b/ Zone 3 not surveyed in 2015

Source: Lynch et al. 2017

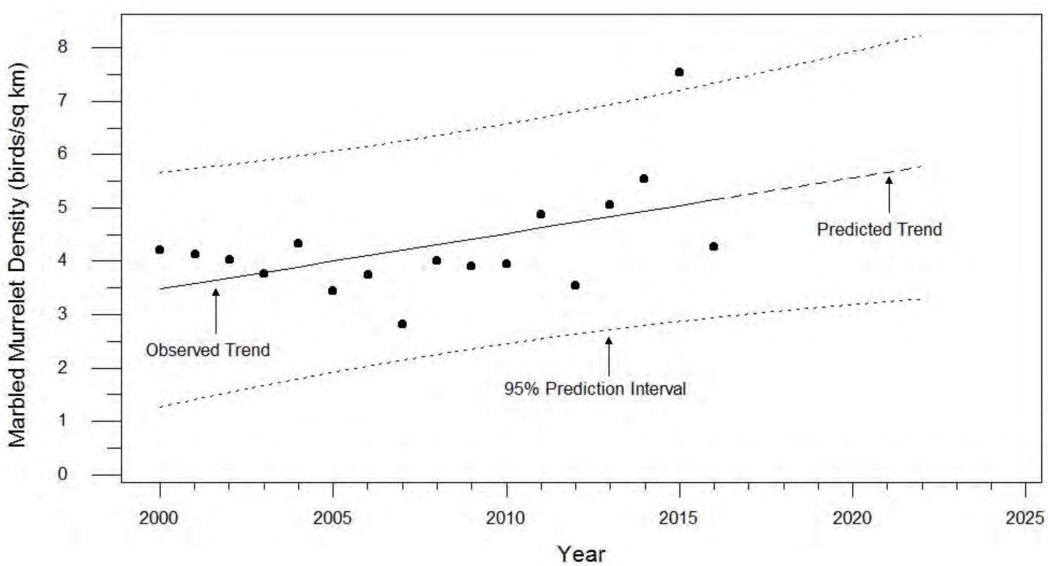


Figure 3.3.3-1 Density trend from 2000 to 2016 and predicted density estimates through 2022. The linear relationship is significant (r^2 = 0.253, P<0.05). (Data from Lynch et al. 2017)

Critical Habitat

Critical habitat for the MAMU was first designated in Washington, Oregon, and California on May 24, 1996 and included 3,887,000 acres in 32 CHUs (FWS 1996). On July 31, 2008, FWS proposed a revision to the 1996 critical habitat designation, proposing to remove approximately 254,070 acres in northern California and Oregon. This proposal was based on new information indicating that these areas do not meet the definition of critical habitat (FWS 2008b). Based on proposed revisions in 2008 critical habitat for the MAMU was revised in 2011, removing approximately 189,671 acres in northern California and southern Oregon from the 1996 designation (FWS 2011b and 2016b). Currently, designated critical habitat includes approximately 3,698,100 acres in 22 CHUs within Washington, Oregon, and California (FWS 2016b).

There are two components of MAMU habitat that are biologically important: 1) marine foraging habitat, including prey spawning and concentration areas, and 2) terrestrial nesting habitat and associated stands. Because FWS is unable to define specific marine areas essential to the conservation of the species, only terrestrial habitat is considered for designation as critical habitat. Throughout the forested portion of their range, MAMU habitat use is positively associated with the presence and abundance of mature and old-growth forests, large core areas of old-growth, low amounts of edge and fragmentation, proximity to the marine environment, and increasing forest age and height, although the presence of platforms is the most important characteristic of nesting habitat (FWS 2006c). As a result, the FWS designated the following as PCEs (FWS 2006c) that remain applicable to the revised critical habitat designated for the MAMU (FWS 2008b, 2011b): 1) forested stands containing large-sized trees, generally greater than 32 inches in diameter with potential nesting platforms at sufficient heights (≥ 33 feet); and 2) surrounding forested areas within 0.5 mile of these stands with a canopy height of at least one-half the site-potential tree height. In Oregon, MAMU nests have been located in trees with platforms greater than 19 inches diameter at breast height (dbh) and at least 98 feet tall (FWS 2006c).

Late-Successional Reserves

Additional habitat protection for the MAMU was established when the BLM and Forest Service in Washington, Oregon, and northern California adopted the NWFP in 1994 (Forest Service and BLM 1994). The NWFP divided the nesting portion of the MAMU range into two inland zones: 1) Inland Zone 1, which is a 10- to 35-mile zone closer to the coast where the majority of MAMU nests and detections are located, and 2) Inland Zone 2 where detection data indicated only a small fraction of the MAMU population nests (FEMAT 1993). Large amounts of NFS and BLM lands were allocated for LSRs, with the primary objective of protecting and enhancing conditions of late-successional and old-growth forest ecosystems. These lands could then serve as habitat for old-growth-related species including the MAMU, while maintaining diversity associated with native species and thus providing a network of fully functioning LSRs in National Forests throughout the Pacific Northwest (Forest Service and BLM 1994). The NWFP Standards and Guidelines also state that sites occupied by marbled murrelets but within Matrix lands are considered “unmapped LSRs” and are managed as lands allocated as LSRs by the NWFP.

In August 2016, the BLM issued two Records of Decision for two RMPs for Southwestern Oregon, and Northwestern and Coastal Oregon (BLM 2016a and 2016b). The NWFP no long applies on BLM-managed lands under the terms of the 2016 RMPs. The 2016 RMPs have similar land allocations that continue to contribute to the conservation of MAMU habitat within BLM-administered lands, including an increase in designated LSRs within the range of the marbled murrelet. The NWFP still applies to lands managed by the Forest Service and is still in effect on the three National Forests crossed by the Pipeline.

The goals for LSR management for both Forest Service and BLM-managed lands are consistent with the function of federally-designated CHUs to contribute to the recovery of MAMUs. Management of LSRs should not only protect habitat currently suitable to marbled murrelets, but also promote the development of additional marbled murrelet habitat. Approximately 25 percent of the LSRs crossed overlap with federally designated critical habitats for MAMU. The Pipeline would cross 8.65 miles of lands managed as LSRs within the marbled murrelet range, including 6.35 miles in Coos Bay BLM District and 2.30 miles in Roseburg BLM District; no lands managed by Forest Service are crossed within the MAMU range.

The NWFP Standards and Guidelines also state that occupied MAMU sites and Known Owl Activity Centers (KOAC: 100-acre areas identified by BLM and Forest Service on January 1, 1994) that occur within NWFP-designated Matrix lands, are considered "unmapped LSRs" and managed as lands allocated as LSRs by the NWFP. Coos Bay and Roseburg BLM Districts also provide more specific management direction to protect MAMU and their habitat on BLM-managed lands within the updated RMPs in all land allocations within Inland Zone 1, and within LSRs and Riparian Reserves within Inland Zone 2 unless otherwise directed through concurrence with the FWS, including (BLM 2016a and 2016b): 1) assess the project area for marbled murrelet nesting structure and conduct pre-project surveys following protocol; 2) prohibit activities that disrupt marbled murrelets nesting at occupied sites; and 3) restrict timber harvest within occupied marbled murrelet stands and all forest within 300 feet of a stand, with the exception of linear and nonlinear rights-of-way as long as the stand continues to support murrelet nesting. The 2016 RMPs also require future allocation of marbled murrelet occupied stands to LSR if occupied stands are identified within marbled murrelet Zone 1 within another land use allocation.

3.3.3.2 Environmental Baseline

Analysis Area

MAMU habitat can be categorized into various components, based on the life cycle needs of the species. Three main areas in which MAMU could be affected by the Project are outlined below.

<u>Terrestrial Nesting Analysis Area</u>

The first area in which MAMU could be affected by the Project is the terrestrial nesting analysis area. Per direction provided by FWS in the Revised Conservation Framework (*Revised Conservation Framework for the Northern Spotted owl and Marbled Murrelet: Jordan Cove Energy and Pacific Connector Gas Pipeline Project*, FWS 2014c), the terrestrial nesting analysis area consists of two components that consider effects from: 1) habitat removal or modification, and 2) disturbance/disruption of MAMU during the breeding season, as described below. The terrestrial nesting analysis area extends inland along the Pipeline route to include MAMU Inland Zone 1 – MPs 0.00 to 53.76 and MAMU Inland Zone 2 – MPs 53.76 to 75.40 and is shown on figure 3.3.3-2.

The FWS (FWS 2008b and 2011b and 2014c) and BLM (BLM 2016a and 2016b) have recognized that forested habitat within 0.5 mile of an occupied stand, or 0.25 mile of occupied murrelet behavior, are important to recruit additional nesting habitat for the marbled murrelet in the future (e.g., "recruitment habitat" which has been defined by FWS as habitat that has the potential to become nesting habitat within 25 years; FWS 1997b). To identify areas of higher importance for the marbled murrelet that could play an important role in maintaining and expanding marbled murrelet populations in the Pipeline Project area, Pacific Connector delineated MAMU suitable habitat units (SHU), as directed by FWS (2014c) in the applicable Conservation Framework.

The MAMU SHU consists of three elements (FWS 2014c): 1) MAMU occupied and unsurveyed suitable habitat (i.e., "presumed occupied" stands – forested stand identified as potential nesting habitat that has not been ground-truthed for suitable nesting structures and/or surveyed following the 2-year protocol); 2) a 300-foot buffer around each MAMU occupied or presumed occupied stand; and 3) federally-designated critical habitat that occurs within a 0.5-mile buffer of MAMU stands that are within 0.5 mile of critical habitat removal. Critical habitat located within the 0.5-mile buffer is an area considered important to the recovery of the species (FWS 2011b and 2014c). The 300-foot buffer incorporates an area that should maintain the integrity of the MAMU stand from windthrow or other environmental disturbances as well as provide protection from potential predation (FWS 1997b; ODF 2004). A protective 300-foot buffer of MAMU stands is also recognized within the updated BLM RMPs (see Option 1 in BLM 2016a and 2016b). Areas included in defined SHUs represent areas of higher importance for the preservation of forested habitat for MAMU. Within the Pipeline Project area where MAMU occupied stands are in close proximity to each other (i.e., less than 300 feet or adjacent), SHUs overlap. Approximately 15.71 miles of SHUs (occupied or presumed occupied stand, 300-foot buffer, and 0.5-mile buffer) would be crossed by the Pipeline: 14.08 miles in Inland Zone 1 and 1.63 mile in Inland Zone 2.

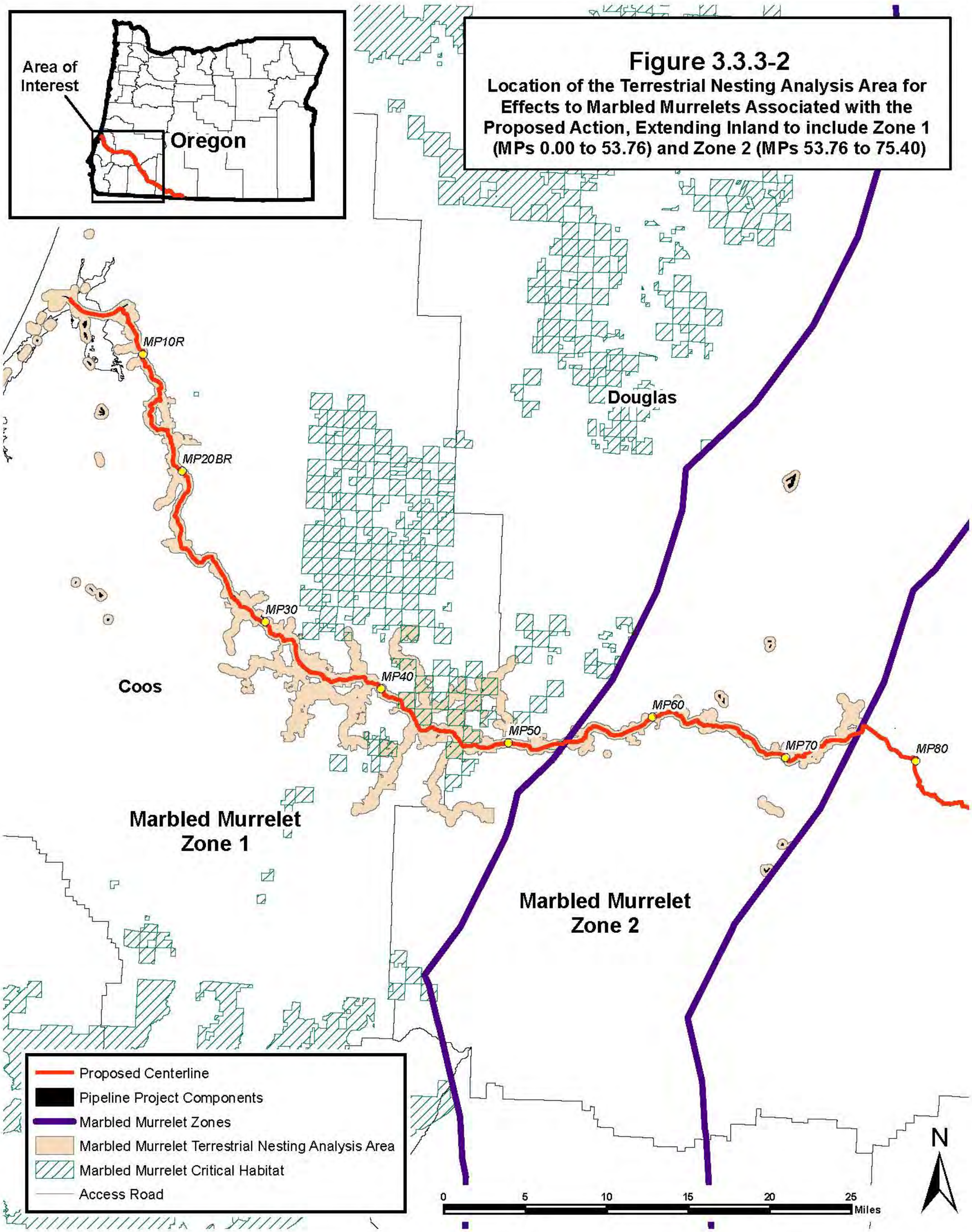


Figure 3.3.3-2
Location of the Terrestrial Nesting Analysis Area for Effects to Marbled Murrelets Associated with the Proposed Action, Extending Inland to include Zone 1 (MPs 0.00 to 53.76) and Zone 2 (MPs 53.76 to 75.40)
Area of Interest
Oregon
Douglas
Coos
MP10R
MP20BR
MP30
MP40
MP50
MP60
MP70
MP80
Marbled Murrelet Zone 1
Marbled Murrelet Zone 2
Proposed Centerline
Pipeline Project Components
Marbled Murrelet Zones
Marbled Murrelet Terrestrial Nesting Analysis Area
Marbled Murrelet Critical Habitat
Access Road
0
5
10
15
20
25
Miles
N

Habitat Removal or modification: This portion of the terrestrial nesting analysis area applies to all Project components that have the potential to remove or modify habitat, including construction of the LNG Project and Pipeline, as well as a 100-meter- (328-foot-) wide buffer along each edge of the area of habitat impact (e.g., edge of right-of-way, TEWAs, new roads built for access, etc.) in recruitment or capable habitat throughout the entire range of MAMU. It also includes MAMU SHUs that are included for analysis within this BA.

Disturbance/Disruption (breeding season only): The terrestrial nesting analysis area also includes all lands within 0.25 mile of the Project components (including identified access roads). Access roads considered do not include paved roads that are used regularly by the public (i.e., county roads and state highways). The size of this analysis area considers the maximum distance (0.25 mile) at which MAMUs could be harassed during the breeding season (April 1 through September 15) by noise generated from general construction, operation, and maintenance activities, smoke from burning slash piles, blasting (with mitigation measures), and/or Boeing Chinook (CH-47) or Boeing Vertol 107 (CH-46) helicopter use (with mitigation measures) during construction, or use of access roads (FWS 2014c; see also Pacific Connector's *Blasting and Helicopter Noise Analysis & Mitigation Plan* in appendix P).

Estuarine Analysis Area

The second area in which MAMU could be affected by the proposed action is the Coos Bay estuarine analysis area (see figure 3.3.3-3) which encompasses all estuarine waters (and substrates) that are within the estuary between the North Jetty and South Jetty at the Coos Head entrance to the bay. The estuarine analysis area includes: 1) the existing Federal Navigation Channel which forms part of the waterway for LNG carrier traffic to and from the LNG Project, 2) the proposed access channel to the terminal slip and pile dike rock apron, 3) the marine waterway modifications, 4) the area of North Slough adjacent to the Trans-Pacific Parkway/US-101 Intersection Widening, 5) the Eelgrass Mitigation site, 6) the Kentuck project site, and 7) sites temporarily occupied during construction activities (see figure 2.1.1-2).

Marine Analysis Area

The third area in which MAMU could be affected by the proposed action is the marine analysis area (see figure 3.2-1), which extends to the edge of the continental shelf, approximately 12 nmi offshore. Within the marine analysis area, effects to MAMU would be associated with LNG carriers, which are assumed to transect the marine analysis area perpendicularly – east and west – as they approach and depart from Coos Bay (see the discussion above under section 3.2.1).

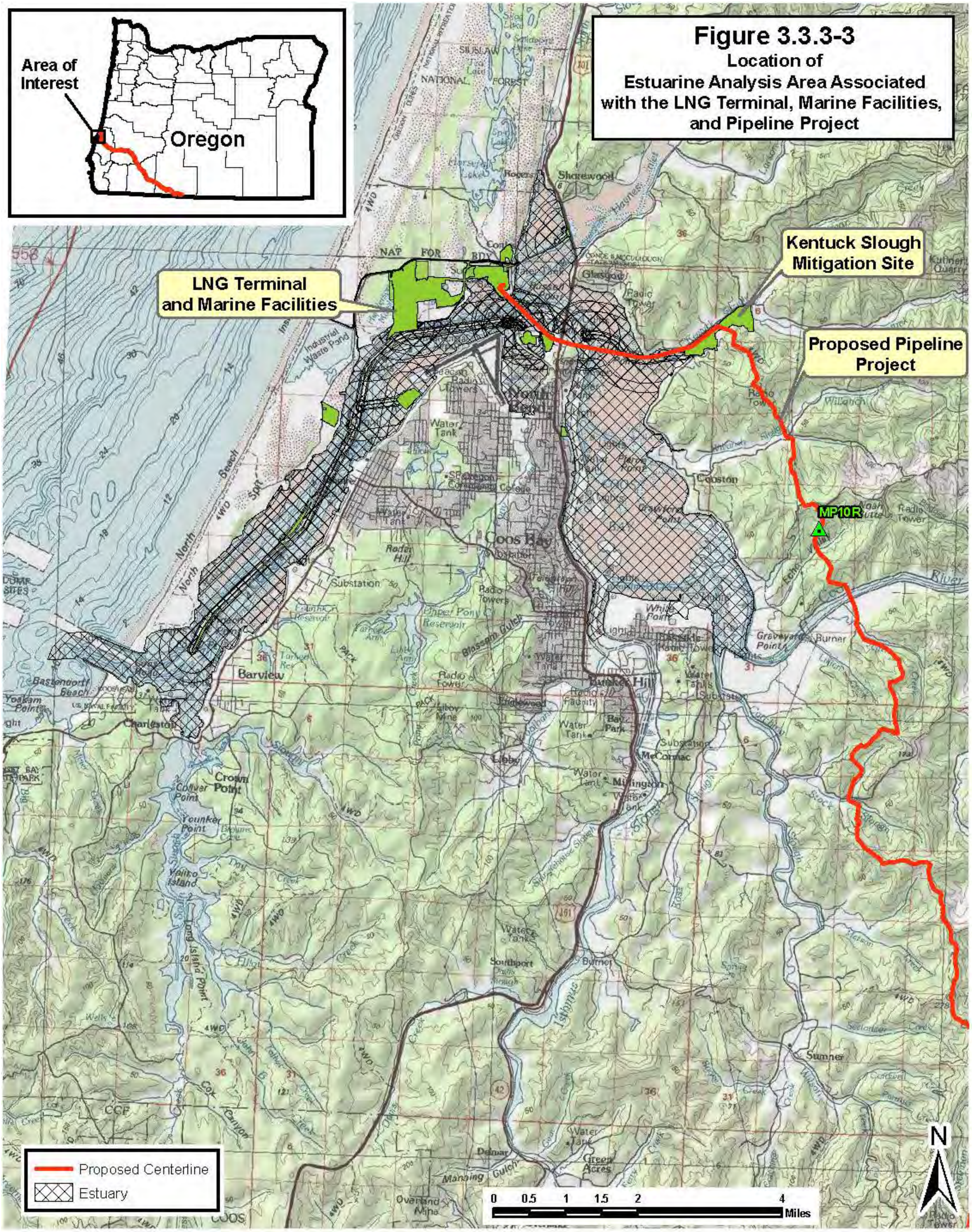


Figure 3.3.3-3
Location of
Estuarine Analysis Area Associated
with the LNG Terminal, Marine Facilities,
and Pipeline Project
Area of Interest
Oregon
LNG Terminal and Marine Facilities
Kentucky Slough Mitigation Site
Proposed Pipeline Project
MP10R
Proposed Centerline
Estuary
0 0.5 1 1.5 2 4
Miles
N

Species Presence

The Project occurs within Marbled Murrelet Inland Zone 1 and Marbled Murrelet Inland Zone 2; MAMU nesting has been documented within the two inland zones in and near the terrestrial nesting analysis area. MAMU nesting behavior is cryptic, however, resulting in few nests being located by biologists. As a result, documented behaviors assumed to be associated with nesting, such as MAMUs flying into the canopy or circling very close above the canopy are used to infer nesting activity and thus occupancy of MAMU stands. Because these occupied behaviors are not detected during every visit to a stand, the Pacific Seabird Group inland MAMU survey protocol (Mack et al. 2003) recommends several visits to a stand that contains potential MAMU nest trees (up to 9 per year) for a duration of two years in order to determine with some certainty that a timbered stand is occupied or unoccupied (probable absence). When occupied behavior is identified, the managing agency delineates the occupied stand and provides a master site number (MSNO). That stand is then considered "occupied" in perpetuity. If after two years of protocol surveys MAMU occupancy has not been determined in potential suitable MAMU habitat, then the site would be considered unoccupied (probable absence) for five years after completion of protocol surveys (Mack et al. 2003).

To determine presence of occupied stands in the vicinity of the Pipeline , Pacific Connector used survey data from 2-year protocol surveys conducted for the Pipeline, as well as GIS data layers with known occupied MAMU stands or areas of suitable MAMU nesting habitat from BLM (2017) and private timber companies (Weyerhaeuser 2007). Areas identified within the vicinity of the Pipeline that are either known to have suitable nesting structures present but have not been surveyed in accordance with the applicable survey protocol or suitable nesting habitat has been presumed based on age of forested stand or height of trees but actual habitat has not been ground-truthed (i.e., landowners did not permit surveys) are considered "presumed occupied stands."

Known Occupied MAMU Stands

GIS data layers were obtained from Coos Bay and Roseburg BLM Districts (BLM 2017) to determine areas with known MAMU occupancy; 277 occupied stands were provided within the Coos Bay (249 stands) and Roseburg (28 stands) BLM Districts, including 10 stands identified during surveys conducted by Pacific Connector in 2007 and 2008, six stands identified during surveys conducted by Pacific Connector in 2013, and two stands identified during surveys conducted by Pacific Connector in 2014 (see Pacific Connector survey details, below). MAMU survey data were requested from private landowners within the Project area and in 2007 Weyerhaeuser Timber Company provided GIS files with areas of known MAMU occupancy (Weyerhaeuser 2007); none of the stands identified by Weyerhaeuser occur within 0.25 mile of the Pipeline or proposed access roads.

Pipeline Project-Specific Marbled Murrelet Surveys

No suitable MAMU nesting habitat occurs at the LNG Terminal site (LBJ Enterprises 2006; SHN 2013a); therefore, MAMU nesting surveys were limited to the Pipeline Project area.

Habitat Assessment: To determine species presence within the Pipeline Project area, Pacific Connector contracted surveyors (Siskiyou BioSurvey LLC [SBS] and Rogers & Associates [R&A]) to conduct two-year surveys within habitat containing suitable nesting structures as described by Mack et al. (2003). Prior to surveys, SBS assessed habitat within 0.25 mile of the Pipeline to identify areas with potential suitable marbled murrelet nesting habitat to determine where marbled murrelet protocol surveys should be conducted for the Pipeline Project. Delineation of suitable habitat was accomplished using a combination of aerial photographs, BLM FOI GIS data, local knowledge of on-the-ground habitat, and light detection and ranging (LiDAR) that was flown in a corridor including 0.25 mile on either side of the proposed Pipeline. The LiDAR data set was used to display all trees with a canopy height greater than 107 feet. Polygons were derived from these data to indicate possible suitable MAMU nesting habitat and/or trees. Within 20 miles of the coastline a single tree qualified as potential nesting habitat, whereas further inland, clusters of 6 or more large trees within a floating 5 acre window were considered potential habitat as directed by FWS (see SBS 2008). These polygons were reviewed using aerial photos and BLM FOI data to determine which areas could provide potential suitable nesting habitat for MAMU.

Based on further direction provided by FWS and BLM Districts (Roseburg and Coos Bay), additional areas within 0.25 mile of construction activities and proposed existing access roads for the Pipeline were delineated that could provide potential suitable nesting habitat for MAMU. On BLM-managed lands, potential habitat was delineated from GIS layers provided by Coos Bay and Roseburg BLM Districts (BLM 2017) that identified suitable MAMU habitat. On private land, additional areas were delineated where the NWFP MAMU habitat model that uses maximum entropy (Maxent models) developed by Raphael et al. (2016) had a dense grouping of modeled "value 4" pixels ("highest suitability") and forested habitat was present in an obvious stand that could be delineated.

Because the proposed route changed since the first surveys were conducted, habitat was reassessed with updated GIS layers, photography, and LiDAR where available and included additional survey efforts, if necessary.

Pacific Connector Surveys (2007-2015): In areas where permission to survey was granted, R&A conducted on-the-ground surveys to determine whether timber stands exhibited the characteristics of nesting habitat outlined in the Pacific Seabird Group protocol (Mack et al. 2003). MAMU survey stations were set up on property where access was allowed and timber stands exhibited the characteristics of nesting habitat outlined in the Pacific Seabird Group protocol (Mack et al. 2003). Survey stations were positioned in such a manner that all of the potential habitat in a given stand could be seen, and that any MAMUs present would be able to be seen against the sky.

In areas identified with potentially suitable nesting structures where survey permission had been granted, R&A conducted protocol surveys in 2007 and 2008 and observed occupied behavior in 10 stands on BLM lands; data was provided to BLM to delineate "occupied stands." Full protocol surveys were conducted in nine other stands with suitable nesting structures in 2007 and 2008 but surveyors did not detect occupied behavior and they were considered "unlikely to be occupied" through 2013; five of these stands were resurveyed in 2013 and 2014. Protocol surveys were also initiated in three other areas with suitable nesting structures that were either included because of a pipeline reroute or had only received one year of protocol surveys; all eight areas were determined occupied in 2013 (six stands) or 2014 (two stands). Coos Bay and Roseburg BLM Districts were provided the appropriate survey results after occupied behavior was detected; each District delineated the occupied stands and provided an MSNO for each MAMU stand that are included in analysis for this BA.

In 2007 and 2008, 65 of 118 identified stands were examined, of which 46 of 65 (71 percent) timber stands and/or trees were determined not to exhibit the necessary nest tree characteristics and were removed from the list of stands/acreage to be surveyed.

Protocol surveys were also initiated along the Blue Ridge route in 2015 where MAMU occupied behavior was detected in 13 stands with suitable nesting structures present. To-date, only one year of survey effort has occurred in this portion of the Pipeline Project. Although occupied behavior was detected in 13 of the stands (sub-canopy murrelet behavior detected), Coos Bay BLM determined that survey results were difficult to interpret and additional survey information was needed in this area because Blue Ridge is the first significant north-south ridge that MAMU encounter as they fly inland from the ocean and behavior documented could have been MAMU flying low over the ridgeline to conserve energy (BLM 2017b). Therefore, stands along the Blue Ridge portion of the proposed Pipeline with occupied behavior detected during 2015 protocol surveys are considered presumed occupied, with presence detected for this BA.

Pacific Connector Surveys (2017–2018): In 2017 and 2018, additional on-the-ground surveys were conducted in potential habitat (presumed occupied stands) where survey permission was granted to determine whether timber stands exhibited the characteristics of nesting habitat, as outlined in the MAMU protocol (Mack et al. 2003). Surveys in fall 2017 assessed eight presumed occupied MAMU stands for suitable nesting structures, of which six stands were determined to provide suitable nesting structures for MAMU; two stands were removed from further consideration as presumed occupied, of which one was along a previously proposed route. Surveys in late spring (May and June) 2018 assessed 12 additional presumed occupied stands to determine if the forested stands provided suitable structure for nesting: three stands were determined to not provide suitable nesting structures and have been removed from analysis as a presumed occupied stand in this BA.

Two-year protocol surveys were also initiated in late spring 2018 in nine presumed occupied stands on BLM-managed lands to determine if the stands were occupied by MAMU: occupied behavior was observed in six presumed occupied stands on both Coos Bay and Roseburg BLM lands, MAMU presence was detected above canopy during survey visits at one other stand where survey efforts were increased from five visits to nine visits in 2018 but no occupied behavior was observed, and two other stands did not detect MAMU presence. Survey data where occupied behavior was detected have been provided to BLM to review and officially delineate occupied stands where and if necessary. Pacific Connector has indicated second year survey efforts in these nine stands will continue as required by the protocol and be completed in 2019. After reviewing these 2018 survey data, the BLM identified inadequate survey efforts outside of the delineated occupied sites, but indicated these could be corrected during the 2019 and 2020 survey seasons. Therefore, stands surveyed in 2018 with occupied behavior detected are considered presumed occupied, with presence detected for this BA; stands surveyed in 2018 with no occupied behavior are considered presumed occupied for this BA.

Additional Stands Delineated – No Survey

Areas of potentially suitable habitat that have been delineated in the Project area, as described above, but have not been ground-surveyed or not surveyed following the 2-year protocol, are considered "presumed occupied stands" and included for analysis within this BA as if they are occupied by marbled murrelets. Some of these areas have been ground-truthed and suitable nesting habitat was observed, but 2-year protocol surveys have not been completed (see table Q-1 in appendix Q). Other areas either did not receive survey permission, or survey permission was not requested due to the habitat location in relation to the Project (i.e., greater than 100 meters from habitat removal or along an existing, proposed access road). The areas greater than 100 meters from habitat removal were included for analysis within this BA to assess direct effects from disturbance of the proposed action. Pacific Connector will continue to conduct additional on-the-ground surveys to determine if habitat within delineated presumed occupied stands that are crossed by the Pipeline provide suitable nesting structures. If the habitat is determined suitable nesting habitat through ground reconnaissance, Pacific Connector would continue to presume occupancy. If the habitat is determined to not be suitable for marbled murrelet nesting, then Pacific Connector would not continue to analyze the area as "presumed occupied," but would consider habitat within the delineated stand as "recruitment" habitat for subsequent analyses. Ground reconnaissance survey results would be provided to FWS to update impact analysis categories.

Marbled Murrelet Stands Considered for Analysis within the Terrestrial Nesting Analysis Area

Overall, 175 MAMU stands have been included for analysis within this BA: 51 occupied MAMU stands and 124 presumed occupied MAMU stands. MAMU stands were included if located within 0.25 mile of the proposed action, including 0.25 mile from proposed existing access roads (excluding paved public roads used regularly by the public – i.e., county roads or state highways). MAMU stands were also included for analysis if located within 0.5 mile of federally-designated critical habitat that would be affected by the proposed action. Fifty-one occupied stands (as defined by occupied behavior and delineated by BLM) are considered for analysis, including 18 stands detected during survey efforts by Pacific Connector within the Pipeline Project area in 2007, 2008, 2013, and 2014. Twenty-six occupied stands are only included because they are within 0.25 mile of existing access roads, including two stands determined to be occupied during Pacific Connector 2007/2008 MAMU survey efforts. The other 124 stands included for analysis in this BA are "presumed occupied" – they either have been incorporated into the analysis based on Coos Bay and Roseburg BLM suitable habitat GIS data layers (71 stands; BLM 2017), or have been incorporated into the analysis considering high suitability values in the NWFP MAMU habitat model (Raphael et al. 2016) and/or LiDAR flown for the Project identifying trees greater than 107 feet in height (53 stands); these presumed occupied stands include 20 stands where occupied or presence behavior was observed in 2015 or 2018, but the full two years of protocol surveys have not been conducted.

The number of "presumed occupied" stands deemed to be present within the analysis area is a conservative number likely resulting in an overestimation. We expect that some presumed occupied stands may not have suitable habitat present, especially habitat located on private lands based on 1) on-the-ground surveys adjacent to those stands with no suitable nesting habitat (see maps included in appendix Z1), 2) location of those identified stands within narrow riparian buffers surrounded by clear-cuts and/or residences, 3) extent of timber stand harvests adjacent or near identified stands, and/or 4) proximity of presumed occupied stands greater than 3.0 miles from known occupied stands. For example in regards to #1, in 2007 and 2008, 46 of 65 (71 percent) timber stands and/or trees examined on the ground as potential MAMU nesting habitat were determined not to exhibit the necessary nest tree characteristics and were removed from the list of stands/acreage to be surveyed. Additionally, FWS (2006d) indicated that generally forests that provide suitable nesting habitat and nest trees require 200 to 250 years to develop. The majority of stands identified as "presumed occupied" do not occur in old-growth forest. However, as noted above, these areas have not been surveyed according to the applicable two-year protocol (Mack et al. 2003) and thus are appropriately categorized as “presumed occupied” due to their potential to support nesting MAMU, as evidenced by the occupied behavior documented within 20 presumed occupied stands.

Table 3.3.3-2 below summarizes the number of MAMU stands (and status) considered for this analysis within each Marbled Murrelet Zone, by landowner in the terrestrial nesting analysis area. The table also tallies the number of stands that are included because of the stand’s proximity to proposed habitat removal and/or access roads for each Zone. Table Q-1 in appendix Q provides details for each stand, including location in relation to proposed action, distance from proposed action including access roads, landowner, land allocation, and overall acres in stand by Marbled Murrelet Inland Zone. Figure 1 in appendix Q shows an overview of occupied and presumed occupied stands within the terrestrial nesting analysis area (occupied stands provided by Coos Bay and Roseburg BLM Districts (BLM 2017) are also depicted beyond the analysis area).

TABLE 3.3.3-1

Summary of Marbled Murrelet Occupied or Presumed Occupied Stands within the Terrestrial Nesting Analysis Area that Are Analyzed in this BA

		Marbled Murrelet Inland Zone 1			**Marbled Murrelet Inland Zone 2**			**Total**		
Status of MAMU Stand a/	**Landowner b/**	**Stands in Zone 1**	**Stands Affected by Construction c/**	**Stands Affected by Access Roads d/**	**Stands in Zone 2**	**Stands Affected by Construction c/**	**Stands Affected by Access Roads d/**	**Total Stands**	**Stands Affected by Construction c/**	**Stands Affected by Access Roads d/**
Occupied	BLM e/	48	22	48	3	3	2	51	25	50
	Other	0	0	0	0	0	0	0	0	0
	Occupied Total	*48*	*22*	*48*	*3*	*3*	*2*	*51*	*25*	*50*
Presumed Occupied	BLM	79	29	76	7	2	6	86	31	82
	Other	38	28	36	0	0	0	38	28	36
Presumed Occupied Total		*117*	*57*	*112*	*7*	*2*	*6*	*124*	*59*	*118*
Overall Total	BLM	127	51	125	10	5	8	137	56	132
	Other	38	28	35	0	0	0	38	28	36
	Overall Total	**165**	**79**	**160**	**10**	**5**	**8**	**175**	**84**	**168**

a/ “Occupied:” delineated stand that has identified occupied behavior during protocol surveys; “ “Presumed Occupied:” forested stand has not been surveyed and habitat present is may provide suitable nesting structures.
b/ BLM includes Coos Bay and Roseburg Districts; three presumed occupied stands with mixed landowner (BLM and private) in MAMU Inland Zone 1 have been included in this category. Other includes private and Bureau of Indian Affairs (BIA); one presumed occupied stand with mixed landowner (private and BIA) in MAMU Inland Zone 1 have been included in this category.
c/ Stand Affected by Construction considers MAMU stands located within 0.25 mile of all proposed disturbance, including uncleared storage areas (UCSAs), as well as stands within 0.5 mile of federally-designated critical habitat removal.
d/ Access roads considered does not include paved roads that are used regularly by the public (i.e., County Roads, State Highways). MAMU stands are included if the stand is within 0.25 mile of a proposed access road.
e/ One occupied MAMU stand occurs in both Marbled Murrelet Inland Zones 1 and 2 but has been included in tabulations for Inland Zone 2.

Table Q-1 in appendix Q provides details for each stand, including location in relation to proposed action, distance from proposed action including access roads, landowner, land allocation, and overall acres in stand by Marbled Murrelet Inland Zone.

Marbled Murrelet Presence within the Estuarine and Marine Analysis Areas

Because occupied MAMU stands have been documented within the proposed terrestrial nesting analysis area (see table 3.3.3-1), and MAMUs have been recorded on the National Audubon Society’s CBCs in the Coos Bay count circle that occurs within the delineated estuarine and marine analysis areas (National Audubon Society 2017), MAMUs are expected to forage within the Project’s estuarine and marine analysis areas throughout the year. The most MAMUs reported in any survey were 16 counted during 95 observation hours (0.2 counted per hour) in 1992. On average, MAMUs have been recorded 3.1 times per count since 1977.

Habitat

The proposed action traverses two MAMU habitat inland zones designated by FEMAT. Inland Zone 1 encompasses a strip of land along the coast approximately 0 to 35 miles from the coast, and Inland Zone 2 includes areas along the western fringe of the species' range, about 35 to 50 miles from the coast (figure 3.3.3-2). The most suitable habitat is expected to occur within MAMU habitat Inland Zone 1, and recent surveys provide evidence to support this (Raphael 2006). The proposed action also occurs within Conservation Zones 3 and 4 as described by the MAMU Recovery Plan (FWS 1997b). Figure Q-1 in appendix Q provides the location of each MAMU Inland Zone and Conservation Zone within the terrestrial nesting analysis area.

Three categories of MAMU habitat have been identified within the terrestrial nesting analysis area within MAMU Inland Zones 1 and 2: suitable nesting habitat, recruitment habitat, and habitat capable of becoming suitable nesting habitat (capable habitat). The following definitions were considered to classify MAMU habitat considering direction provided in several documents (FWS 1996, 2014c; BLM 1995a, 1995b) to provide standardization of terms for habitat categories: 1) suitable habitat includes coniferous forest that provides structures, or may provide structures and/or a forested buffer necessary for nesting MAMUs, and generally consist of late seral forest; 2) recruitment habitat is coniferous forested stands greater than 60 years of age that do not provide suitable nesting structures for MAMUs and could become suitable habitat within 25 years; and 3) capable habitat is coniferous forested stands from 0 to 60 years of age that could become suitable habitat.

Potential MAMU habitat within the Terrestrial Nesting Analysis area was identified in four steps, building upon each layer. Suitable nesting habitat was identified first, then recruitment; all other coniferous forest not included in the previous two categories was considered capable habitat. Non-forested habitat and deciduous forest was considered non-capable habitat. The vegetation file developed for the Pipeline Project was used as the base file. Vegetation cover types were digitized with GIS from 2016 aerial photography and delineated based on the predominate vegetation physiognomy (e.g., trees, shrubs, herbaceous vegetation) and the dominant species present. Forested vegetation was assigned an age class using available GIS data (BLM FOI database, Gradient Nearest Neighbor raster data set [developed by Landscape Ecology, Modeling, Mapping & Analysis, or LEMMA: http://lemma.forestry.oregonstate.edu/], Moeur et al. (2006) LANDSAR late successional old-growth coverage, and an index called the old-growth structure index that further assisted monitoring the abundance of old-growth forest across large landscapes, including the NWFP area in the 20-year late successional and old-growth forest status and trend report (see Davis et al. 2015). Age class within previous versions of mapped vegetation for the Pipeline was also reviewed by BLM and Forest Service biologists on their respective lands with specific focus on verifying/classifying late seral forest stands (Habitat Quality subtask group, 2007 through 2008), as well as verified/revised by SBS who conducted biological surveys for Pacific Connector. Age class for forested stands was categorized within five age ranges: clearcut (0-5 years), regenerating (5-40 years), mid-seral (40-80 years), late successional (80-175 years), and old-growth (175+ years) (Lint 2005). Areas of regenerating forest that appear to be "clearcut" on the aerial photography were identified as "early-regenerating" forest. The Pacific Connector vegetation file extends at least 100 meters (328 feet) from the proposed action and consists of smooth polygons following obvious vegetation breaks. Outside of the Pipeline Project vegetation layer and outside BLM-managed lands, the MAMU habitat file becomes more pixelated (25-meter by 25-meter squares) and less refined because it relied on MAMU habitat modeled from Raphael et al. (2016) (see Habitat Modeling, Pacific Northwest Research Station below).

Table 3.3.3-2 provides a summary of MAMU habitat within the terrestrial nesting analysis area by MAMU Inland Zone, Recovery Plan Conservation Zone, general landownership, and within SHUs and outside of SHUs that was developed for the proposed action.

TABLE 3.3.3-2

Marbled Murrelet Habitat Available within the Terrestrial Nesting Analysis Area

Conservation Zone	Landowner a/	General Location	Total Acres within Analysis Area	Suitable Habitat b/ Acres Available	Suitable Habitat b/ Percent	Recruitment Habitat c/ Acres Available	Recruitment Habitat c/ Percent	Capable Habitat d/ Acres Available	Capable Habitat d/ Percent	Total MAMU Habitat e/ Acres Available	Total MAMU Habitat e/ Percent
Marbled Murrelet Inland Zone 1											
Zone 3	Federal	Within SHUs	84	43	50.7	14	16.2	27	32.2	83	99.1
		Outside of SHUs	479	0	0.0	4	0.8	275	57.5	279	58.3
		Total	**563**	**43**	**7.6**	**18**	**3.1**	**302**	**53.7**	**363**	**64.4**
	Non-Federal	Within SHUs	204	17	208	34	16.7	102	50.3	153	75.0
		Outside of SHUs	8,996	0	0.0	432	4.8	2,853	31.7	3,285	36.5
		Total	**9,199**	**17**	**0.2**	**466**	**5.1**	**2,956**	**32.1**	**3,439**	**37.4**
	Total Conservation Zone 3	Within SHUs	288	60	20.8	48	16.7	130	45.0	238	82.6
		Outside of SHUs	9,475	0	0.0	436	4.6	3,129	33.0	3,565	37.6
		Total	**9,762**	**60**	**0.6**	**484**	**5.0**	**3,258**	**33.4**	**3,802**	**38.9**
Zone 4	Federal	Within SHUs	18,588	11,557	62.2	3,154	17.0	3,735	20.1	18,446	99.2
		Outside of SHUs	8,412	13	0.2	5,407	64.3	2,889	34.3	8,309	98.8
		Total	**27,000**	**11,570**	**42.9**	**8,562**	**31.7**	**6,624**	**24.5**	**26,756**	**99.1**
	Non-Federal	Within SHUs	4,058	336	8.3	553	13.6	3,072	75.7	3,961	97.6
		Outside of SHUs	18,014	0	0.0	1,440	8.0	14,110	78.3	15,550	86.3
		Total	**22,073**	**336**	**1.5**	**1,993**	**9.0**	**17,182**	**77.8**	**19,511**	**88.4**
	Total Conservation Zone 4	Within SHUs	22,647	11,893	52.5	3,707	16.4	6,807	30.1	22,407	98.9
		Outside of SHUs	26,426	13	0.1	6,848	25.9	16,999	64.3	23,860	90.3
		Total	**49,073**	**11,906**	**24.3**	**10,555**	**21.5**	**23,806**	**48.5**	**46,267**	**94.3**
Outside Conservation Zones	Federal	Within SHUs	2,536	1,610	63.5	442	17.4	389	15.3	2,441	96.2
		Outside of SHUs	1,193	0	0.0	1,107	92.8	56	4.7	1,163	97.5
		Total	**3,729**	**1,610**	**43.2**	**1,548**	**41.5**	**445**	**11.9**	**3,603**	**96.6**
	Non-Federal	Within SHUs	688	66	9.6	132	19.2	405	58.4	600	87.2
		Outside of SHUs	3,226		0.0	666	20.6	1,839	57.0	2,505	77.7
		Total	**3,914**	**66**	**1.7**	**798**	**20.4**	**2,244**	**57.2**	**3,105**	**79.3**
	Total Outside Conservation Zone	Within SHUs	3,224	1,676	52.0	574	17.8	794	24.5	3,040	94.3
		Outside of SHUs	4,419	0	0.0	1,773	40.1	1,896	42.9	3,668	83.0
		Total	**7,643**	**1,676**	**21.9**	**2,347**	**30.7**	**2,689**	**35.1**	**6,708**	**87.8**
MAMU Inland Zone 1 Total	Federal	Within SHUs	21,208	13,210	62.3	3,610	17.0	4,151	19.6	20,970	98.9
		Outside of SHUs	10,084	13	0.1	6,518	64.6	3,220	31.9	9,751	96.7
		Total	**31,292**	**13,223**	**42.3**	**10,128**	**32.4**	**7,371**	**23.6**	**30,722**	**98.2**

TABLE 3.3.3-2 (continued)

Marbled Murrelet Habitat Available within the Terrestrial Nesting Analysis Area

Conservation Zone	Landowner a/	General Location	Total Acres within Analysis Area	Suitable Habitat b/		Recruitment Habitat c/		Capable Habitat d/		Total MAMU Habitat e/	
				Acres Available	Percent	Acres Available	Percent	Acres Available	Percent	Acres Available	Percent
MAMU Inland Zone 1 Total	Non-Federal	Within SHUs	4,950	419	8.5	719	14.5	3,579	72.2	4,714	95.2
		Outside of SHUs	30,236	0	0.0	2,538	8.4	18,803	62.2	21,341	70.6
		Total	**35,186**	**419**	**1.2**	**3,257**	**9.3**	**22,382**	**63.6**	**26,055**	**74.0**
	Subtotal Marbled Murrelet Zone1	Within SHUs	26,158	13,629	52.1	4,329	16.5	7,730	29.5	25,683	98.2
		Outside of SHUs	40,320	13	0.0	9,056	22.5	22,023	54.6	31,091	77.1
		Total	**66,478**	**13,642**	**20.5**	**13,386**	**20.1**	**29,753**	**44.8**	**56,777**	**85.4**
Marbled Murrelet Inland Zone 2											
Outside Conservation Zones	Federal	Within SHUs	789	641	81.2	23	2.9	100	12.7	764	96.8
		Outside of SHUs	1,095	6	0.6	767	70.1	229	20.9	1,002	91.5
		Total	**1,884**	**647**	**34.3**	**790**	**42.0**	**329**	**17.4**	**1,766**	**93.7**
	Non-Federal	Within SHUs	392	1	0.2	188	47.8	184	47.0	373	95.0
		Outside of SHUs	15,423	20	0.1	3,990	25.9	5,010	32.5	9,021	58.5
		Total	**15,815**	**21**	**0.1**	**4,177**	**26.4**	**5,195**	**32.8**	**9,393**	**59.4**
	Subtotal Marbled Murrelet Zone2	Within SHUs	1,182	641	54.3	211	17.8	284	24.1	1,136	96.2
		Outside of SHUs	16,518	26	0.2	4,757	28.8	5,239	31.7	10,023	60.7
		Total	**17,699**	**668**	**3.8**	**4,968**	**28.1**	**5,524**	**31.2**	**11,159**	**63.0**
Total Marbled Murrelet Range											
Total Marbled Murrelet Range	*Federal*	Within SHUs	21,997	13,851	63.0	3,633	16.5	4,251	19.3	21,734	98.8
		Outside of SHUs	11,179	19	0.2	7,285	65.2	3,449	30.9	10,753	96.2
		Total	**33,176**	**13,870**	**41.8**	**10,918**	**32.9**	**7,700**	**23.2**	**32,488**	**97.9**
	Non-Federal	Within SHUs	*5,342*	*420*	7.9	*907*	17.0	*3,764*	70.4	*5,087*	95.2
		Outside of SHUs	*45,659*	*20*	0.0	*6,528*	14.3	*23,813*	52.2	*30,361*	66.5
		Total	***51,001***	***440***	**0.9**	***7,434***	**14.6**	***27,577***	**54.1**	***35,448***	**69.5**
	Total Marbled Murrelet Range	Within SHUs	*27,340*	*14,271*	52.2	*4,540*	16.6	*8,015*	29.3	*26,819*	98.1
		Outside of SHUs	*56,838*	*39*	0.1	*13,813*	24.3	*27,262*	48.0	*41,114*	72.3
		Total	***84,177***	***14,310***	**17.0**	***18,354***	**21.8**	***35,277***	**41.9**	***67,936***	**80.7**

a/ Federal Landowners include Coos Bay BLM and Roseburg BLM Districts, Non-federal Landowners include private and State lands.
b/ Suitable Habitat: generally late-seral forested stands that provide or are presumed to provide nesting structures for marbled murrelet based on modeling and other available GIS data.
c/ Recruitment Habitat: forested land not currently suitable for marbled murrelet nesting that may be capable of becoming suitable marbled murrelet habitat within the next 25 years (FWS 2006c; BLM 1995a, 1995b); generally forested stands 60 years or greater (FWS 2014c).
d/ Capable Habitat: forested land that has the capability of becoming suitable nesting marbled murrelet habitat, generally includes forest stand age 0 to 60 years (FWS 2014c).
e/ Total MAMU Habitat does not include "non-capable habitat" that occurs within the Marbled Murrelet Terrestrial Nesting Analysis Area.

Estimate of Suitable Habitat

For this BA, suitable habitat includes all habitat that occurs within BLM delineated occupied stands (BLM 2017) including where BLM-delineated occupied stands include younger forest (e.g., regenerating forest) or non-forested habitat (e.g., roads). Habitat that is included within "presumed occupied stands" analyzed within this BA (see species presence section, above) was also included in the MAMU habitat file as suitable habitat, including potential habitat areas identified by Coos Bay and Roseburg BLM Districts (2017 suitable habitat GIS files), or potential habitat based on LiDAR and habitat modeling developed by the Pacific Northwest Research Center (Raphael et al. 2016). Based on the vegetation file developed for the Pipeline Project, these "presumed occupied" stands include coniferous forest ranging from mid-seral to old-growth.

Suitable habitat was incorporated into the MAMU habitat GIS file first. On BLM lands, additional suitable habitat was incorporated into the MAMU habitat file where GIS data provided by Coos Bay and Roseburg BLM Districts (BLM 2017) identified suitable habitat based on BLM FOI coverage (includes coniferous stands at least 80 years of age); these areas correspond to presumed occupied stands described above for species presence. On non-federal lands, additional suitable habitat was identified using a MAMU habitat model developed by the Pacific Northwest Research Center (see Raphael et al. 2011). Within 0.25 mile of the proposed action, areas modeled with "highest" suitable habitat potential (value 4 in the Raphael et al. 2016 model) and where obvious late seral stands were present (2016 aerial photography and Pacific Connector GIS vegetation layer) were included in the MAMU habitat file developed for the proposed action. Additional description of the MAMU habitat model developed at the Pacific Northwest Research Center is included, below. Suitable habitat included in the MAMU habitat GIS file consists of coniferous forest in the following age classes: old-growth (175+ years), late successional (80 to 175 years), and mid-seral (40 to 80 years), with the exception of some habitat within BLM-delineated MAMU stands that include lower seral and nonforested habitat.

Based on the proportion of suitable habitat known to be occupied by nesting MAMUs either as surveyed per protocol (see Mack et al. 2003), or expected to be occupied based on survey history in the area and the application of an occupancy index to unsurveyed areas, FWS estimated that approximately 408,621 acres of suitable MAMU habitat (51 percent of reported suitable habitat) are likely occupied in Oregon (McShane et al. 2004). Also, 97 percent of the stands identified by SBS that were potential MAMU nesting habitat were determined to be non-suitable nesting habitat after on-the-ground habitat surveys by R&A in 2007; most of those areas are uniform 40-60 year old stands. Therefore, the estimates of suitable nesting habitat included in the MAMU habitat file and summarized in table 3.3.3-2 are most likely an overestimation.

Estimate of Recruitment Habitat

Recruitment habitat was included into the MAMU habitat file next and only included areas not considered "suitable habitat," as described above. Delineation of recruitment habitat relied on several sources: Roseburg BLM District's MAMU-specific GIS layer (BLM 2017), BLM FOI database, SBS habitat delineation for the Pipeline Project and on-the-ground survey results, Pacific Connector's delineated vegetation GIS file, Pacific Northwest Research Center's MAMU habitat model developed by Raphael et al. (2016), and nesting, roosting, and foraging (NRF) and High NRF modeled for the NSO habitat model (discussed below in section 3.3.4 for NSO).

First, areas that were identified as potential suitable nesting habitat (gray habitat) based on LiDAR and aerial photography by SBS but had subsequently been ground-truthed and determined to not provide suitable nesting structures were included as "recruitment" habitat. Next, habitat was identified as recruitment habitat on BLM lands where forest had not been recently harvested (review of 2016 aerial photography) and 1) coniferous forest and mixed forest habitat was 60 years or greater (BLM 2016c), and/or 2) where Roseburg BLM District's MAMU-specific GIS layer identified the area as recruitment habitat (BLM 2017).

On non-federal lands not included in the previous steps, the Pacific Connector vegetation GIS file was used to identify additional recruitment habitat. All coniferous late successional and old-growth forest not previously incorporated into the MAMU habitat GIS file as suitable habitat were included as recruitment habitat. Mid-seral habitat included in the vegetation GIS file located on non-federal lands and not previously identified as suitable habitat was included as "recruitment habitat." Outside of Pacific Connector's vegetation GIS file, recruitment habitat was incorporated in the MAMU habitat file where Raphael et al. (2016) pixel values were classed as "moderately high" potential to be suitable MAMU habitat (pixel value 3). Recruitment habitat included in the MAMU habitat GIS file consists of coniferous forest in the following age classes: old-growth (175+ years), late successional (80 to 175 years), and mid-seral (40 to 80 years).

Estimate of Capable Habitat

Capable habitat incorporated into the MAMU habitat GIS file includes all other coniferous forested habitat not previously identified as suitable or recruitment habitat (see above). This includes coniferous forest areas that have been clearcut and are regenerating. On BLM lands, mid-seral coniferous forest between 40 and 60 years of age not previously included as suitable or recruitment habitat was also included as capable in the MAMU habitat file. Capable habitat included in the MAMU habitat GIS file consists of coniferous forest in the following age classes: mid-seral (40 to 60 years), regenerating (5 to 40 years), and clearcut (0 to 5 years).

Non-Capable Habitat

This category includes all areas that are non-forested habitat (i.e., waterbodies, agriculture fields, existing rights-of-ways and corridors, grasslands/shrublands) and deciduous forest, as delineated within Pacific Connector's vegetation GIS layer.

Habitat Modeling, Pacific Northwest Research Station

Modeling of potential suitable MAMU nesting habitat has been generated by the Pacific Northwest Research Station (see Raphael et al. 2016; General Technical Report PNW-GTR-933) with the objective to estimate a baseline amount and distribution of potential nesting habitat since the inception of the NWFP in 1994 (Forest Service and BLM 1994). Methods to determine the baseline of MAMU habitat suitability within the NWFP area on both federal and nonfederal lands have been improved and updated during the 10-year (Raphael et al., 2006), 15-year (Raphael et al 2011), and 20-year (Raphael et al. 2016) monitoring reports. Raphael et al. (2006) used vegetation data derived from satellite imagery to model MAMU habitat suitability to establish the habitat baseline. Raphael et al (2011) updated the baseline model focusing on results of a new approach for estimating baseline potential nesting habitat, and on changes to date from the original 2006 baseline.

To model relative suitability of MAMU nesting habitat, Raphael et al. (2011) used recently developed habitat suitability modeling software called Maxtent (Phillips et al. 2006; Phillips and Dudík 2008), which estimates probabilities of occurrence at unobserved locations by using information at the observed locations and assuming as little as possible about background sites for which there is not information (Baldwin 2009). The newest model (Raphael et al. 2016) relies on updated spatial habitat data from 1993 through 2012 using GNN methods, updated vegetation disturbances using Landsat-based detection of Trends in Disturbance and Recovery Methods (LandTrendr), and a slightly expanded set of murrelet nest and occupied sites in Oregon and California. The resulting model includes four habitat classes: highest (value 4), moderately high (value 3), marginal (value 2), and lowest (value 1). In many instances where the earlier models had indicated high or moderately high potential for suitable nesting habitat, the newer model indicated marginal or low. Because available LiDAR indicated trees greater than 107 feet (which was one factor considered to identify presumed occupied stands; see Species Presence section, above), Pacific Connector presumed occupied MAMU stands that had been previously analyzed continued to be included, even though the updated MAMU habitat model may not have identified the area as highly suitable habitat.

Critical Habitat

MAMU CHU OR-06-d has been designated within the Pipeline Project area (FWS 2011b and 2016c). Approximately 2.17 miles of MAMU critical habitat are crossed by the Pipeline on BLM-administered lands, although CHUs OR-06-b and OR-06-c are within the terrestrial nesting analysis area located on lands of the Coos Bay and Roseburg BLM Districts (FWS 2011b and 2016c). No designated critical habitat would be affected by the LNG Project. Habitat modeled for the proposed action (see discussion, above) was intersected with each CHU to determine the amount of MAMU habitat available within the terrestrial nesting analysis area and CHU. Table 3.3.3-3 summarizes the MAMU habitat associated with the CHUs, and identifies known occupied stands from data provided by BLM (2017) within each CHU (both within the entire CHU and CHU within the terrestrial nesting analysis area). PCEs are included in table 3.3.3-3 and below:

- PCE 1 includes individual trees with potential nest platforms, including supporting trees delineated as occupied or suitable (comparable to suitable habitat); and
- PCE 2 includes forest lands of at least one half site-potential tree height, within 0.5 mile of individual trees/suitable habitat stand that are recruitment or capable habitat (comparable to recruitment habitat) not currently suitable for MAMU nesting that may be capable of becoming suitable MAMU habitat within the next 25 years (FWS 2006c; BLM 1995a, 1995b); generally forested stands 60 years or greater (FWS 2014c).

Suitable MAMU nesting habitat within the terrestrial nesting analysis area is considered equivalent to the MAMU critical habitat designation PCE 1 for analysis within this BA – individual trees (and delineated stands) with potential nesting platforms. Recruitment habitat (or PCE 2) is defined by FWS (2011b) as coniferous forested land not currently suitable for MAMU nesting that may be capable of becoming suitable MAMU habitat within the next 25 years, generally forested stands 60 years or greater (FWS 2014c). FWS (2011b) considers all forests within 0.5 mile of an occupied stand containing trees with at least one-half the site-potential tree height of the occupied stand to be recruitment habitat. Recruitment habitat is essential to provide and support suitable nesting habitat for successful reproduction of the MAMU. Benefits of this habitat include reducing the differences in microclimates associated with forested and unforested areas, reducing the potential for windthrow during storms, and providing a landscape that has a higher probability of occupancy by MAMUs. FWS (Trask & Associates 2013) requested that, for this BA, PCE 2 consider recruitment and capable habitat as defined above in the habitat section.

Only 8,417 acres, or 11.2 percent of 75,334 acres available within MAMU CHUs OR-06-b, OR-06-c, and OR-06-d, occur within the terrestrial nesting analysis area, of which approximately 4,301 acres (50.7 percent of the analysis area) are presumed to provide suitable nesting habitat for MAMUs (see table 3.3.3-3). The other portion of CHUs consists of recruitment habitat and forested stands capable of becoming suitable habitat (approximately 28.6 percent and 19.9 percent of available CHU in the terrestrial analysis area, respectively). The majority of CHU within the analysis area (5,431 acres or 64.5 percent) is located on federal lands designated as LSRs. The overlap of CHU with LSR affords a greater degree of protection to the designated critical habitat as the BLM RMP protections for LSRs are automatically imposed on those LSR acres that are found within a CHU. Thus, MAMUs located within these land allocations also benefit from increased protection. Ten occupied MAMU stands occur within CHU OR-06 (b, c, and d) within the terrestrial analysis area, including six occupied stands detected during Pacific Connector survey efforts in 2007, 2008, 2013, and 2014. Twenty-four other stands have also been delineated as presumed occupied stands within designated critical habitat in the terrestrial analysis area: OR-06-b (one stand), OR-06-c (three stands), and OR-06-d (20 stands). Table Q-1 in appendix Q provides land allocations, including CHU that each MAMU stand (occupied and presumed occupied) analyzed within this BA is associated with, if applicable.

TABLE 3.3.3-3

Summary of Available Marbled Murrelet (MAMU) Habitat within MAMU Critical Habitat Units within the Terrestrial Nesting Analysis Area

CHU Number	Total Acres in CHU	% Subunit within Analysis Area	Total Acres of CHU in Analysis Area a/	Occupied Stands in CHU (Analysis Area) b/	PCE 1 (Suitable Habitat) c/		PCE 2 (Recruitment Habitat) d/		PCE 2 (Capable Habitat) e/		Total MAMU Habitat	
					Acres Available	Percent	Acres Available	Percent	Acres Available	Percent	Acres Available	Percent
Marbled Murrelet (MAMU) Inland Zone 1												
OR-06-b	52,851	1.4	726	15 (1)	478	65.8	137	18.9	110	15.2	724	99.7
OR-06-c	4,762	15.1	721	0 (0)	415	57.6	90	12.5	214	29.7	720	99.9
OR-06-d	17,721	39.3	7,044	11 (9)	3,408	48.4	2,203	31.3	1,362	19.3	6,973	99.0
Total CHU	**75,334**	**11.2**	**8,491**	**26 (10)**	**4,301**	**50.7**	**2,430**	**28.6**	**1,686**	**19.9**	**8,417**	**99.1**

a/ Total Acres within CHU Subunit in the terrestrial nesting analysis area
b/ Occupied stands consider only known occupied stands (BLM 2017); the number in parenthesis identify stands that occur within the terrestrial nesting analysis area.
c/ PCE 1/Suitable habitat: individual trees with potential nest platforms, including supporting trees delineated as occupied or suitable (comparable to suitable habitat)
d/ PCE 2/Recruitment habitat: forest lands of at least one half site-potential tree height, within 0.5 mile of individual trees/suitable habitat stand that are recruitment or capable habitat (comparable to recruitment habitat) not currently suitable for marbled murrelet nesting that may be capable of becoming suitable marbled murrelet habitat within the next 25 years (FWS 2006c; BLM 1995a, 1995b); generally forested stands 60 years or greater (FWS 2014c).
e/ PCE 2/Capable Habitat: forested land that has the capability of becoming suitable nesting marbled murrelet habitat, generally includes forest stand age 0 to 60 years (FWS 2014c).
CHU = critical habitat unit; PCE = primary constituent element

Late-Successional Reserves

BLM has designated LSR within BLM checkerboard lands on Coos Bay and Roseburg BLM Districts. Approximately 18,065 acres of LSR occur within the terrestrial nesting analysis area, of which 12,045 acres (66.7 percent) provide suitable nesting habitat; 3,903 acres (21.6 percent) provide recruitment habitat; and 1,941 acres (10.7 percent) consist of forested areas capable of becoming suitable habitat. Table 3.3.3-4, below, provides a summary of MAMU habitat that occurs within lands allocated as LSRs in the terrestrial nesting analysis area.

Approximately 5,431 acres of the LSRs within the terrestrial nesting analysis area overlap the FWS designated CHUs for MAMU. The overlap of LSRs with federally designated MAMU critical habitat affords a greater degree of protection to the MAMU and its critical habitat as the protections for LSRs are automatically imposed on those LSR acres that are found within a CHU. Thus, MAMUs located within these land allocations also benefit from increased protection. Table Q-1 in appendix Q provides land allocations, including LSRs that each MAMU stand (occupied and presumed occupied) analyzed within this BA is associated, if applicable.

TABLE 3.3.3-4

Summary of Marbled Murrelet Habitat Available within LSRs within the Terrestrial Nesting Analysis Area

Landowner	Total Acres Available in Analysis Area	Suitable Habitat a/		Recruitment Habitat b/		Capable Habitat c/		Total Acres	
		Acres Available	Percent Available	Acres Available	Percent Available	Acres Available	Percent Available	Acres Available	Percent Available
Marbled Murrelet (MAMU) Inland Zone 1									
Coos Bay BLM District	14,563	9,800	67.3	2,922	20.1	1,726	11.9	14,448	99.2
Roseburg BLM District	2,548	1,626	63.8	702	27.6	174	6.8	2,502	98.2
Total MAMU Zone 1	**17,111**	**11,426**	**66.8**	**3,624**	**21.2**	**1,900**	**11.1**	**16,950**	**99.1**
MAMU Inland Zone 2									
Roseburg BLM District	955	619	64.8	279	29.2	41	4.3	939	98.3
Total MAMU Zone 2	**955**	**619**	**64.8**	**279**	**29.2**	**41**	**4.3**	**939**	**98.3**
MAMU Inland Zones 1 and 2									
Coos Bay BLM District	14,563	9,800	67.3	2,922	20.1	1,726	11.9	14,448	99.2
Roseburg BLM District	3,502	2,245	64.1	981	28.0	215	6.1	3,441	98.3
Overall Total	**18,065**	**12,045**	**66.7**	**3,903**	**21.6**	**1,941**	**10.7**	**17,889**	**99.0**

a/ Suitable Habitat: generally late-seral forested stands that provide or are presumed to provide nesting structures for MAMU based on modeling and other available GIS data.
b/ Recruitment Habitat: forested land not currently suitable for marbled murrelet nesting that may be capable of becoming suitable MAMU habitat within the next 25 years (FWS 2006c; BLM 1995a, 1995b); generally forested stands 60 years or greater (FWS 2014c).
c/ Capable Habitat: forested land that has the capability of becoming suitable nesting MAMU habitat, generally includes forest stand age 0 to 60 years (FWS 2014c).

3.3.3.3 Effects of the Proposed Action

Direct Effects – Marine and Estuarine Analysis Areas

MAMUs that forage offshore (marine analysis area) and/or within Coos Bay (estuarine analysis area) could be directly affected by 1) noise (in-air and underwater) generated during construction of the LNG Project and noise generated by LNG carriers transiting the marine analysis area and estuary during Project operation; and 2) disturbance during feeding by LNG carrier traffic,.

In-Air Noise

MAMUs are expected to forage within the Project's estuarine and marine analysis areas throughout the year, and foraging MAMUs could be directly affected by in-air noise from construction and operation. Noise levels 50 feet away from typical construction equipment that might be used during LNG Terminal construction are provided in table 3.3.2-1 included above for the snowy plover.

The standard for noise reduction from point sources such as construction machinery is 6 dBA per doubling of distance under hard site conditions (over calm water, or hard, smooth ground surface) and 7.5 dBA per doubling of distance under soft site conditions (because of roughened ground and/or vegetation cover; WSDOT 2019). Based on the data in table 3.3.2-1, the noise produced by construction activities would attenuate to daytime ambient noise levels (estimated at 55 dBA because of breaking wave noise) within distances of 230 feet to 2,850 feet, depending on equipment/actions and hard site or soft site reduction ground surface conditions. Obscuring vegetation (tree cover), topography (interruption of line-of-sight), and atmospheric conditions (wind, air temperature, humidity) also affect noise reduction but can be highly variable between locations and over time and are generally not taken into account in estimates of noise attenuation over short distances. Consequently, predicted noise levels are likely to be higher than actual noise levels. Based on this information, general construction noise above ambient noise could occur within about 0.5 mile of the LNG Terminal site, and therefore MAMUs foraging within Coos Bay within 0.5 mile of the site could potentially be affected. Impacts would likely include movement of birds outside of this area of impact.

Proposed pile-driving activities would generate the greatest noise and would occur over an approximately 24-month period, on a schedule of two shifts, 6 days per week. The cumulative long term average airborne sound level created by pile driving activities for 14 impact pile driving rigs and 6 vibratory pile driving rigs in operation, simultaneously, was used to calculate the day and night sound levels (L_{nd}) and daytime average (L_d or L_{eq} daytime) (see appendix BB). The noise produced by sheet pile and pile installation activities would attenuate to daytime ambient noise levels (estimated at 55 dBA because of breaking wave noise) within distances of approximately 4,200 feet (SRL 2017). Based on this information, noise from pile driving above ambient noise could occur within about 0.8 mile of the LNG Terminal site, and therefore MAMUs foraging within Coos Bay within 0.8 mile of the site could potentially be affected. Impacts would likely include movement of birds outside of this area of impact.

Underwater Noise

Propeller cavitations produce most carrier broadband noise, especially if damaged, operating asynchronously, or operating without nozzles. Engines and auxiliary machinery can also radiate noise during operation that is related to ship size (larger ships are noisier than small ones), speed (noise increases with ship speed), and mode of operation (ships underway with full loads, towing or pushing loads, are noisier than unladen ships) (Greene and Moore 1995).

The Federal Highway Administration, FWS, and WSDOT (WSDOT 2019) developed and agreed to underwater noise level criteria for injury to MAMUs from noise. The criteria are for underwater sound resulting from impact pile driving of steel piles and/or repetitive impulsive underwater sounds (see table 3.3.3-5). However, FWS considers the sound levels in table 3.3.3-5 to be used as guidelines in effects analysis rather than threshold criteria for foraging MAMUs. Other factors, including duration, are important when considering whether exposure in the zones would result in adverse effects. The thresholds do not apply to non-impact, non-impulsive underwater sounds such as ship noise. In this analysis, however, they serve as references for potential effects of ship noise produced by LNG carriers on diving MAMUs.

TABLE 3.3.3-5

Current In-water Acoustic Thresholds for Marbled Murrelets

Criterion Zone	Threshold a/
Auditory Injury Threshold	202 dB SEL b/
Non-auditory Injury Threshold	208 dB SEL
Non-injurious Hearing Threshold Shift Zone	183 dB SEL
Potential Behavioral Effects Zone	150 dB_{rms} c/

a/ All decibels (dB) referenced to 1 micropascal (re: 1 µPa).
b/ SEL – sound level exposure – reported as the cumulative amount of exposure for a single pile driving event.
c/ rms – the root mean squared for pile driving during a single pile driving impulse pressure event.

A review of LNG carriers in service during 2013 (Colton 2013; MarineTraffic 2013) revealed there are 267 carriers with capacities of 148,000 m^3 or less, the current size limit for LNG carriers utilizing the LNG Project. Hatch et al. (2008) determined underwater noise levels from various commercial ships while transiting the Stellwagen Bank National Marine Sanctuary off the Massachusetts coast. Estimates of sound levels from one ship, an LNG carrier (the Berge Everett also known as the BW Suez Everett) built in 2003 with 138,028 m^3 capacity (93,844 gross tonnage), are used here to estimate exposure of MAMU to project-related shipping noise. Also, Hatch et al. (2008) reported noise for three tugs in the same area, and they are used here as the standard for the following analysis of noise effects on MAMUs within the marine analysis area.

The ocean or waterway offshore from the entrance to Coos Bay is partially within the southern portion of offshore Conservation Zone 3 and partially within the northern portion of offshore Conservation Zone 4, as defined by Miller et al. (2012). In those portions of the Northern California- Oregon coast, the researchers estimated at-sea densities of MAMUs per km^2 of ocean surveyed from 2000 through 2016. As discussed in section 3.3.3.1, the predicted estimate of MAMU densities within Conservation Zones 3 and 4 shows an increasing trend for all of Oregon (see Figure 4 in Lynch et al. 2017).

The LNG carrier in the Hatch et al. (2008) study produced sound levels (with one standard error) of 182 ± 2 dB re: 1 µPa at 1 meter that attenuated to 160 dB at 35 ± 11 meters and to 120 dB at 16,185 ± 5,359 meters (Hatch et al. 2008). MAMUs diving and feeding in the marine analysis area are not expected to be exposed to ship propulsion noise that would cause harm (see table 3.3.3-5), although MAMUs would likely detect noise from LNG carriers transiting the analysis area. MAMU could be exposed to propulsion related noise levels of 160 dB, which could cause potential behavioral effects due to LNG carrier noise. However, because MAMUs forage in shallow offshore areas, they would not be expected to be exposed to LNG carrier noise but would be in areas of potential exposure to tug noise.

Three tractor tugs would guide each LNG carrier from a point approximately 5 nmi offshore the entrance to Coos Bay and to the LNG Project. Noise produced by tugs would attenuate to 160 dB at 11 ± 4 meters (upper end) and to 120 dB at 4,992 ± 1,599 meters (upper end) (Hatch et al. 2008). MAMU diving and foraging would be exposed to noise levels of 160 dB, which could cause potential behavioral effects due to tug noise, such as flushing or avoidance (Bellefleur et al. 2009; Agness et al. 2008; Teachout 2013). Exposure to noise levels of 120 dB would not be expected to cause potential behavioral effects due to tug noise, as indicated in table 3.3.3-5, although may interfere with communications between MAMUs in the vicinity of the tug (Teachout 2013).

As discussed in section 3.5.1.3, underwater noise can be generated by driving piles on land (dry piles). The propagation of underwater construction noise from the "dry" impact pile driving associated with the MOF was modeled for marine mammals in several reports prepared by JASCO Applied Sciences (Wladichuk et al. 2018; appendix BB). The Phase 5 modeling study examined the threshold radii from driving a pile at the MOF face and at 98.4 feet (30 meters) setback distance behind the MOF. Based on analysis for listed fish, the model results indicate the 187 dB SEL injury level threshold extends a maximum range of 5,653 feet (1,723 meters) for piles at the MOF face and 2,890 feet (881 meters) for piles at the 98.4 feet (30 meter) setback. The fish noise analysis indicates the MAMU 183 dB SEL non-injurious Hearing Threshold Shift Zone (see table 3.3.3-5) may be exceeded. Pile driving of the eight mooring bollards located at the MOF is anticipated to take 14 days to install, and pile driving of the 28 east mooring piles located at the LNG berth is anticipated to take approximately 8 days to install. Pile driving associated with the MOF and the east mooring structures may reduce foraging efficiency by impairing communication between individual MAMU within the impact area shown in figure 3.5.1-2.

Underwater noise harassment or potential injury to MAMU could occur from pile driving associated with in-water temporary piles within the estuarine analysis area. However, the low abundance and density of MAMU and the limited number and area of in-water pile installation would make these effects unlikely. The harassment and injury area would be determined by the pile installation methods used and the number of pile driven within in a given area and period of time. Using the NMFS pile driving effects calculator, vibratory installation of piles, presumed to be the primary installation type for pipe piles would exceed harassment thresholds within 328 feet (100 meters) of pile installations from cumulative sound exposure levels for the installation of up to 85 temporary pipe pile. The NMFS pile driving calculator established that impact driven piles, if utilized could produce injurious peak level sound within approximately 40 feet (12 meters) and harassment levels of sound created from cumulative sound exposure extending to 5.3 miles (8,577 meters).

LNG Carrier Traffic

MAMUs are expected to forage in the estuarine analysis area and probably within the marine analysis area at the same time LNG carriers would be in transit to and from the LNG Project. No information has been found that describes MAMU response to ships' presence and/or ship above-water noise. However, responses of Kittlitz's murrelet (*Brachyramphus brevirostris*, a congeneric of MAMU) to ships' approach were studied in Glacier Bay, Alaska (Agness et al. 2008). The study reported that Kittlitz's murrelets were observed to immediately fly away from carriers; they flew 30 times more from carriers than in the absence of carriers and non-breeding birds (birds not holding fish) were more likely to take flight than breeding birds (those holding a fish; Agness et al. 2008). Applying the behavioral response of the MAMU congener to MAMU would suggest that the species may also avoid and disperse from approaching carrier vessels, disrupting foraging and other behaviors in the process.

Modeled estimates of energy expense showed that non-breeding murrelets had a greater increase in energy expenditure when disturbed (up to 30 percent increase under the average scenario of ship traffic and greater than 50 percent increase under the peak scenario of ship traffic) than breeders (up to 10 percent and 30 percent increases under the average and peak carrier traffic scenarios, respectively). Likewise, non-breeding birds were more likely to experience chronic increases in energy expense (i.e., a greater percentage of days with an increase in energy expenditure) than breeding birds which would be expected to adversely affect energy partitioning for reproduction and survival behaviors (Agness et al. 2013).

Similar responses by foraging MAMUs to LNG carrier traffic would be expected once the LNG Project is in operation. MAMUs foraging within the marine and estuarine analysis areas could potentially fly away from approaching carriers. This could result in expenditure of additional energy and thus reduce energy available for reproduction and other survival behaviors.

Indirect Effects – Marine and Estuarine Analysis Areas

Foraging Habitat

MAMUs forage in shallow offshore and inland saltwater areas on a variety of small fish and invertebrates, including large pelagic invertebrates (Marshall 1988a, 1988b, and 1989; Becker 2001). In Oregon and Washington, anchovy, sand lance, and smelt appear to be the major prey types provided to chicks (McShane et al. 2004).

Turbidity associated with dredging activities within Coos Bay may temporarily affect MAMU forage/prey species and their habitat. Turbidity from dredging at the marine waterway modifications dredge sites are modeled to extend from 2,170 to 2,880 feet upstream/up channel beyond each of the dredging footprints and from 2,820 to 4,600 feet downstream/down channel from each of the dredging footprints. Dredging could be conducted through up to four in-water work windows. Dredging taking place at the access channel and MOF are expected to produce turbidity plumes approximately half the area of the LNG Project slip and access channel prism. This plume may reach the existing navigation channel where currents would influence its shape up and downstream. Dredging at the Eelgrass Mitigation site is expected to be completed in one in-water work window and is not expected to extend beyond the dredge prism as it is a low energy part of the bay. Dredging is planned from October 1 through February 15 following ODFW's recommendation, and timing of these activities would minimize impact to MAMU forage/prey species.

Many MAMU prey species are intertidal spawners, and are more susceptible to oil pollution than pelagic spawners (Carter and Kuletz 1995). However, as discussed previously, fuels and lubricants are kept in relatively small quantities on LNG carriers and therefore spills are unlikely to result in impacts to forage species. As a result, effects to MAMU prey species from accidental spills are expected to be insignificant and discountable.

An inadvertent release of drilling mud from one or both HDDs beneath Coos Bay would temporarily affect water quality as described below in section 3.5.1 and could affect prey species for chicks such as anchovy, sand lance, and smelt.

Direct Effects – Terrestrial Nesting Analysis Area

MAMUs nesting within the terrestrial nesting analysis area would be directly affected by 1) removal of nest trees or potential nest trees during the breeding season (April 1 through September 15) and 2) human presence and noise disturbance during the breeding period. No direct effects to nesting MAMU are expected from construction or operation of the LNG Project. Analysis of potential direct effects to MAMU by the Pipeline Project within the terrestrial nesting analysis area followed guidance provided by FWS included in the Revised Conservation Framework developed for the Project (see FWS 2014c).

Nest Removal During Breeding Season

Removal of habitat during the breeding season within an occupied or presumed occupied stand could result in the loss of nestlings if the nest tree is removed. Removing suitable nesting habitat outside of the entire breeding season (September 16 through March 31) would avoid direct impacts to individual MAMUs or nestlings. Pacific Connector met with FWS on June 5, 2008, to review and discuss the proposed action and construction schedule and identify areas where the project and schedule could be adjusted to avoid or further decrease the disturbance impacts to MAMUs while allowing for a constructible Pipeline Project that considered 1) MAMU seasonal and daily timing restrictions, 2) safety of the construction crew, and 3) meeting the targeted in-service date within a two-year construction period. FWS provided a preference of activities associated with timber removal and construction, including the following specific to habitat removal, listed below in descending order of importance:

- Felling nest trees outside the entire breeding season.
- No removal of habitat within an occupied stand during the entire breeding season.
- No fragmentation of an occupied stand (i.e., clipping the edge of the stand is not as bad as dissecting through the middle).

In response to FWS concerns, Pacific Connector modified portions of the Pipeline route to avoid and/or minimize effects to MAMU. Appendix V.1 (Marbled Murrelet and Northern Spotted Owl Avoidance and Minimization Plan) identifies the additional measures that have been incorporated into the design of the Pipeline in relation to occupied MAMU stands or potentially suitable MAMU habitat. Maps within appendix V.1 show the timing constraints that would be applied in relation to each MAMU stand for timber felling and Pipeline construction.

Also, considering the factors above, Pacific Connector developed a timber removal and construction schedule that would reduce effects to MAMU, as well as ensure the safety of the timber removal and construction crew (see section 2.5.1). Pacific Connector would remove forested habitat within 300 feet of an occupied stand, or presumed occupied stand outside of the entire breeding season to reduce direct impacts to individual MAMUs or nestlings. Timber would be removed beginning in the fourth quarter prior to initiating construction and, if necessary, continue the following fall after the breeding season. This includes habitat that would be removed or potentially removed from 37 MAMU stands (19 occupied and 18 presumed occupied stands) and 300-foot buffers of 59 MAMU stands (21 occupied stands and 38 presumed occupied stands). Habitat would also be removed within 0.25 mile of an NSO activity center outside of the breeding season (from October 1 through February 28); within the range of the MAMU, this includes forested habitat between MPs 37.33 and 37.86, MPs 53.74 and 54.04, and MPs 64.02 and 64.43. Elsewhere in the range of the MAMU, timber removal would precede construction and could occur during the breeding season; however, direct effects to MAMUs or nestlings would not be expected because suitable nesting habitat would have been removed outside of the breeding season.

Table 3.3.3-6 tabulates the number of occupied and presumed occupied stands by Murrelet Inland Zone that would have timber cleared within 300 feet of the MAMU Stand (i.e., the SHU) outside of the breeding season, including 37 MAMU stands that would have suitable habitat removed from the stand.

TABLE 3.3.3-6

Number of Occupied and Presumed Occupied Stands that Would Have Habitat Removed Outside of the Breeding Season, Including the 300-foot Buffer (i.e., the Suitable Habitat Unit)

Status Of Marbled Murrelet (MAMU) Stand	Number of MAMU Stands		
	Stand	300-foot Buffer	Total
Marbled Murrelet Inland Zone 1			
Occupied	16	18	18
Presumed Occupied	19	39	39
Total	**35**	**57**	**57**
Marbled Murrelet Inland Zone 2			
Occupied a/	2	2	2
Presumed Occupied	0	0	0
Total	**2**	**2**	**2**
Overall Total			
Occupied	18	20	20
Presumed Occupied	19	39	39
Total	**37**	**59**	**59**

a/ One occupied MAMU stand occurs in both Marbled Murrelet Inland Zones 1 and 2 but has been included in tabulations for Inland Zone 2.

No suitable MAMU nesting habitat would be removed during the construction of the LNG Project because no suitable nesting habitat exists within the LNG Terminal site; therefore, no direct effects to MAMUs would result from the construction of the LNG Project.

Noise and Visual Effects

In the Revised Conservation Framework, FWS (2014c) provided guidance on determining potential impacts to NSO and MAMU from noise. This guidance included disturbance and disruption distances based on noise thresholds (as described in FWS 2003a and 2006a; discussed below), and prescribed associated impact levels (No, Low, Moderate, or High) based on Project timing and activity.

Disruption and Disturbance

Noise associated with timber clearing and other construction and operation activities associated with the Pipeline could disturb nesting MAMUs and negatively affect productivity. The term "disruption" was alluded to in the ESA, under the definition of "harassment" (50 CFR 17.3) as:

> *an intentional or negligent act or omission which creates the likelihood of injury by annoying it (the organism) to such an extent as to significantly disrupt normal behavior patterns which include but are not limited to, breeding, feeding or sheltering.*

The term "disturbance" was not included in the ESA but a reasonable working definition was provided by Leal (2006) and has been incorporated into this BA:

> *any potential auditory or visual stimuli or deviation from ambient/baseline conditions [that] an individual bird, at a given site, is likely to detect and potentially react to.*

There is limited information on distances from noise and/or visual stimuli at which MAMUs react or flush from the nest, or the effect of such disturbance on productivity (FWS 2003a). Most data gathered for disturbance on MAMUs have been obtained from observations incidental to other research (e.g., Long and Ralph 1998). The sensitivity of an individual MAMU to noise and/or visual disturbance is likely related to levels of disturbance to which the bird is accustomed, including the level and proximity of the disturbance (Hamer and Nelson 1998) as well as the timing of disturbance (time of day, time of year, and time within breeding season). The available research and incidental observations show that the effects of noise and vehicles on roads can elicit disturbance as well as disruption responses from MAMUs, including responses such as flushing, flight, and/or missed feedings of chicks in nests that would be to a level that could interfere with normal behavior patterns including but not limited to, breeding, feeding or sheltering. The following are brief summaries of available research and incidental observations.

- No visible response to vehicles driving past MAMU nests 70 meters (230 feet) away from a paved, "well traveled park road" (Singer et al. 1995 in Long and Ralph 1998).
- MAMU in nests in Big Basin Redwoods State Park showed no response to passing cars during several days of observation in 1989 (Nelson, personal communication, in Long and Ralph 1998).
- MAMU nests 70 meters (230 feet) from lightly used logging road show little to no response when observers drove by in light trucks (Chinnici, personal communication, in Long and Ralph 1998).
- MAMU in nests across river from road with moderate traffic (30 cars/day) showed no reactions when vehicles passed (Nelson, personal communication, in Long and Ralph 1998).
- In a study comparing responses to four types of disturbance (automobiles, trucks, cars, humans), adult MAMU reacted least to trucks and automobiles on U.S. Highway 101 even though truck noise averaged 84 dB and auto noise averaged 72 dB, although one or more vehicles passing by the nest sometimes caused adults to abort a nest visit and return later; MAMU chicks showed only low response to cars/trucks (Hamer and Nelson 1998). The authors concluded that visual disturbances may be of much more concern to nesting birds than noise, which they note is not surprising given the fact they hunt prey solely by visual means.
- There is evidence of MAMU flushing from car doors/people talking within about 100 feet (FWS 2006a, 2014d), although Hébert and Golightly (2006) found that trail use does not appear to influence the behavior of MAMU adults or chicks on the nest.
- Field study to measure behavioral responses of MAMU adults and chicks to disturbance produced by trail users, proximity to paved highways, and experimental disturbances produced by maintenance activities (chainsaws) (Hébert and Golightly 2006):
  - Ambient sound at nest sites was less than 50 dB before and after exposure to chainsaw noise. Experimental noise was greater than 65 dB generated by chainsaws.
  - MAMU chicks and adults in nests exposed to significantly louder experimental noise than before or after trial.
  - Adult MAMU spent less time at rest during disturbance than before and after.
  - Adult MAMU spent more time with head raised during disturbance than before and after.
  - MAMU chicks spent similar times at rest before, during, and after chainsaw noise trials.
  - Controlled for temporal variations, hatching success at control nests (69 percent) was not significantly different than hatching success at experimental nests (exposed to chainsaw noise; 67 percent).
  - Fledging success at control nests was 25 to 50 percent; fledging success at experimental nest did not show a statistically significantly difference.
  - Overall, MAMU avoided nesting close to high volume roads (U.S. Highway 101).

- Concluded that in some instances vehicular traffic noise may have little or no effect on MAMU nesting success.

Available research suggests that MAMUs may be more sensitive to visual disturbances than to auditory disturbance conditioned by predators in the vicinity that may cause aborted or delayed feedings (Phifer 2003; Hamer and Nelson 1998; Bednarz and Hayden 1994). Studies from other bird species suggest that disturbance can affect productivity by causing nest abandonment, egg and hatchling mortality due to exposure and predation, longer periods of incubation, premature fledging or nest evacuation, depressed feeding rates of adults and offspring, reduced body mass or slower growth of nestlings, and avoidance of otherwise suitable habitat (Henson and Grant 1991; Rodgers and Smith 1995 as cited in BLM and Forest Service 2008).

Auditory and Visual Disturbance – FWS Guidance

Based on analysis of published literature and anecdotal accounts of harassment of MAMUs, the FWS (2003a, 2006a, 2014c) established distances within which sound levels and visual disturbance for various activities may result in injury or harassment of MAMUs by disrupting the normal behavior pattern of individuals or breeding pairs. FWS determined that visual disturbances within 100 yards of MAMU nest sites could lead to increased predation of nests by corvids when humans are present during project-related activities and would constitute a disruption of the nest site (Phifer 2003).

FWS identified distances within which activities may "disrupt" nesting MAMUs (noise and/or visual disturbance). Disruption distances identify a distance from activities that FWS have determined would likely cause a MAMU to be distracted to such an extent as to substantially disrupt normal behavior and increase the likelihood of breeding season failure. Activities that occur beyond the disruption distances may "disturb" MAMU but the effects should be minimal and not result in harm or "disrupt" reproductive activities. Activities may disturb MAMU if the activities occur within 0.25 mile of MAMU; disturbance distances have often been applied as seasonal buffers to minimize impacts of projects to nesting MAMUs. FWS determined that activities occurring beyond these disturbance distances would not likely cause MAMUs to be distracted from their normal activity. This direction is consistent with guidance provided in the FWS Conservation Framework prepared for this Project (FWS 2014c).

Table 3.3.3-7 provides the threshold distances beyond which noise and visual disturbances are unlikely to result in disruption or disturbance to nesting MAMUs during the breeding season (April 1 through September 15), which are generally based on distances to which noise levels and/or human presence are expected to disrupt or disturb nesting MAMU. In addition to the temporal and spatial restrictions presented in table 3.3.3-7, FWS also recommends limiting Project-related disturbance to two hours after sunrise until two hours before sunset near occupied and presumed occupied stands. Adhering to this daily timing restriction (DTR) minimizes the potential to disrupt adult MAMUs delivering meals to chicks at dawn and dusk. Application of DTRs during the breeding season should minimize effects from project activities, and would result in no disturbance or disruption for most activities if applied in the late breeding period, as identified in table 3.3.3-7.

TABLE 3.3.3-7

Threshold Distances Beyond which Noise and Visual Disturbances are Unlikely to Result in Disruption or Disturbance to Nesting Marbled Murrelets during the Breeding Season a/

	Disruption Threshold Distances From Occupied or Presumed Occupied Stands			Disturbance Threshold Distance From Occupied or Presumed Occupied Stands		
Activity	**MAMU Critical Breeding Season b/**	**MAMU Late Breeding Season — No DTRs b/, c/**	**MAMU Late Breeding Season — With DTRs b/, c/**	**MAMU Critical Breeding Season b/**	**MAMU Late Breeding Season — No DTRs b/, c/**	**MAMU Late Breeding Season — With DTRs b/, c/**
Use of Existing Low Use Roads d/	35 yards (105 feet)	No Disruption Anticipated	No Disruption Anticipated	0.25 mile	0.25 mile	No Disturbance Anticipated
Use of Existing High Use Roads e/	No Disruption Anticipated	No Disruption Anticipated	No Disruption Anticipated	0.25 mile	0.25 mile	No Disturbance Anticipated
Chainsaws	100 yards (300 feet)	100 yards (300 feet)	No Disruption Anticipated	0.25 mile	0.25 mile	No Disturbance Anticipated
Heavy equipment f/	120 yards (360 feet)	120 yards (360 feet)	No Disruption Anticipated	0.25 mile	0.25 mile	No Disturbance Anticipated
Rock Ditching Equipment g/	120 yards (360 feet)	120 yards (360 feet)	No Disruption Anticipated	0.25 mile	0.25 mile	No Disturbance Anticipated
Blasting — more than 2 lbs with mitigation measures	120 yards (360 feet)	120 yards (360 feet)	120 yards (360 feet)	0.25 mile	0.25 mile	0.25 mile
Small Helicopter/Airplanes	120 yards (360 feet)	120 yards (360 feet)	No Disruption Anticipated	0.25 mile	0.25 mile	No Disturbance Anticipated
Large/ Transport Helicopters with mitigation measures h/	240 yards (720 feet)	240 yards (720 feet)	240 yards (720 feet)	0.25 mile	0.25 mile	0.25 mile

a/ Sources: FWS 2003a; Michael Minor & Associates 2008 (appendix P); FWS 2014c; Phifer 2003.
b/ MAMU breeding period is from April 1-September 15; critical breeding period is considered from April 1-August 5; late breeding season is considered from August 6 – September 15.
c/ DTRs (Daily Timing Restrictions) – restricting activity to between 2 hours after sunrise until 2 hours before sunset.
d/ Existing Low Use Roads include federal roads designated as local/resource and private roads that appear to receive light traffic and periodic maintenance.
e/ Existing High Use Roads include federal roads that are designated as arterial and collector roads. Includes some federal roads local/resources roads that are paved or receive regular traffic/maintenance and are the primary access routes within checkerboard (federal/private) ownership. Also includes other private residential roads driveways or other roads that provide access to multiple rural residences.
f/ Heavy equipment includes: back trackhoes, side-booms, bulldozers, semi-trucks, pneumatic hammers.
g/ Rock Ditching Equipment includes: auger drill rig, mounted impact hammer, rock drill, and blasting (mitigated or less than 2 lbs).
h/ Transport helicopters proposed for use during construction of the Pipeline include: Boeing Chinook (CH-47) and Boeing Vertol 107-II (CH-46)

FWS (2003a and 2006a) reviewed available scientific literature on behavioral and physiological responses of different bird species to various noise sources. They determined that birds would likely detect noises that were 4 decibels or more above ambient noise levels. FWS (2006a) defined an "injury threshold" of 92 dBA, and a "tolerance threshold" of 82 dB for MAMUs and NSOs. The tolerance threshold assumes that respective nest sites become "intolerable" to the species and harassment occurs due to the total sound level the species must endure. FWS (2006a) did recognize that a tolerance threshold of 92 dB for aircraft (e.g., helicopters) would be applicable due to the usually slow onset of aircraft noise approaching, but otherwise FWS (2006a) applied the threshold of 82 dB as a sound-related injury threshold level. Based on Delaney et al. (1999) and Brown (1990), FWS (2006a) subtracted the noise level that elicited a harassment-indicating behavior (flight or flushing) from the minimum ambient noise at the respective sites and deduced that action-generated noise levels that are 25 dB above ambient levels constitute the sound level threshold above which harassment is likely to occur. From that exercise, FWS (2006a) deduced that a noise level of 70 dB would be a disturbance threshold and noise greater than 70 dB would be disruptive.

FWS (2003a) did not analyze injury threshold distances for noise associated with blasting or large helicopters. Rather, a conservative assumption was used for blasting with charges of 2 pounds or less; for larger blasts (greater than 2 pounds) a conventional one-mile distance was considered due to the lack of dB information. During informal consultation with FWS (Smith et al. 2007; Wille et al. 2006), restricting the use of large helicopters to remove large timber and transport pipe to the construction right-of-way to a one-mile disturbance threshold distance was considered as well. However, FWS also suggested that if additional studies could demonstrate that use of larger blasts (greater than 2 pounds) and large helicopters attenuated to less than 92 dB, and preferably 70 dB (disturbance threshold versus 92 dB disruption threshold) within a mile, the report and additional data demonstrating this would be considered to reduce the disturbance threshold distances for those activities (Smith et al. 2007; Wille et al. 2006).

Blasting and Helicopter Noise Levels

Pacific Connector prepared a noise report (see appendix P) that analyzes the distances at which conventional blasting required for trenching within rock substrate for construction and transport helicopters attenuates to 92 dB, the threshold for injury to individual MAMUs and is the sound level above which MAMU are likely to respond with behavior that indicate harassment (FWS 2006a). Under the worst case conditions, with common and appropriate mitigation measures applied to trench blasting operations (greater than 2 pounds of explosives), it is expected that blasting noise would attenuate to 92 dB within 200 feet of the source and to 70 dB within 1,025 feet of the blast source in soft rock. Large transport helicopters would attenuate to 92 dB within 700 feet. The greater distance for helicopter use is due to the directional aspects of blade slap noise that is directed toward the ground.

Mitigation for helicopter noise includes operational restrictions such as maintaining a high altitude and keeping away from noise sensitive areas whenever possible. Analyses for MAMUs in this BA consider the distances for larger blasts and large helicopters to be more conservative than what the noise report suggests. A disruption threshold distance for blasting greater than 92 dB has been used but with mitigation measures discussed in appendix P applied to be the same disruption distance expected for smaller blasts (less than 92 dB) – 120 yards or 360 feet – more conservative than the noise report describes, and the disturbance threshold distance associated with large blasts to be expected within 0.25 mile of blasting activity (see table 3.3.3-7). It is expected that these distances be considered throughout the entire breeding season (April 1 – September 15), regardless of the application of DTRs, because of the sudden onset of noise associated with blasting activities. A disruption threshold distance for large/transport helicopter use has been used with proposed mitigation techniques discussed in appendix P to be slightly farther than the report suggests, considering a disruption distance of 240 yards or 720 feet and a disturbance threshold distance of 0.25 mile (see table 3.3.3-7).

FWS (2003a) does not anticipate effects from smaller aircraft after the critical breeding period with DTRs applied, and provided some evidence suggesting that noise that builds in intensity (e.g., a helicopter approaching from a distance) may result in less risks. However, for analysis within this assessment, it is anticipated that similar to large blasts (greater than 2 pounds), use of large/transport helicopters may disrupt or disturb MAMUs throughout the entire breeding season (April 1–September 15), regardless of the application of DTRs. The FWS indicated that if noise level above 92 dB is recorded at 0.25 mile of the blasting activities, that blasting operations should cease until more effective mitigation measures can be employed (FWS 2008f).

Noise Evaluation Procedure

In the Revised Conservation Framework, FWS (2014c) provides the threshold distances beyond which noise and visual disturbances are unlikely to result in disruption or disturbance to nesting MAMUs during the breeding season (April 1 through September 15), which are generally based on distances to which noise levels and/or human presence are expected to disrupt or disturb nesting MAMU (see table 3.3.3-7). Pacific Connector is aware of the temporal and spatial restrictions recommended by FWS (see table 3.3.3-7) and has indicated they would adhere to them where feasible. Due to construction constraints within the range of the MAMU and safety of construction crew, Pacific Connector has indicated they cannot adhere to all recommended restrictions.

No suitable nesting MAMU habitat is within 0.25 mile of proposed construction of the LNG terminal and no disruption or disturbance to nesting MAMU is expected, including construction at the Kentuck Project site.

Disruption and Disturbance – Timber Clearing, Pipeline Construction, Existing Road Use

To avoid direct effects to MAMUs, chicks, or eggs within MAMU stands and adjacent habitat, Pacific Connector would clear timber within MAMU Stands and a 300-foot buffer of MAMU stands outside of the entire breeding season (between September 16 and March 31): this includes at least 15.0 miles of forested habitat within 300 feet of 59 occupied and presumed occupied MAMU stands (tables 3.3.3-6 and 3.3.3-8). Timber removal is expected to begin the fourth quarter prior to construction, and if timber removal within 300 feet of MAMU stands is not completed prior to the MAMU breeding season (April 1), timber removal would continue the following fall outside of the breeding season (between September 16 and March 31). Noise, visual disturbance, and in some instances large helicopter use associated with timber removal within 300 feet of MAMU stands outside of the breeding season would be consistent with the temporal restrictions recommended by FWS to protect nesting MAMUs (see table 3.3.3-7) and would not be expected to disturb or disrupt MAMUs. However, to safely construct the Pipeline within two years, Pacific Connector indicated they could not commit to removing timber within the entire 0.25-mile spatial buffer recommended by FWS outside of the breeding season; therefore, some disturbance would be expected from timber removal outside of the 300-foot buffer. An additional 15.1 miles of timber clearing (greater than 300 feet but within 0.25 mile of MAMU stand) could occur during the MAMU breeding period within 0.25 mile of 25 occupied and 57 presumed occupied MAMU stands (see tables 3.3.3-8 and 3.3.3-9). As a result, acoustic and visual disturbances from timber removal could affect MAMU nesting and rearing activities.

TABLE 3.3.3-8

Total Miles Crossed by the Pipeline within the MAMU Stand, and the 300-foot and 0.25-mile Buffer of MAMU Stands

Location of Project Activity	Marbled Murrelet Habitat (miles crossed) Suitable	Recruitment	Capable	Not Capable	Total Miles Crossed
Total MAMU Inland Zone 1					
MAMU Stand a/	4.9		0.1	<0.1	5.1
300-foot Buffer a/, b/		3.4	4.8	2.4	10.7
0.25-mile Buffer c/		3.7	10.1	3.4	17.1
MAMU Inland Zone 1 Total	**4.9**	**7.2**	**15.0**	**5.9**	**32.9**
MAMU Inland Zone 2					
MAMU Stand a/	0.9				0.9
300-foot Buffer a/, b/		0.3	0.5	<0.1	0.8
0.25-mile Buffer c/		0.8	0.1	1.1	1.9
MAMU Inland Zone 2 Total	**0.9**	**1.1**	**0.5**	**1.1**	**3.5**
Overall MAMU Range					
MAMU Stand a/	5.8		0.1	<0.1	6.0
300-foot Buffer a/, b/		3.7	5.3	2.4	11.4
0.25-mile Buffer c/		4.6	10.2	4.5	19.0
Overall Total MAMU Range	**5.8**	**8.3**	**15.5**	**6.9**	**36.4**

a/ Timber would be harvested outside of the entire breeding season (between September 16 and March 31); this includes habitat associated with 59 MAMU stands (see table 3.3.3-6).
b/ Miles provided for 300-foot buffer exclude the MAMU stand.
c/ Miles provided for 0.25-mile buffer exclude the MAMU stand and the 300-foot buffer.

TABLE 3.3.3-9

Number of Occupied or Presumed Occupied Stands within the Marbled Murrelet Zones with Expected Disturbances from Noise and/or Visuals Associated with Activities Proposed within 0.25 Miles of Stands a/

Status of Marbled Murrelet Stand	General Landowner b/	Total Number of Stands	Construction Activities and Road Use c/		Construction Activities Only d/		Road Use Only e/		
			Disruption	Disturbance	Disruption	Disturbance	Disruption	Disturbance	None f/
Marbled Murrelet Zone 1									
Occupied Stand	BLM	48	20	2	0	0	6	20	0
	Other	0	0	0	0	0	0	0	0
	Total	*48*	*20*	*2*	*0*	*0*	*6*	*20*	*0*
Presumed Occupied	BLM	79	19	7	1	0	2	48	2
	Other	38	22	4	2	0	2	8	0
	Total	*117*	**41**	**11**	**3**	*0*	**4**	**56**	*2*
Total MAMU Zone 1	**BLM**	**127**	39	9	1	**0**	8	68	**2**
	Other	**38**	22	4	2	**0**	2	8	**0**
	Total	**165**	**61**	**13**	**3**	**0**	**10**	**76**	**2**
Marbled Murrelet Zone 2									
Occupied Stand	BLM g/	3	2	0	0	1	0	0	0
	Other	0	0	0	0	0	0	0	0
	Total	*3*	*2*	*0*	*0*	*1*	*0*	*0*	*0*
Presumed Occupied	BLM	7	0	1	0	1	2	3	0
	Other	0	0	0	0	0	0	0	0
	Total	*7*	*0*	*1*	*0*	*1*	*2*	*3*	*0*
Total Murrelet Zone 2	**BLM**	**10**	**2**	**1**	**0**	**2**	**2**	**3**	**0**
	Other	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	Total	**10**	**2**	**1**	**0**	**2**	**2**	**3**	**0**
Entire MAMU Range									
Occupied Stand	BLM	51	22	2	0	1	6	20	0
	Other	0	0	0	0	0	0	0	0
	Total	*51*	*22*	*2*	*0*	*1*	*6*	*20*	*0*
Presumed Occupied	BLM	86	19	8	1	1	4	51	2
	Other	38	22	4	2	0	2	8	0
	Total	*124*	**41**	**12**	**3**	*1*	**6**	**59**	*2*
Total MAMU Range	**BLM**	**137**	41	10	1	2	10	71	2
	Other	**38**	22	4	2	**0**	2	8	**0**
	Total	**175**	**63**	**14**	**3**	**2**	**12**	**79**	**2**

a/ Summarized from table Q-2 in appendix Q.; see appendix Z1 for D/D Impact Categories for each MAMU stand applying guidance provided by FWS (2014c) in the Revised Conservation Framework.

b/ BLM includes Coos Bay and Roseburg Districts; three presumed occupied stands with mixed landowner (BLM and private) in MAMU Inland Zone 1 have been included in this category. Other includes private and Bureau of Indian Affairs (BIA); one presumed occupied stand with mixed landowner (private and BIA) in MAMU Inland Zone 1 have been included in this category.

c/ Construction Activities (see d/) and Road use (see e/): both proposed activities occur within 0.25 miles of MAMU Stands

d/ Construction Activities Only: includes general construction activities, blasting (> 2lbs explosives), and large transport helicopter use; no proposed road use within 0.25 miles of MAMU Stands

e/ Road use only: does not include paved roads that are used regularly by the public (i.e., County Roads, State Highways). MAMU stands are included if the stand is within 0.25 miles of a proposed access road; no construction activities proposed within 0.25 miles of MAMU Stand

f/ None: construction and proposed road use > 0.25 mile of MAMU Stands but within 0.5 mile of critical habitat removal (see appendix Z-1).

g/ One occupied MAMU stand occurs in both Marbled Murrelet Inland Zones 1 and 2 but has been included in tabulations for Inland Zone 2.

After timber has been cleared, approximately 37.5 miles of construction activities along the Pipeline route could occur during the MAMU breeding period within 0.25 mile of 25 occupied and 57 presumed occupied MAMU stands (see tables 3.3.3-8 and 3.3.3-9), including mitigated blasting along the trenchline and across waterbodies, and use of large transport helicopters for pipe delivery (see table Q2 in appendix Q). As a result, acoustic and visual disturbances from construction of the Pipeline Project could affect MAMU nesting and rearing activities.

Pacific Connector has proposed to apply DTRs recommended by FWS for timber removal and construction activities that occur within 0.25 mile of a MAMU stand through the critical breeding period (April 1 through August 5), which would reduce direct effects from noise and visual disturbance. Pacific Connector has indicated that DTRs would also be applied to large transport helicopters in the late breeding period (August 6 through September 15), if use of helicopters is necessary during that time period. Although timber removal and construction activities would likely occur within one breeding season in the proximity of each MAMU stand, Pacific Connector conservatively assumes that each MAMU stand could experience effects from activities for 2 years.

Informal consultations with FWS (June 5, 2008 meeting; see NSO and MAMU Avoidance Plan, appendix V1) identified disturbance from travel on existing roads to be less of an impact than other actions associated with the construction, especially if farther than 35 yards (105 feet). In the Revised Conservation Framework, FWS (2014c) identified that use of existing low use roads within 35 yards (105 feet) of an active MAMU nest has the potential to disrupt normal behavior patterns and lead to harassment, whereas use of existing high use roads would not be expected to disrupt normal behavior at an active MAMU nest. However, utilization of high or low traffic use access roads would be expected to disturb MAMU up to 0.25 miles of the road (see table 3.3.3-7). For the purposes of this analysis, existing low use roads include federal roads designated as local/resource and private roads that appear to receive light traffic and periodic maintenance. Existing high use roads include federal roads that are designated as arterial and collector roads as well as some local/resources roads that are paved or receive regular traffic/maintenance and are the primary access routes within checkerboard (federal/private) ownership. Existing high use roads also include other private residential roads driveways or other roads that provide access to multiple rural residences.

Expected Disturbance Effects

Impact assessments were prepared following guidance from FWS's Revised Conservation Framework (FWS 2014c) for each MAMU stand analyzed within this BA (appendix Z1) that identify existing access roads within 0.25 mile of occupied or presumed occupied stands, including distance from roads, expected improvements within the stand or 0.25-mile buffer, and surface of existing roads, including maps of the particular stand. The impact assessments in appendix Z1 also identify the distance between a MAMU stand and proposed construction activities, including large helicopter use and blasting (>2 pounds explosives). Many of the MAMU stands occur in areas with higher existing disturbance (i.e., residential, commercial, and agricultural areas) and although noise associated with construction would be detectable, but often times not disruptive, Pacific Connector has conservatively applied direction provided by FWS to determine possible effects to MAMU if nesting in the stand (see table 3.3.3-7).

Table Q-2 in appendix Q provides distances from actions and timing of those actions that are expected to occur within the occupied or presumed occupied stands during Pipeline Project activities (timber clearing, construction activities, road use) and through the life of the Pipeline (i.e., maintenance and operation activities). Because nest locations within MAMU stands are not known, analyses in this BA have assumed that MAMUs are nesting along the closest edge to disturbance or existing road from the MAMU stand which is unlikely but, absent specific nest locations, is the most conservative approach. Additionally, table Q-2 in appendix Q provides the expected effect from noise and visual presence of construction activities (disruption, disturbance, no disturbance, or no effect) and rationale for each occupied or presumed occupied stand based on timing and distance from the activities for each proposed activity (based on disturbance distances from table 3.3.3-7).

Maps 1 through 10 in appendix Q show the locations of occupied and presumed occupied stands in relation to different Project components and identify spatial buffers (360 feet and 0.25-mile buffers) associated with a MAMU stand. The rationale for location of the proposed Pipeline within each known occupied stand and presumed occupied stand is provided in Pacific Connector's *Marbled Murrelet and Northern Spotted Owl Avoidance and Minimization Plan* (see appendix V.1).

Table 3.3.3-9 provides a summary of occupied and presumed occupied stands within the terrestrial nesting analysis area that may be affected by the Pipeline and is based on the timing of activities (summarized from table Q-2 in appendix Q). Forested stands that may provide suitable habitat for MAMU that have not had two-year protocol surveys conducted to date to determine presence of nesting structures have been presumed occupied for this analysis, resulting in a conservative estimate of potential effects. However, as noted above, presumed occupied stands also include stands for which only one year of surveys has been conducted, even where those surveys documented occupied behavior. If stands are surveyed and no suitable nesting structures are present, then no disturbance effect would be expected.

Additionally, activities would not occur simultaneously along the Pipeline route, and as a result some activities near MAMU stands may occur outside of the breeding period and/or within the latter part of the breeding season within the DTR timing window. Also, disturbance or disruption associated with construction activities would likely only occur in one year; however, Pacific Connector cannot guarantee that activities would only occur in one year (they have indicated there may be unforeseeable circumstances that result in two years of activities). Therefore, it is possible that disruption and disturbance activities could occur in both Years 1 and 2.

MAMU stands identified in the timber and removal/construction column could also experience effects during reclamation; however, reclamation activities within 0.25 miles of MAMU stands would occur outside of the MAMU breeding season (September 15 through March 31). Effects by reclamation to nesting MAMUs would not be expected.

The FWS (2014c) provided a method in the Revised Conservation Framework to categorize direct effects to MAMU stands within a disruption and/or disturbance distance (0.25 mile) of project activities, including use of access roads, into the following Disruption-Disturbance (D/D) Impact Categories: High Impact, Moderate Impact, Low Impact, Low Impact – no mitigation, and No Impact. The assessment considers the timing, types, and location of project-related activities in relation to MAMU stands that could result in disturbance or disruption of nesting MAMU to assist in determining a D/D Impact Category for each activity for each MAMU stand. In many instances a MAMU stand is provided more than one D/D Impact Category because of different project effects and different locations of effects on the MAMU stand (i.e., construction effects and proposed use of existing access roads).

The Revised Conservation Framework (FWS 2014c) guided individual assessments included in appendix Z1 for each MAMU stand (occupied and presumed occupied) to determine the amount of acres by D/D Impact Type; the resulting D/D Impact Category(ies) is also included for each stand in table Q2 in appendix Q. In May 2018, FWS reviewed the D/D impact categories provided for each MAMU stand and agreed with the categories provided by Pacific Connector. Table MAMU-1 in the introduction to appendix Z1 summarizes the acres of MAMU stands (occupied and presumed occupied) within 0.25 mile of proposed activities that would be categorized as Moderate Impact, Low Impact, and No Impact. No MAMU stand was assigned a “High” category, because Pacific Connector would adhere to DTRs during the critical breeding period for construction and timber removal activities that occur within 0.25 mile of MAMU stands.

Temporary Loss of Habitat – Noise and Human Presence

There is a potential for MAMU that may be present within 0.25 mile of Pipeline activities to be disturbed or disrupted from normal activities due to associated noise or human presence from Pipeline Project activities, which could cause MAMU to temporarily avoid or flush from suitable nesting habitat (i.e., temporary habitat loss). Approximately 7,145 acres of suitable nesting habitat (occupied and presumed occupied MAMU stands) within the terrestrial nesting analysis area could occur within 0.25 miles of the Project which could result in temporary loss of habitat due to noise and visual disturbance where construction activities, including existing road use (non-public) occur within 0.25 miles of suitable habitat within MAMU stands during the breeding season (April 1 through September 15; table 3.3.3-10).

Construction activities within the range of the MAMU could occur during the breeding season for up to two years, with DTRs applied for timber removal and construction during the critical breeding season (April 1 through August 5) to minimize direct effects to MAMU. Pacific Connector would continue to apply DTRs in the late breeding season for use of large transport helicopter, if use of large transport helicopters is still necessary, to further minimize disturbance and disruption effects. Proposed activities would not occur simultaneously within MAMU Inland Zones 1 and 2, and therefore, actual temporary, indirect habitat loss would be less than estimated within table 3.3.3-10, and potential direct effects to MAMU utilizing habitat would be short in duration.

TABLE 3.3.3-10

Amount (acres) of Suitable Nesting Habitat (a/) within 0.25 mile of Proposed Disturbance from Timber Removal and Construction, and Access Roads (b/) that could Directly Impact MAMU during the Entire Breeding Season (April 1 through September 15)

	Length of Pipeline / EARs within 0.25 mile of MAMU Stands		Suitable Nesting Habitat (MAMU Stands) within 0.25 mile of Proposed Project Activities			
Landowner	**Pipeline (miles)**	**Access Roads (miles)**	**Construction/ Timber Removal and Access Roads**	**Construction/ Timber Removal Only**	**Access Roads Only**	**Overall Total**
Marbled Murrelet Inland Zone 1						
Federal	14.8	61.9	1895.31	332.02	4,299.40	6,526.73
Non-Federal	18.1	54.3	166.28	21.43	39.83	227.54
Total Zone 1	**32.9**	116.2	**2,061.59**	**353.45**	**4,339.22**	**6,754.27**
Marbled Murrelet Inland Zone 2						
Federal	0.9	1.9	133.63	213.76	42. 50	389.89
Non-Federal	2.7	4.5	0. 50	0. 11	0.01	0. 63
Total Zone 2	**3.5**	6.4	**134.13**	**213. 87**	**42.52**	**390.52**
Overall Marbled Murrelet Range						
Federal	15.7	63.8	2, 028.94	545.78	4,341.90	6,916.62
Non-Federal	20.7	58.9	166.78	21. 55	39.84	228.17
Overall Total	**36.4**	**122.6**	**2,195.73**	**567.32**	**4,381.74**	**7,144.79**

a/ Acres of suitable habitat (MAMU Stands – occupied and presumed occupied, including non-capable and early regenerating habitat within BLM-delineated occupied stands) includes only the area of MAMU stands considered for analysis within this BA within 0.25 miles of proposed activities.

b/ Access Roads do not include roads currently identified as public access roads; only nonpublic access roads within 0.25 mile of MAMU stands (occupied and presumed occupied) that have been identified for use by the Pipeline Project.

Table 3.3.3-10 identifies that approximately 7,145 acres of potentially suitable MAMU nesting habitat (occupied and presumed occupied stands) could become effectively unavailable on a temporary basis due to noise and/or human presence during Pipeline construction. This overestimates potential Pipeline Project effects, because conservative assumptions are used, as explained above. Additionally, BLM-delineated occupied stands include habitat not suitable for nesting (non-capable habitat and early seral forested habitat). If considering the occupancy index (see McShane et al. 2004), approximately 3,643.84 acres (51 percent of available suitable habitat in terrestrial nesting analysis area; 7,144.79 acres in table 3.3.3-10) is likely occupied and could be indirectly impacted.

Helicopter Rotor Wash

Strong winds can also cause direct mortality by blowing chicks out of nests (FWS 1992a). Helicopter drive rotors produce high velocity vortices (winds) that extend from the center of the helicopter outward in all directions. Vertical downwash of air (rotor wash) close enough to the ground produces surface winds that dissipate with distance away from the helicopter (sidewash). Induced winds caused by helicopter rotor wash may exceed hurricane force velocities that would be expected to adversely affect nesting MAMUs on a local level. Since induced rotor downwash and surface sidewash are functions of helicopter size, rotor surface area, helicopter weight, flight speed, and height above ground (Teske et al. 1997; Gordon et al. 2005), effects to nesting birds can be minimized or avoided by routing helicopter flight paths and staging locations far enough away from nests so that induced winds would not adversely affect nests or nestlings.

Maximum induced surface velocities produced by downwash and sidewash from various helicopters were measured in the field to determine the decay function of rotor-produced vortices near ground level (Teske et al. 1997). Field studies included measurements on three helicopter models that might be utilized during construction of the Pipeline: 1) the twin-rotor CH-47 (civilian variant is the Boeing HH-47 Chinook) with rotor diameter 59.1 feet, 2) the single rotor CH-54 with a rotor diameter of 72 feet (civilian variant is the Sikorsky S-64 Skycrane), and 3) the twin-rotor CH-46 (civilian variant Boeing Vertol 107) with a rotor diameter of 49.9 feet (Teske et al. 1997). Using parameters derived from the field trials, estimates of maximum induced surface velocities were made for each of the three helicopter models at varying heights above ground while flying at different ground speeds. In general, maximum induced surface velocities increase with rotor diameters, decrease with distance above ground, and decrease with faster ground speeds.

Results of modeling maximum induced surface velocities (model described in Teske et al. 1997) produced by a Chinook helicopter are shown in figure 3.3.3-4 for drop heights (heights above ground level at which the helicopter would discharge a payload of foam, water, or retardant during wild fire control) ranging from 10 to 320 feet while flying at ground speeds ranging from 5 to 25 mph. Included in figure 3.3.3-4 are four wind speed categories on the Beaufort Scale (NOAA 2015b) which was developed to describe damage associated with wind forces ranging from calm to hurricane forces. On the Beaufort Scale, induced surface winds of 9 to 11 mph produced by rotor wash would be equivalent to a "gentle breeze" during which leaves and small twigs would be constantly moving and light flags would be extended. Wind velocities of 19 to 24 mph are classified as a "fresh breeze" (small trees in leaf would sway). Winds 39 to 46 mph are "gale" force strength: difficult to walk against, twigs and small branches blown off trees. Winds greater than 74 mph are classified as a hurricane.

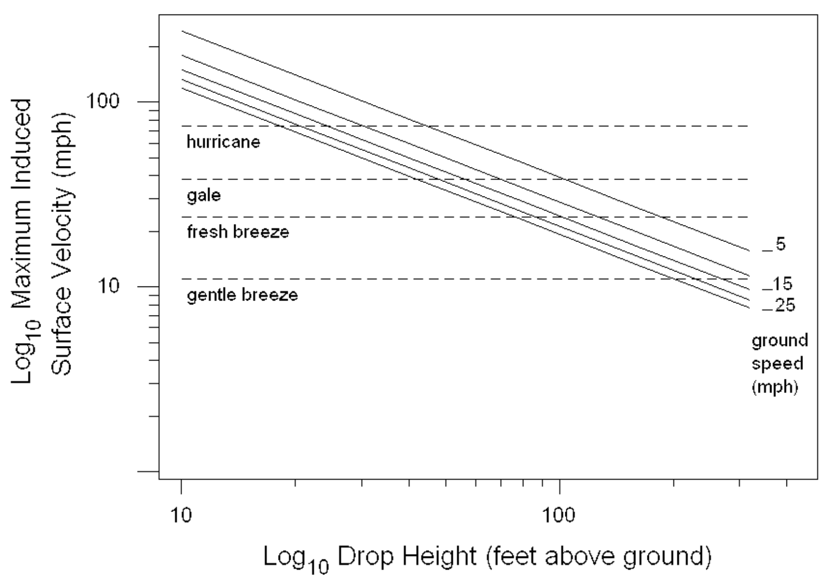


Figure 3.3.3-4 Modeled Maximum Surface Velocities Induced by Chinook C-47 Helicopters while Flying at Ground Speeds From 5 to 25 mph at Heights From 10 to 320 feet Above Ground (Modeled from data in Teske et al. 1997) .

Figure 3.3.3-4 shows the heights above ground that Chinook helicopters would produce maximum induced surface winds with velocities equivalent to a "fresh breeze" while traveling at ground speeds of 5, 10, 15, 20 or 25 mph. For example, if traveling at a ground speed of 5 mph, the Chinook would have to be approximately 185 feet above ground to produce a maximum induced surface velocity of 24 mph, equivalent to a "fresh breeze." If traveling at ground speed of 25 mph, the Chinook could be 75 feet above ground and still induce a maximum surface velocity of 24 mph.

In the Pipeline Project area, wind speeds reported by the Western Regional Climate Center (2015) at the North Bend airport averaged 10.2 mph in June, 11.2 mph in July and 9.9 mph in August, the three months with highest average wind velocities during the period from 1996 to 2006. During the same period, winds in Roseburg averaged 5.0 mph in June, 5.2 mph in July, and 4.4 mph in August. These data indicate that winds as strong as a fresh breeze (19 to 24 mph) would be expected along the Oregon Coast and most likely inland during the period when MAMUs are nesting. It is assumed that induced winds the strength of a fresh breeze would not adversely affect young or nests.

Incoming or outgoing Chinook helicopters flying at 5 mph while 185 feet above a tree with a nest would most likely produce winds with velocities less than a fresh breeze at the tree top because there would be no resistance by the ground to induce maximum sidewash vortices.

Similar results were produced by the Boeing Vertol 107 (see figure 3.3.3-5) even though it is smaller than the Chinook (rotor diameter 49.9 feet compared to 59.1 feet). The Vertol 107, flying at a ground speed of 5 mph, would have to be approximately 200 feet above ground to produce a maximum induced surface velocity of 24 mph, equivalent to a fresh breeze. If traveling at ground speed of 25 mph, the Vertol 107 could be 82 feet above ground and still induce a maximum surface velocity of 24 mph. Overall, the Vertol 107 produces slightly greater maximum induced surface velocities than the Chinook CH-47 even though its maximum equipment weight is less than the Chinook.

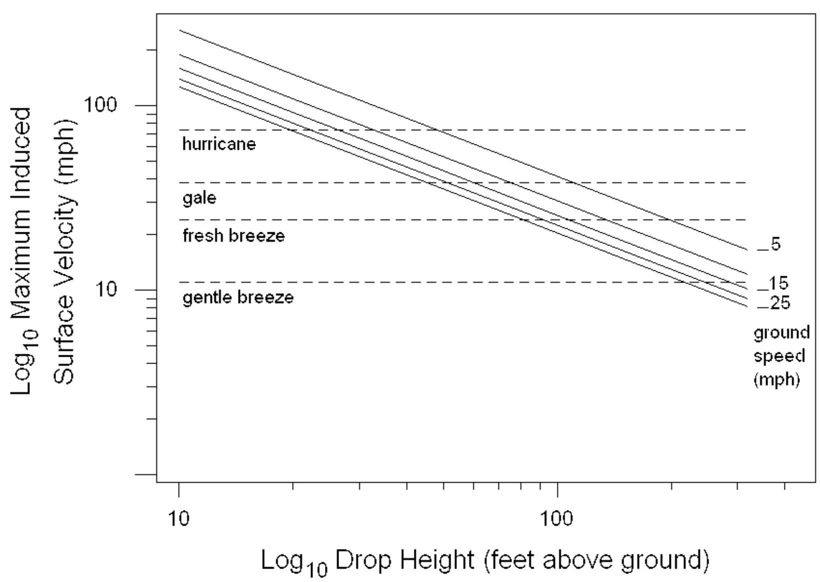


Figure 3.3.3-5 Modeled Maximum Surface Velocities Induced by Boeing Vertol 107 Helicopters while Flying at Ground Speeds From 5 to 25 mph at Heights From 10 to 320 feet Above Ground (Modeled from data in Teske et al. 1997).

The single rotor S-64 Skycrane has the largest rotor diameter (72 feet diameter) of the three models. As modeled in figure 3.3.3-6, the Skycrane would produce greater maximum induced surface velocities while flying at the same ground speeds and same drop heights as the other two helicopter models.

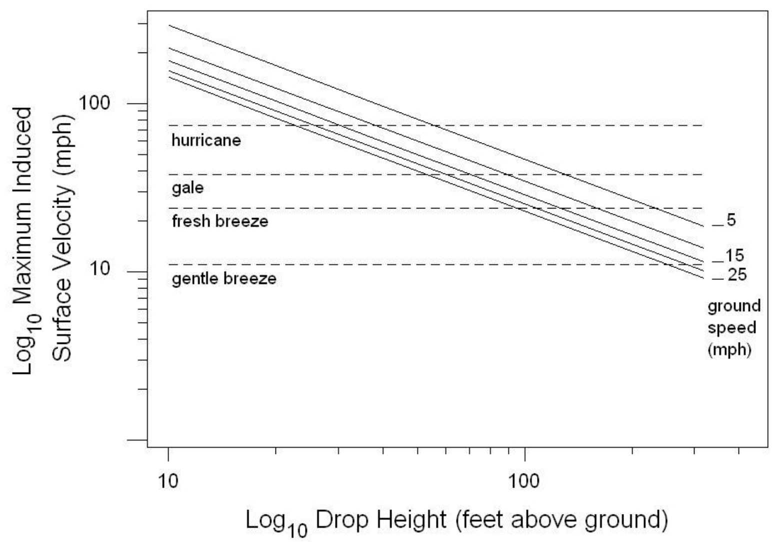


Figure 3.3.3-6 Modeled Maximum Surface Velocities Induced by Skycrane S-64 Helicopters while Flying at Ground Speeds From 5 to 25 mph at Heights From 10 to 320 feet Above Ground (Modeled from data in Teske et al. 1997) .

Flying at a ground speed of 5 mph, the Skycrane would have to be approximately 233 feet above ground to produce a maximum induced surface velocity of 24 mph, equivalent to a fresh breeze. The Chinook and Vertol 107 helicopters would induce similar maximum surface velocities flying at heights of 185 feet and 200 feet above ground, respectively. If traveling at ground speed of 25 mph, the Skycrane could be 95 feet above ground to induce a maximum surface velocity of 24 mph.

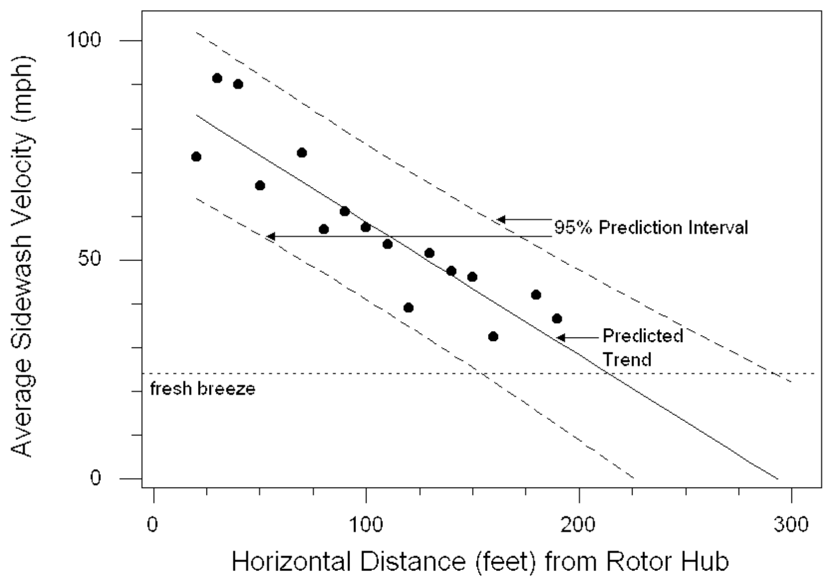
Actual downwash and sidewash vortices produced by Chinook CH-47 and Skycrane (CH-54) helicopters were measured during field tests (Leese and Knight 1974) while aircraft were hovering at 40-50 feet and 80-90 feet above ground level (agl) while under maximum loads of 36,000 pounds (CH-47) and 45,000 to 47,000 pounds (CH-54). The Vertol 107 (CH-46) was not included in the field tests.

With a 47,000-pound load, the single rotor CH-54 hovering at 40 feet agl produced a maximum sidewash velocity of 87 mph 50 feet away from the rotor hub; at 80 feet agl, the maximum sidewash was 74 mph, also measured at 50 feet from the hub though the gross weight was 45,000 pounds during that particular trial. Both maximum sidewash measurements were at heights of 0.3 feet above ground (Leese and Knight 1974). Under the specified load conditions, the CH-54 produced a sidewash of 11 mph 170 feet away from the rotor hub while hovering at 40 feet agl and a sidewash of 9 mph 150 feet away from the hub while hovering at 80 feet agl. Maximum sidewash velocities of 74 to 87 mph that were associated with the CH-54 helicopter while it was hovering, are within the range of hurricane force winds on the Beaufort Scale while winds of 9 to 11 mph produced by rotor sidewash would be described as a “gentle breeze.” Sidewash velocities between 9 and 11 mph at distances 150 to 170 feet away from a CH-54 helicopter (Skycrane) would be unlikely to blow young MAMUs from their nests.

Downwash and sidewash velocities measured for the CH-47 helicopter (Chinook) were greater than 100 mph up to 70 feet horizontally from the rotor hub when it was hovering at 90 feet agl with maximum load of 36,000 pounds (Leese and Knight 1974). The twin rotor CH-47 produced sidewash velocities as high as 56 mph 190 feet away from the rotor hub when it was hovering at

90 feet agl. The Beaufort Scale classifies winds between 55 and 63 mph as a "storm," with trees uprooted and structural damage likely. The greater strength of winds produced by the CH-47 is likely due to the interaction of descending air produced by the two rotors (Fabey 2008); sidewash winds are generally strongest at 120 and 240 degrees (4 o'clock and 8 o'clock, respectively) relative to the helicopter's heading (data in Leese and Knight 1974).

Sidewash wind velocities produced by the CH-47 at various distances away from the rotor hub (Leese and Knight 1974) were used to predict the distance at which the helicopter would be far enough to avoid adversely affecting MAMU nests and young. The prediction is based on the sidewash wind velocities produced by the CH-47, averaged for wind measurements made 0.3 feet above ground at angles of 120 and 240 degrees while the helicopter was hovering 90 feet agl under a load of 36,000 pounds. The prediction is shown below in figure 3.3.3-7 in which a sidewash velocity of 0 mph would occur 293 feet away from the rotor hub. Due to the observed variation in sidewash winds at different distances away from the rotor hub (solid circles in figure 3.3.3-7), the upper 95 percent prediction interval on that predictive estimate of 0 mph at 293 feet from the hub would be 23.8 mph. A wind velocity of 23.8 mph is classified as a fresh breeze on the Beaufort Scale. One can be 95 percent certain that a stronger wind, which would potentially adversely affect nesting MAMUs, would not occur.



Source: Leese and Knight 1974

Figure 3.3.3-7 Average Sidewash Wind Velocities Produced by the CH-47 at Varying Horizontal Distances from the Rotor Hub While Hovering 90 feet agl Under a Load of 36,000 pounds. The observed averages (solid circles) were used to predict sidewash winds at distances out to 300 feet.

These estimates clearly suggest that greater distances would be required to avoid adverse effects to MAMUs if Chinook helicopters, rather than Skycranes, are employed for heavy lifting along remote sections of the construction right-of-way. Based on the similarities of maximum induced surface velocities between Chinook and Vertol 107 helicopters, sidewash velocities induced while hovering are likely to be similar as well. However, if known nest trees or stands can be avoided by at least 200 feet above tree tops by heavy-lifting helicopters in transit, and avoided horizontally by at least 300 feet while helicopters hover above staging sites, no adverse effects to the species from rotor downwash and induced sidewash would be expected.

Eight MAMU stands occur within 0.25 mile of proposed helicopter use, of which six occupied stands are within 300 feet of proposed helicopter use (C3073, C3090, C3094, C3095, R3035 [EAR 46.51_A], and R3051 [B14]). Helicopter use for timber extraction within 300 feet of a MAMU stand would occur outside of the entire breeding season (between September 16 and March 31); no adverse effects from rotor wash of large helicopters are expected during timber extraction. Adverse effects to MAMUs in the six stands identified above could occur from rotor wash of large helicopters during pipe delivery during construction of the proposed action, because activity could occur during the entire breeding season and may be within 200 feet above nest trees and horizontally within 300 feet of nest trees; the nest site is unknown within these stands but potential nest trees have been identified adjacent to the construction right-of-way and rotor wash could affect MAMU if present.

Burning and Smoke

Whether by prescribed burning as a habitat enhancement procedure or by burning slash, effects of smoke on MAMUs have not been studied. However, FWS et al. (2007) have declared (see Table 15, FWS et al. 2007) "that smoke can cause [NSO] adults to move off nest sites, therefore leaving eggs or young exposed to predation or resulting in lost feedings reducing the young's fitness." In the absence of reliable information, one would reasonably assume that the same effects apply to MAMUs.

According to BLM and Forest Service (2008, page 35), MAMUs "are potentially affected by fire control activities and drifting smoke during burning. The threshold distance for disturbance from smoke is 0.25 mile for MAMUs," which also would be subject to smoke-related disturbance during the critical breeding period (April 1 through August 5). Pacific Connector would not conduct slash burning on any land during the critical breeding season within 0.25 mile of an occupied or presumed occupied MAMU stand. Therefore, no direct effect to MAMUs due to slash burning is expected.

Maintenance and Operation

No activities associated with general maintenance and operations of the Pipeline Project are expected to affect occupied MAMU stands. Vegetation maintenance activities would occur only between August 1 and April 15 of any year (see appendix C), generally outside of the critical breeding season. Pacific Connector would apply DTRs during activities within 0.25 mile of MAMU stands during the late breeding season (August 5 through September 15) to ensure no effects to MAMU (see table 3.3.3-7); therefore, no disturbance is expected. Routine clearing of vegetation within the 30-foot permanent right-of-way would not occur more frequently than every three years. A 10-foot-wide corridor centered over the pipeline would be maintained annually in an herbaceous state to facilitate periodic corrosion and leak surveys. Pacific Connector would also require pilots conducting annual aerial inspection (small plane/helicopter) of the pipeline to adhere to the spatial restrictions recommended in the vicinity of occupied stands (no overflight within 1,300 feet agl during the critical breeding season; April 1 through August 5), resulting in no adverse effect from aerial pipeline inspection. However, some routine activities such as right-of-way inspection may require pipeline personnel to visit the right-of-way at any time; these visits along the right-of-way would be by a vehicle or via walking and would adhere to DTRs.

Indirect Effects – Terrestrial Nesting Analysis Area

A primary indirect effect to MAMUs would be removal of suitable nesting habitat, and could also include removal of recruitment or capable habitat. Removal of MAMU habitat would be a long-term impact to MAMUs and would be expected to last at least 5 years or more. Short-term impact is expected with the use of UCSAs and is likely to last from the initiation of timber clearing until 1 to 5 years after restoration/revegetation. Other indirect or secondary effects by the Pipeline could include increased human presence as a result of the requirements of the action itself (the workforce needed to construct or operate the Pipeline), increased recreation (including ORV use, hunting), and habitat degradation, including a reduction of those habitats that are capable of achieving higher quality habitat status but for the Pipeline's impacts within LSR, Riparian Reserves, or within MAMU SHUs (Comer 1982). No effects to MAMU habitat is expected from construction of the LNG Project; the following section is specific to construction of the Pipeline.

Analysis of indirect effects to MAMU habitat by Pipeline construction and operation within the terrestrial nesting analysis area followed guidance provided by FWS included in the Revised Conservation Framework developed for the Project (see FWS 2014c).

Focus of Effects Analyses

Indirect effects from construction of the Pipeline analyzed within this BA are considered within three habitat areas defined by FWS as an SHU (FWS 2014c), which include habitat that could play an important role in maintaining and expanding MAMU populations: 1) the MAMU stand with known or presumed suitable nesting structures; 2) a 300-foot buffer around the MAMU stand that includes forested habitat to protect/provide a buffer to nesting MAMUs as described by the MAMU recovery plan (FWS 1997b); and 3) federally-designated critical habitat within a 0.5-mile buffer around a MAMU stand that is within 0.5 mile of critical habitat removal by the proposed action. The FWS (2008b, 2011b) recognize that forested habitat within 0.5 mile of an occupied stand is important to recruit additional nesting habitat for the MAMU in the future (e.g., coniferous forested stands greater than 60 years of age that are capable of becoming potential nesting habitat within 25 years; FWS 2014c; BLM 1995a, 1995b). Therefore, this latter defined area includes forested habitat proximal to the MAMU stand that could provide suitable nesting structures in the future for the MAMU and has been federally protected through critical habitat designation.

Within the terrestrial nesting analysis area where MAMU stands are in close proximity of each other (i.e., less than 300 feet or adjacent), SHUs overlap. Therefore, analyses provided in this BA consider the SHUs within the terrestrial nesting analysis area collectively to eliminate duplication of acres of impact. Impacts to individual MAMU SHUs are included in appendix Z.1. Figure 1 in appendix Z.1 shows the MAMU SHUs in relation to the proposed action and Marbled Murrelet Inland Zones 1 and 2.

Nesting Habitat Removal/Modification

Long-Term Effects to Habitat. Removal of suitable nesting habitat by harvest of old-growth timber has been cited as the primary reason for the species' decline (FWS 1992a). Implementation of the NWFP and management of LSRs, and the designation of critical habitat were designed to increase the amount of late successional forest habitat available for the long term, thus increasing potential nesting habitat for MAMUs. The BLM RMPs (BLM 2016a, 2016b) also identify the importance of forested habitat within 0.25 mile of occupied MAMU stands and state that removal of habitat within occupied stands should not occur and other forested habitat within a 0.25-mile radius of any occupied stand should be protected for recruitment of nesting habitat for MAMUs (i.e., stands that are capable of becoming MAMU habitat). Since 2003, effects to MAMU suitable habitat have been minimal (BLM and Forest Service 2006). Suitable MAMU nesting habitat takes a long time to develop (more than 250 years on average); therefore, any removal of suitable habitat or recruitment habitat may affect the recovery of the MAMU because recent trends indicate that MAMUs may be declining (see section 3.3.3.1).

Based on MAMU habitat delineated for the Pipeline, construction of the Pipeline would remove approximately 806.45 acres of MAMU habitat, including 78.04 acres of "suitable habitat" removed from 37 MAMU stands (19 occupied MAMU stands and 18 presumed occupied stands; see tables 3.3.3-6 and 3.3.3-11). Removal of 78.04 acres of suitable MAMU habitat amounts to approximately 0.5 percent of the 14,310 acres of suitable habitat available in the terrestrial nesting analysis area (see table 3.3.3-12) and accounts for 0.09 percent of potential nesting habitat in Conservation Zones 3 and 4 in Oregon (approximately 867,219 acres of higher suitable nesting habitat; Falxa and Raphael 2016). It is expected that recruitment habitat within SHUs, especially forested habitat greater than 60 years located on federally-managed lands, could provide potential nesting habitat for MAMUs in the future (BLM 1995a, 1995b; FWS 2008a, 2011b, 2014c). The removal of suitable habitat would indirectly affect MAMUs over the long term, exceeding the expected 40-year life of the Project.

Additionally, 157.13 acres of MAMU habitat (23.51 acres of suitable habitat) have been identified for use by the Pipeline Project as UCSAs that may be used to store forest slash, stumps, and dead and downed log materials that would be removed and scattered across the right-of-way after construction during restoration (see UCSA Column in table 3.3.3-11). Use of the UCSAs would be a short-term modification of understory species and would not affect the nesting habitat or characteristics.

Table 3.3.3-11 below summarizes the amount of suitable habitat, recruitment habitat, and capable habitat that would be removed or used as UCSAs within and outside of SHUs within the range of the MAMU.

Table 3.3.3-11 (summarized from table Q-3 in appendix Q) also identifies 192.71 acres of MAMU habitat that occur within the designated 30-foot maintenance corridor (21.33 acres of suitable habitat, 75.65 acres of recruitment habitat, and 95.73 acres of capable habitat) within Marbled Murrelet Inland Zones 1 and 2. After construction of the Pipeline, a maximum of 613.74 acres of forested habitat within Marbled Murrelet Inland Zones 1 and 2 outside of the 30-foot maintenance corridor (see Suitable, Recruitment, and Capable in table 3.3.3-11, computed by subtracting areas in the 30-foot Corridor from areas in the Removed columns) would be replanted with trees. This acreage represents a maximum because replanting may not occur or be maintained on non-federal lands and federal lands slated for timber harvest.

In areas where trees are planted and maintained as forested habitat, edge effects would decrease over time, although these areas would provide minimal benefit to MAMUs because it would take decades at a minimum to restore replanted forests to recruitment or suitable habitat conditions. Douglas-firs (12-inch seedlings in one-gallon containers or bare root) would be planted on dry sites and western hemlock (12-inch seedlings in one-gallon containers) would be planted on moist sites (see ECRP in appendix F). It is expected that 12-inch Douglas-firs and western hemlocks planted the year of or year after construction could be approximately 70 feet tall in 50 years (expected end of the Pipeline Project life). During the first 30 years or so, coastal Douglas-fir are expected to grow at an average rate of 24 inches per year and may grow at a continuous rate of 6 to 9 inches per year to age 120 (McArdle et al. 1961; Hermann and Lavender 2004). Young, unthinned stands of Douglas-fir (38 to 70 years old) were documented between 115 and 154 feet tall while young, thinned stands (40 to 73 years old) were 121 to 151 feet tall (Tappeiner et al. 1997). Western hemlock are highly productive; trees in Oregon were 140 feet tall at 100 years old (an approximate height growth rate of 16-17 inches per year). MAMU habitat within the 30-foot corridor would remain in an early seral state, maintained free of vegetation greater than 6 feet in height, through the life of the project.

Figure 1 in appendix Q provides an overview of MAMU habitat (suitable, recruitment, and capable) within the proposed terrestrial nesting analysis area and includes known occupied and presumed occupied stands, designated critical habitat, and LSRs within Marbled Murrelet Zones 1 and 2 and Conservation Zones 3 and 4. Table 3.3.3-12 summarizes the amount of MAMU habitat affected by the Pipeline Project within the terrestrial nesting analysis area pre- and post-action. The proposed action would remove the greatest percentage of available MAMU habitat within the terrestrial nesting analysis area on non-federal lands; however, only a small amount of habitat on non-federal lands is expected to provide suitable nesting structures, and a majority of capable or recruitment habitat is not expected to mature to provide suitable MAMU nesting structures based on review of timber harvest practices in Oregon (Zhou et al. 2005; Rasmussen et al. 2012). These studies noted that forest harvest practices on non-federal lands typically occur between 45 and 65 years of age.

Pacific Connector used the Revised Conservation Framework (FWS 2014c) to guide categorizing effects to MAMU habitat within SHUs into Habitat Impact Categories (Severe, High, Moderate, and Low categories) based on the amount and type of MAMU Habitat removed, as well as the area from which the habitat is removed within the MAMU SHU (see MAMU habitat impact categorization for each MAMU stand in appendix Z1).

The Habitat Impact Category assigned to each MAMU SHU (appendix Z1 and table Q-1 in appendix Q) was applied to acres of MAMU habitat affected by the proposed action (summarized in table 3.3.3-11 from table Q-3 in appendix Q). Where MAMU SHUs overlapped, the higher impact category was considered. MAMU habitat affected outside of MAMU SHUs or within a MAMU SHU that were provided a “No Impact Category” in appendix Z1 are considered areas of “Low Impact,” as well. Table MAMU-3 in the introduction to appendix Z1 provides a summary of MAMU habitat affected by Habitat Impact Category within and outside of interior forest.

TABLE 3.3.3-11

Summary of Marbled Murrelet Suitable, Recruitment, and Capable Habitat Impacted during Pipeline Project Construction and Operation (30-foot Corridor) within Marbled Murrelet Inland Zones 1 and 2, Recovery Plan Conservation Zones, and within/outside Marbled Murrelet SHUs by Landowner

			Suitable Habitat b/			Recruitment Habitat c/			Capable Habitat d/			Non-Capable Habitat e/			Total Acres		
			Construction		Operation	Construction		Operation	Construction		Operation	Construction		Operation	Construction		Operation
Conservation Zones	Land Owner	General Location a/	Removed f/ (acres)	UCSA g/ (acres)	30-foot Corridor h/ (acres)	Removed f/ (acres)	UCSA g/ (acres)	30-foot Corridor h/ (acres)	Removed f/ (acres)	UCSA g/ (acres)	30-foot Corridor h/ (acres)	Removed f/ (acres)	UCSA g/ (acres)	30-foot Corridor h/ (acres)	Removed f/ (acres)	UCSA g/ (acres)	30-foot Corridor h/ (acres)
Marbled Murrelet Inland Zone 1																	
Conservation Zone 3	Coos Bay BLM	Within SHUs	2.22	1.57	0.08	0.00		0.00	2.99	1.33	1.30	0.12	0.04	0.04	5.33	2.94	1.43
		Outside SHUs							3.84	0.89	1.03				3.84	0.89	1.03
		Subtotal	2.22	1.57	0.08	0.00		0.00	6.84	2.22	2.33	0.12	0.04	0.04	9.18	3.83	2.46
	State	Within SHUs													0.00	0.00	0.00
		Outside SHUs				0.18						103.35		3.92	103.53	0.00	3.92
		Subtotal				0.18						103.35		3.92	103.53	0.00	3.92
	Private / Other	Within SHUs	0.62		0.21	1.45		0.35	3.28		0.80	1.43		0.50	6.77	0.00	1.85
		Outside SHUs				7.08		1.05	56.12	1.39	12.59	47.45	0.03	7.70	110.65	1.41	21.35
		Subtotal	0.62		0.21	8.53		1.40	59.40	1.39	13.39	48.88	0.03	8.20	117.43	1.41	23.20
Total Conservation Zone 3		*Within SHUs*	*2.84*	*1.57*	*0.29*	*1.45*	*0.00*	*0.35*	*6.27*	*1.33*	*2.10*	*1.55*	*0.04*	*0.54*	*12.11*	*2.94*	*3.28*
		Outside SHUs	*0.00*	*0.00*	*0.00*	*7.26*	*0.00*	*1.05*	*59.96*	*2.27*	*13.62*	*150.80*	*0.03*	*11.62*	*218.02*	*2.30*	*26.30*
		Total	*2.84*	*1.57*	*0.29*	*8.71*	*0.00*	*1.40*	*66.23*	*3.61*	*15.72*	*152.35*	*0.06*	*12.17*	*230.13*	*5.24*	*29.58*
Conservation Zone 4	Coos Bay BLM	Within SHUs	45.24	12.74	13.14	30.63	7.08	8.58	37.58	8.71	7.14	17.12	0.50	5.21	130.58	29.03	34.07
		Outside SHUs				65.15	5.24	16.34	26.44	3.69	6.44	10.91	0.61	2.79	102.49	9.54	25.56
		Subtotal	45.24	12.74	13.14	95.78	12.32	24.91	64.02	12.40	13.58	28.03	1.11	8.00	233.06	38.57	59.63
	Roseburg BLM	Within SHUs	2.47		0.72	1.55		0.22	1.47		0.03	0.91		0.03	6.41	0.00	0.99
		Outside SHUs							0.03		0.00				0.03	0.00	0.00
		Subtotal	2.47		0.72	1.55		0.22	1.51		0.03	0.91		0.03	6.44	0.00	0.99
	State	Within SHUs													0.00	0.00	0.00
		Outside SHUs										6.23			6.23	0.00	0.00
		Subtotal										6.23			6.23	0.00	0.00
	Private / Other	Within SHUs	7.73	2.83	2.29	18.69	3.37	4.38	30.28	9.38	6.67	7.20	0.10	1.97	63.91	15.67	15.30
		Outside SHUs				23.33	3.87	4.07	201.84	28.96	44.74	127.76	0.93	14.45	352.93	33.76	63.25
		Subtotal	7.73	2.83	2.29	42.02	7.24	8.44	232.12	38.34	51.40	134.96	1.02	16.42	416.84	49.44	78.56
Total Conservation Zone 4		*Within SHUs*	*55.44*	*15.58*	*16.14*	*50.87*	*10.45*	*13.18*	*69.34*	*18.08*	*13.83*	*25.24*	*0.59*	*7.21*	*200.89*	*44.70*	*50.36*
		Outside SHUs	*0.00*	*0.00*	*0.00*	*88.48*	*9.11*	*20.40*	*228.31*	*32.65*	*51.17*	*144.90*	*1.54*	*17.24*	*461.68*	*43.30*	*88.82*
		Total	*55.44*	*15.58*	*16.14*	*139.35*	*19.56*	*33.58*	*297.65*	*50.74*	*65.01*	*170.14*	*2.14*	*24.45*	*662.58*	*88.01*	*139.18*
Outside Conservation Zones	Roseburg BLM	Within SHUs	4.20	1.64	0.99	1.47	0.02	0.41	8.02	0.14	2.35	2.04	0.12	0.56	15.72	1.92	4.30
		Outside SHUs				13.10		3.25	0.15		0.07	1.56		0.52	14.82	0.00	3.83
		Subtotal	4.20	1.64	0.99	14.57	0.02	3.66	8.17	0.14	2.42	3.60	0.12	1.07	30.54	1.92	8.14
	Private / Other	Within SHUs	2.40	0.00	0.75	0.44	0.00	0.18	3.51	0.89	0.90	2.34		0.52	8.69	0.89	2.34
		Outside SHUs				10.57		2.98	15.06	3.75	3.80	28.88	0.06	6.23	54.51	3.80	13.00
		Subtotal	2.40	0.00	0.75	11.01	0.00	3.16	18.57	4.64	4.70	31.22	0.06	6.74	63.20	4.69	15.35
Total Outside Conservation Zones		*Within SHUs*	*6.60*	*1.64*	*1.74*	*1.91*	*0.02*	*0.59*	*11.53*	*1.03*	*3.24*	*4.37*	*0.12*	*1.07*	*24.41*	*2.81*	*6.65*
		Outside SHUs	*0.00*	*0.00*	*0.00*	*23.67*	*0.00*	*6.23*	*15.21*	*3.75*	*3.87*	*30.45*	*0.06*	*6.74*	*69.33*	*3.80*	*16.84*
		Subtotal	*6.60*	*1.64*	*1.74*	*25.57*	*0.02*	*6.81*	*26.74*	*4.77*	*7.11*	*34.82*	*0.18*	*7.82*	*93.74*	*6.61*	*23.49*
Marbled Murrelet Inland Zone 1	Coos Bay BLM	Within SHUs	47.45	14.32	13.22	30.64	7.08	8.58	40.58	10.04	8.44	17.24	0.53	5.26	135.91	31.97	35.50
		Outside SHUs	0.00	0.00	0.00	65.15	5.24	16.34	30.28	4.57	7.46	10.91	0.61	2.79	106.33	10.43	26.59
		Subtotal	47.45	14.32	13.22	95.78	12.32	24.91	70.85	14.61	15.91	28.15	1.15	8.05	242.24	42.40	62.09
	Roseburg BLM	Within SHUs	6.67	1.64	1.71	3.02	0.02	0.63	9.49	0.14	2.37	2.95	0.12	0.58	22.13	1.92	5.29
		Outside SHUs	0.00	0.00	0.00	13.10	0.00	3.25	0.19	0.00	0.07	1.56	0.00	0.52	14.85	0.00	3.83
		Subtotal	6.67	1.64	1.71	16.12	0.02	3.88	9.68	0.14	2.44	4.51	0.12	1.10	36.98	1.92	9.13
	State	Within SHUs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Outside SHUs	0.00	0.00	0.00	0.18	0.00	0.00	0.00	0.00	0.00	109.58	0.00	3.92	109.76	0.00	3.92
		Subtotal	0.00	0.00	0.00	0.18	0.00	0.00	0.00	0.00	0.00	109.58	0.00	3.92	109.76	0.00	3.92
	Private / Other	Within SHUs	10.75	2.83	3.25	20.58	3.37	4.91	37.07	10.27	8.36	10.96	0.10	2.98	79.37	16.56	19.50
		Outside SHUs	0.00	0.00	0.00	40.98	3.87	8.09	273.02	34.10	61.13	204.10	1.01	28.38	518.10	38.98	97.61
		Subtotal	10.75	2.83	3.25	61.56	7.24	13.00	310.09	44.36	69.49	215.06	1.11	31.37	597.47	55.54	117.11
Total MAMU Inland Zone 1		*Within SHUs*	*64.88*	*18.80*	*18.18*	*54.24*	*10.47*	*14.11*	*87.14*	*20.44*	*19.17*	*31.15*	*0.75*	*8.82*	*237.41*	*50.46*	*60.29*
		Outside SHUs	*0.00*	*0.00*	*0.00*	*119.40*	*9.11*	*27.68*	*303.48*	*38.67*	*68.67*	*326.15*	*1.62*	*35.61*	*749.04*	*49.41*	*131.95*
		Total	*64.88*	*18.80*	*18.18*	*173.64*	*19.57*	*41.79*	*390.63*	*59.11*	*87.84*	*357.30*	*2.38*	*44.43*	*986.44*	*99.86*	*192.24*
Marbled Murrelet Inland Zone 2																	
Outside Conservation Zones	Roseburg BLM	Within SHUs	13.11	4.68	3.14							0.00			13.11	4.68	3.14
		Outside SHUs				18.27	1.83	4.90	0.17	0.21	0.04	3.61	0.06	0.91	22.05	2.09	5.85
		Subtotal	13.11	4.68	3.14	18.27	1.83	4.90	0.17	0.21	0.04	3.61	0.06	0.91	35.16	6.77	8.99
	Private / Other	Within SHUs	0.05	0.03	0.01	3.48	2.90	1.08	5.12	1.38	1.66	0.45	0.26	0.05	9.10	4.58	2.80
		Outside SHUs				111.54	39.78	27.88	25.57	8.83	6.20	314.47	4.70	32.82	451.58	53.31	66.89
		Subtotal	0.05	0.03	0.01	115.02	42.68	28.96	30.69	10.21	7.85	314.91	4.96	32.87	460.67	57.88	69.70

TABLE 3.3.3-11 (continued)

Summary of Marbled Murrelet Suitable, Recruitment, and Capable Habitat Impacted during Pipeline Project Construction and Operation (30-foot Corridor) within Marbled Murrelet Inland Zones 1 and 2, Recovery Plan Conservation Zones, and within/outside Marbled Murrelet SHUs by Landowner

			Suitable Habitat b/			Recruitment Habitat c/			Capable Habitat d/			Non-Capable Habitat e/			Total Acres		
			Construction		Operation	Construction		Operation	Construction		Operation	Construction		Operation	Construction		Operation
Conservation Zones	**Land Owner**	**General Location a/**	**Removed f/ (acres)**	**UCSA g/ (acres)**	**30-foot Corridor h/ (acres)**	**Removed f/ (acres)**	**UCSA g/ (acres)**	**30-foot Corridor h/ (acres)**	**Removed f/ (acres)**	**UCSA g/ (acres)**	**30-foot Corridor h/ (acres)**	**Removed f/ (acres)**	**UCSA g/ (acres)**	**30-foot Corridor h/ (acres)**	**Removed f/ (acres)**	**UCSA g/ (acres)**	**30-foot Corridor h/ (acres)**
Total Marbled Murrelet Zone2		*Within SHUs*	*13.16*	*4.71*	*3.15*	*3.48*	*2.90*	*1.08*	*5.12*	*1.38*	*1.66*	*0.45*	*0.26*	*0.05*	*22.21*	*9.26*	*5.94*
		Outside SHUs	*0.00*	*0.00*	*0.00*	*129.81*	*41.61*	*32.78*	*25.74*	*9.04*	*6.24*	*318.07*	*4.75*	*33.73*	*473.62*	*55.40*	*72.75*
		Total	*13.16*	*4.71*	*3.15*	*133.29*	*44.51*	*33.86*	*30.86*	*10.42*	*7.89*	*318.52*	*5.01*	*33.78*	*495.83*	*64.66*	*78.69*
Entire Marbled Murrelet Range																	
Entire Marbled Murrelet Range	Coos Bay BLM	Within SHUs	*47.45*	*14.32*	*13.22*	*30.64*	*7.08*	*8.58*	*40.58*	*10.04*	*8.44*	*17.24*	*0.53*	*5.26*	*135.91*	*31.97*	*35.50*
		Outside SHUs	*0.00*	*0.00*	*0.00*	*65.15*	*5.24*	*16.34*	*30.28*	*4.57*	*7.46*	*10.91*	*0.61*	*2.79*	*106.33*	*10.43*	*26.59*
		Subtotal	*47.45*	*14.32*	*13.22*	*95.78*	*12.32*	*24.91*	*70.85*	*14.61*	*15.91*	*28.15*	*1.15*	*8.05*	*242.24*	*42.40*	*62.09*
	Roseburg BLM	Within SHUs	19.79	6.33	4.85	3.02	0.02	0.63	9.49	0.14	2.37	2.95	0.12	0.58	35.24	6.60	8.43
		Outside SHUs	0.00	0.00	0.00	31.37	1.83	8.15	0.35	0.21	0.11	5.17	0.06	1.43	36.90	2.09	9.69
		Subtotal	19.79	6.33	4.85	34.39	1.84	8.78	9.85	0.35	2.48	8.12	0.18	2.01	72.14	8.70	18.12
	State	Within SHUs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Outside SHUs	0.00	0.00	0.00	0.18	0.00	0.00	0.00	0.00	0.00	109.58	0.00	3.92	109.76	0.00	3.92
		Subtotal	0.00	0.00	0.00	0.18	0.00	0.00	0.00	0.00	0.00	109.58	0.00	3.92	109.76	0.00	3.92
	Private / Other	Within SHUs	10.80	2.86	3.27	24.06	6.27	5.98	42.19	11.65	10.02	11.41	0.36	3.03	88.47	21.14	22.30
		Outside SHUs	0.00	0.00	0.00	152.51	43.65	35.97	298.59	42.93	67.33	518.57	5.71	61.20	969.67	92.29	164.50
		Subtotal	10.80	2.86	3.27	176.58	49.92	41.95	340.78	54.58	77.35	529.98	6.06	64.24	1,058.14	113.43	186.80
Total Marbled Murrelet Range		*Within SHUs*	*78.04*	*23.51*	*21.33*	*57.72*	*13.37*	*15.19*	*92.26*	*21.82*	*20.83*	*31.60*	*1.01*	*8.88*	*259.62*	*59.71*	*66.23*
		Outside SHUs	*0.00*	*0.00*	*0.00*	*249.21*	*50.72*	*60.46*	*329.22*	*47.71*	*74.90*	*644.23*	*6.38*	*69.34*	*1,222.66*	*104.81*	*204.70*
		Subtotal	*78.04*	*23.51*	*21.33*	*306.93*	*64.09*	*75.65*	*421.48*	*69.53*	*95.73*	*675.82*	*7.39*	*78.21*	*1,482.28*	*164.52*	*270.93*

a/ General Location identifies areas within Marbled Murrelet SHUs – marbled murrelet stands – occupied and presumed occupied, and appropriate buffers and areas outside of Marbled Murrelet SHUs within the range of the marbled murrelet.
b/ Suitable Habitat: generally late-seral forested stands that provide or are presumed to provide nesting structures for marbled murrelet based on modeling and other available GIS data.
c/ Recruitment Habitat: forested land not currently suitable for marbled murrelet nesting that may be capable of becoming suitable marbled murrelet habitat within the next 25 years (FWS 2006c; BLM 1995a, 1995b); generally forested stands 60 years or greater (FWS 2014c).
d/ Capable Habitat: forested land that has the capability of becoming suitable nesting marbled murrelet habitat, generally includes forest stand age 0 to 60 years (FWS 2014c).
e/ Non-Capable habitat: not forested and not capable of becoming forest, or deciduous forest stands.
f/ Pipeline Project components considered in calculation of habitat "Removed:" construction right-of-way, temporary extra work areas, aboveground facilities, permanent and temporary access roads (PAR, TAR), and pipe storage yards.
g/ Acres identified as UCSAs would not be cleared of trees during construction and would not affect nesting structures or characteristics. These areas would be used to store forest slash, stumps and dead and downed log materials that would be removed and scattered across the right-of-way after construction during restoration and are considered as temporary insignificant understory habitat effects.
h/ Acres of habitat that would be maintained in an early seral / shrub state during the life of the project within the 30-foot maintenance corridor.

Summarized from table Q-3 in appendix Q, which also provides project effects by land allocation and within and outside of interior forest.

TABLE 3.3.3-12

Summary of Effects to Marbled Murrelet Habitat within Marbled Murrelet Zones 1 and 2 and Recovery Plan Conservation Zones 3 and 4 within the Defined Terrestrial Nesting Action Area as a Result of the Proposed Project

Conservation Zone	Landowner a/	General Location	Total Acres within Analysis Area	Suitable Habitat b/ Pre-Action Acres	Suitable Removed Acres	Suitable Removed Percent	Suitable Post-Action Acres	Recruitment Habitat c/ Pre-Action Acres	Recruitment Removed Acres	Recruitment Removed Percent	Recruitment Post-Action Acres	Capable Habitat d/ Pre-Action Acres	Capable Removed Acres	Capable Removed Percent	Capable Post-Action Acres	Total MAMU Habitat Pre-Action Acres	Total Removed Acres	Total Removed Percent	Total Post-Action Acres
Marbled Murrelet Inland Zone 1																			
Conservation Zone 3	Federal	Within SHUs	84	43	2.22	5.2	41	14	0.00	0.0	14	27	2.99	11.1	24	83	5.21	6.3	78
		Outside of SHUs	479	0			0	4		0.0	4	275	3.84	1.4	271	279	3.84	1.4	275
		Total	**563**	**43**	2.22	5.2	41	**18**	0.00	0.0	18	**302**	6.84	2.3	295	**363**	9.06	2.5	354
	Non-Federal	Within SHUs	204	41	0.62	1.5	40	34	1.45	4.3	33	102	3.28	3.2	99	177	5.35	3.0	172
		Outside of SHUs	8,996	0	0.00		0	408	7.26	1.8	401	2,853	56.12	2.0	2,797	3,261	63.38	1.9	3,198
		Total	**9,199**	**41**	0.62	1.5	40	**441**	8.71	2.0	432	**2,956**	59.40	2.0	2,897	**3,438**	68.73	2.0	3,369
	Total Conservation Zone 3	Within SHUs	*288*	*84*	*2.84*	*3.4*	*81*	*47*	*1.45*	*3.1*	*46*	*130*	*6.27*	*4.8*	*124*	*261*	*10.56*	*4.0*	*250*
		Outside of SHUs	*9,475*	*0*	*0.00*		*0*	*412*	*7.26*	*1.8*	*405*	*3,129*	*59.96*	*1.9*	*3,069*	*3,540*	*67.22*	*1.9*	*3,473*
		Total	***9,762***	***84***	*2.84*	*3.4*	*81*	***459***	*8.71*	*1.9*	*450*	***3,258***	*66.23*	*2.0*	*3,192*	***3,801***	*77.78*	*2.0*	*3,723*
Conservation Zone 4	Federal	Within SHUs	18,588	11,557	47.71	0.4	11,509	3,154	32.18	1.0	3,122	3,735	39.06	1.0	3,696	18,446	118.95	0.6	18,327
		Outside of SHUs	8,412	13	0.00	0.0	13	5,407	65.15	1.2	5,342	2,889	26.47	0.9	2,863	8,309	91.61	1.1	8,217
		Total	**27,000**	**11,570**	47.71	0.4	11,522	**8,562**	97.32	1.1	8,465	**6,624**	65.53	1.0	6,558	**26,756**	210.56	0.8	26,545
	Non-Federal	Within SHUs	4,058	336	7.73	2.3	328	553	18.69	3.4	534	3,072	30.28	1.0	3,042	3,961	56.71	1.4	3,904
		Outside of SHUs	18,014	0	0.00		0	1,439	23.33	1.6	1,416	14,110	201.84	1.4	13,908	15,549	225.17	1.4	15,324
		Total	**22,073**	**337**	7.73	2.3	329	**1,992**	42.02	2.1	1,950	**17,182**	232.12	1.4	16,950	**19,510**	281.88	1.4	19,228
	Total Conservation Zone 4	Within SHUs	*22,647*	*11,893*	*55.44*	*0.5*	*11,838*	*3,707*	*50.87*	*1.4*	*3,656*	*6,807*	*69.34*	*1.0*	*6,738*	*22,407*	*175.66*	*0.8*	*22,231*
		Outside of SHUs	*26,426*	*13*	*0.00*	*0.0*	*13*	*6,847*	*88.48*	*1.3*	*6,759*	*16,999*	*228.31*	*1.3*	*16,771*	*23,859*	*316.78*	*1.3*	*23,542*
		Total	***49,073***	***11,907***	*55.44*	*0.5*	*11,852*	***10,554***	*139.35*	*1.3*	*10,415*	***23,806***	*297.65*	*1.3*	*23,508*	***46,266***	*492.44*	*1.1*	*45,774*
Outside Conservation Zones	Federal	Within SHUs	2,551	1,621	4.20	0.3	1,617	451	1.47	0.3	450	389	8.02	2.1	381	2,461	13.69	0.6	2,447
		Outside of SHUs	1,193	0			0	1,101	13.10	1.2	1,088	56	0.15	0.3	56	1,158	13.25	1.1	1,145
		Total	**3,744**	**1,621**	4.20	0.3	1,617	**1,553**	14.57	0.9	1,538	**445**	8.17	1.8	437	**3,619**	26.94	0.7	3,592
	Non-Federal	Within SHUs	694	66	2.40	3.6	64	135	0.44	0.3	135	405	3.51	0.9	401	606	6.35	1.0	600
		Outside of SHUs	3,226				0	666	10.57	1.6	655	1,839	15.06	0.8	1,824	2,506	25.63	1.0	2,480
		Total	**3,920**	**66**	2.40	3.6	64	**801**	11.01	1.4	790	**2,244**	18.57	0.8	2,225	**3,111**	31.98	1.0	3,079
	Total Outside Conservation Zone	Within SHUs	3,245	1,687	*6.60*	0.4	1,680	586	*1.91*	0.3	584	794	*11.53*	1.5	782	3,067	20.04	0.7	3,047
		Outside of SHUs	4,419	0	*0.00*		0	1,768	*23.67*	1.3	1,744	1,896	*15.21*	0.8	1,881	3,663	38.88	1.1	3,624
		Total	**7,664**	**1,687**	*6.60*	0.4	1,680	**2,354**	*25.57*	1.1	2,328	**2,689**	*26.74*	1.0	2,662	**6,730**	58.92	0.9	6,671
MAMU Inland Zone 1 Total	Federal	Within SHUs	21,223	13,220	54.13	0.4	13,166	3,619	33.65	0.9	3,585	4,151	50.07	1.2	4,101	20,991	137.85	0.7	20,853
		Outside of SHUs	10,084	13	0.00	0.0	13	6,513	78.24	1.2	6,435	3,220	30.47	0.9	3,190	9,746	108.71	1.1	9,637
		Total	**31,307**	**13,234**	54.13	0.4	13,180	**10,132**	111.90	1.1	10,020	**7,371**	80.53	1.1	7,290	**30,737**	246.56	0.8	30,490
	Non-Federal	Within SHUs	4,956	444	10.75	2.4	433	721	20.58	2.9	700	3,579	37.07	1.0	3,542	4,744	68.41	1.4	4,676
		Outside of SHUs	30,236	0	0.00		0	2,513	41.16	1.6	2,472	18,803	273.02	1.5	18,530	21,316	314.17	1.5	21,002
		Total	**35,192**	**444**	10.75	2.4	433	**3,234**	61.74	1.9	3,172	**22,382**	310.09	1.4	22,072	**26,060**	382.58	1.5	25,677
	Subtotal Marbled Murrelet Zone1	Within SHUs	26,179	13,664	*64.88*	0.5	13,599	4,340	*54.24*	1.2	4,286	7,730	*87.14*	1.1	7,643	25,735	206.26	0.8	25,529
		Outside of SHUs	40,320	13	*0.00*	0.0	13	9,026	*119.40*	1.3	8,907	22,023	*303.48*	1.4	21,720	31,062	422.88	1.4	30,639
		Total	**66,500**	**13,678**	*64.88*	0.5	13,613	**13,366**	*173.64*	1.3	13,192	**29,753**	*390.63*	1.3	29,362	**56,797**	629.14	1.1	56,168
Marbled Murrelet Inland Zone 2																			
Outside Conservation Zones	Federal	Within SHUs	789	641	13.11	2.0	628	23		0.0	23	100		0.0	100	764	13.11	1.7	751
		Outside of SHUs	1,095	6		0.0	6	767	18.27	2.4	749	229	0.17	0.1	229	1,002	18.44	1.8	984
		Total	**1,884**	**647**	13.11	2.0	634	**790**	18.27	2.3	772	**329**	0.17	0.1	329	**1,766**	31.55	1.8	1,734
	Non-Federal	Within SHUs	392	1	0.05	5.1	1	188	3.48	1.9	185	184	5.12	2.8	179	373	8.65	2.3	364
		Outside of SHUs	15,423	20		0.0	20	3,990	111.54	2.8	3,878	5,010	25.57	0.5	4,984	9,021	137.11	1.5	8,884
		Total	**15,815**	**21**	0.05	0.2	21	**4,177**	115.02	2.8	4,062	**5,195**	30.69	0.6	5,164	**9,393**	145.76	1.6	9,247
	Subtotal Marbled Murrelet Zone2	Within SHUs	1,182	641	*13.16*	2.1	628	211	*3.48*	1.6	208	284	*5.12*	1.8	279	1,136	21.76	1.9	1,114
		Outside of SHUs	16,518	26	*0.00*	0.0	26	4,757	*129.81*	2.7	4,627	5,239	*25.74*	0.5	5,213	10,023	155.55	1.6	9,867
		Total	**17,699**	**668**	*13.16*	2.0	655	**4,968**	*133.29*	2.7	4,835	**5,524**	*30.86*	0.6	5,493	**11,159**	177.31	1.6	10,982

TABLE 3.3.3-12 (continued)

Summary of Effects to Marbled Murrelet Habitat within Marbled Murrelet Zones 1 and 2 and Recovery Plan Conservation Zones 3 and 4 within the Defined Terrestrial Nesting Action Area as a Result of the Proposed Project

Conservation Zone	Landowner a/	General Location	Total Acres within Analysis Area	Suitable Habitat b/ Pre-Action Acres	Suitable Habitat b/ Removed Acres	Suitable Habitat b/ Removed Percent	Suitable Habitat b/ Post-Action Acres	Recruitment Habitat c/ Pre-Action Acres	Recruitment Habitat c/ Removed Acres	Recruitment Habitat c/ Removed Percent	Recruitment Habitat c/ Post-Action Acres	Capable Habitat d/ Pre-Action Acres	Capable Habitat d/ Removed Acres	Capable Habitat d/ Removed Percent	Capable Habitat d/ Post-Action Acres	Total MAMU Habitat Pre-Action Acres	Total MAMU Habitat Removed Acres	Total MAMU Habitat Removed Percent	Total MAMU Habitat Post-Action Acres
Total Marbled Murrelet Range																			
Total Marbled Murrelet Range	*Federal*	Within SHUs	22,012	13,861	67.24	0.5	13,794	3,642	33.65	0.9	3,608	4,251	50.07	1.2	4,201	21,754	150.96	0.7	21,603
		Outside of SHUs	11,179	19	0.00	0.0	19	7,280	96.52	1.3	7,183	3,449	30.63	0.9	3,418	10,748	127.15	1.2	10,621
		Total	**33,191**	**13,881**	67.24	0.5	13,814	**10,922**	130.17	1.2	10,792	**7,700**	80.70	1.0	7,619	**32,503**	278.11	0.9	32,225
	Non-Federal	Within SHUs	*5,349*	*444*	10.80	2.4	433	*909*	24.06	2.6	885	*3,764*	42.19	1.1	3,722	*5,117*	77.06	1.5	5,040
		Outside of SHUs	*45,659*	*20*	0.00	0.0	20	*6,503*	152.69	2.3	6,350	*23,813*	298.59	1.3	23,514	*30,337*	451.28	1.5	29,886
		Total	***51,008***	***465***	10.80	2.3	454	***7,412***	176.76	2.4	7,235	***27,577***	340.78	1.2	27,236	***35,453***	528.34	1.5	34,925
	Total Marbled Murrelet Range	***Within SHUs***	***27,361***	***14,306***	***78.04***	***0.5***	***14,228***	***4,551***	***57.72***	***1.3***	***4,493***	***8,015***	***92.26***	***1.2***	***7,923***	***26,871***	***228.02***	***0.8***	***26,643***
		Outside of SHUs	***56,838***	***40***	***0.00***	***0.0***	***40***	***13,783***	***249.21***	***1.8***	***13,534***	***27,262***	***329.22***	***1.2***	***26,933***	***41,085***	***578.43***	***1.4***	***40,507***
		Total	***84,199***	***14,345***	***78.04***	***0.5***	***14,267***	***18,334***	***306.93***	***1.7***	***18,027***	***35,277***	***421.48***	***1.2***	***34,856***	***67,956***	***806.45***	***1.2***	***67,150***

a/ Federal landowners include Coos Bay BLM and Roseburg BLM Districts; Non-federal landowners include private and state.
b/ Suitable Habitat: generally late-seral forested stands that provide or are presumed to provide nesting structures for marbled murrelet based on modeling and other available GIS data.
c/ Recruitment Habitat: forested land not currently suitable for marbled murrelet nesting that may be capable of becoming suitable marbled murrelet habitat within the next 25 years (FWS 2006c; BLM 1995a, 1995b); generally forested stands 60 years or greater (FWS 2014c).
d/ Capable Habitat: forested land that has the capability of becoming suitable nesting marbled murrelet habitat, generally includes forest stand age 0 to 60 years (FWS 2014c).

Habitat Fragmentation

Fragmentation of contiguous MAMU habitat can reduce the amount and heterogeneous nature of the habitat, forest patch size, and amount of interior or core habitat, and can increase the amount of edge, and create "sink" habitats (FWS 2006c). The ecological consequences of this type of habitat change to MAMUs can include effects on population viability and size, local or regional extinctions, displacement, fewer nesting attempts, failure to breed, reduced fecundity, reduced nest abundance, lower nest success, increased predation and parasitism rates, and reduced adult survival (FWS 2006c).

One manifestation of fragmentation is the amount of edge created through otherwise contiguous habitats. In the context of habitat fragmentation, edge is the portion of habitat (or ecosystem on a larger scale) "near its perimeter, where influences of the surroundings prevent development of interior environmental conditions" (page 38 in Forman 1995). As compared to interior habitats, edge habitats generally support different species composition, structure, and species' abundance (Forman and Godron 1986). For example, higher levels of flower and fruit production often occur along the edge (Forman 1995) and vertebrate species richness (bird and amphibian) has positively associated with edges in fragmented Douglas-fir forests (Rosenberg and Raphael 1986).

Research indicates that MAMUs within southern Oregon tend to nest in stands that are generally located away from high-contrast edge created from timber stand harvests and adjacent immature forests (Ripple et al. 2003; Meyer et al. 2002). In Canada, Zharikov et al. (2006) found MAMUs commonly nesting in stands near edges, although when edge increased in the nest stand, more nests failed (Zharikov et al. 2007). Nest failure observed by Zharikov et al. (2007) could be a result of increased risk of nest predation by corvids, as Raphael et al. (2011) and McShane et al. (2004) indicated that MAMU have reduced nest success along forested edges as a result of nest predation, predominantly by species of corvids. Alternatively, a study conducted in British Columbia found no evidence suggesting that nesting near forest edges, especially natural edges, reduced reproductive success in MAMUs (Bradley 2002). In addition, nests at edges of clearcuts, old-growth, and second-growth transitional forests were generally more successful than not successful. In that study, increased reproductive success at natural edges compared to interior forest stands was thought to be related to the ease of nest tree accessibility having a greater benefit to MAMUs than the risk of nest predation (Bradley 2002). Based on this varied research, it is inconclusive if an increase in edge within SHUs from construction of the Pipeline would result in reduced nest success as a result of increased nest predation by corvids

Fragmentation of an SHU may also result in eventual abandonment of the stand. For example, Meyer et al. (2002) reported that fragmentation may result in increased predation on nests near forest edges, which could cause the birds to abandon small old-growth stands with high edge/area ratios. Meyer et al. (2002) determined that stands with large core areas over 50 to 100 meters from edge had higher occupancy and abundance than patches with little or no core area, and on average, occupied old-growth stands were 136 acres (55 hectares) in size. However, because the terrestrial nesting analysis area has already been subjected to extensive fragmentation by past land uses including transportation corridors, timber harvest and associated activities (i.e., road construction), and urban development, occupied and presumed occupied stands analyzed within this BA are generally smaller than 136 acres (see overall acres in the stand in table Q1 in appendix Q).

To minimize further fragmentation to MAMU stands in the terrestrial analysis area from construction and operation of the Pipeline, Pacific Connector routed the Pipeline in or adjacent to existing edge (forested or non-forested) or corridors where feasible. Within MAMU Inland Zone 1 and Zone 2 (MP 0.0 to MP 75.40), the Pipeline would be located within or parallel to existing corridors for approximately 30.5 miles (40 percent of proposed action in MAMU range; see table Q-4 in appendix Q), thus minimizing fragmentation within known or potential suitable MAMU nesting habitat. Table Q-4 in appendix Q identifies the location of MAMU stands and associated SHU habitat areas in relation to existing rights-of-ways and corridors. However, additional fragmentation would occur within suitable nesting habitat (occupied and presumed occupied stands), as well as recruitment and capable habitat due to the Project.

Table 3.3.3-13 identifies 39 MAMU stands (occupied and presumed occupied) that overlap the Pipeline. The 39 affected stands range in size from 0.86 acre (presumed occupied stand on edge of right-of-way and uncapable habitat on private land) to 326.96 acres in an occupied stand, of which most stands (20 presumed occupied stands and 9 of 19 occupied stands) are currently smaller than 124 acres (table 3.3.3-13). With the exception of 14 MAMU stands (eight occupied and six presumed occupied), most suitable habitat that would be removed by construction of the Pipeline Project either occurs on the edge of the MAMU stand or between the interface of the older occupied stand and an adjacent young, regenerating stand and/or existing access roads. Additionally, five presumed occupied stands occur on the extreme edge of the Pipeline Project footprint and would not be expected to have suitable habitat or large trees removed from the stand and two other occupied MAMU stands would have in-road construction that would minimize or avoid removing potentially suitable nesting habitat (see underlined stands in table 3.3.3-13). Table 3.3.3-13 summarizes the length that each of the 39 MAMU stands is crossed by the proposed Pipeline, how much each stand is reduced in size, and the resulting habitat patches for the 14 stands bisected by the Pipeline.

The Pipeline would bisect eight occupied stands and six presumed occupied stands (see asterisk in table 3.3.3-13), although some stands identified with an asterisk would remove additional habitat adjacent to existing roads, essentially creating two lobes of the stand. Five of the MAMU stands that would be bisected are currently 136 acres or greater, and within those occupied stands, construction of the Pipeline would create habitat patches smaller than 136 acres (C1080, C3073, and R3051; see table 3.3.3-13). Although these stands would be reduced below 136 acres, a mean patch size that Meyer et al. (2002) indicated was generally occupied by MAMUs, most stands analyzed in the terrestrial nesting analysis area are below the 136 acres as a result of the currently fragmented landscape but still have observed MAMU nesting.

TABLE 3.3.3-13

Suitable Nesting Habitat Removed from Occupied and Presumed Occupied Stands Affected by the Pipeline Project

MSNO or Site ID a/	Status b/	Project Location (MP range in stand)	Landowner	Land Allocation c/	Overall Acres in the Stand	Length Crossed		Edge Created	Suitable Habitat Affected in MAMU Stand d/		Additional Description (see Maps in appendix Z1)
						Feet	Miles		Acres	Percent of Stand	
Marbled Murrelet Zone 1											
WC1A-C	Presumed (No Permission)	8.24R - 8.25R	Private	None	0.86	0	0	0	0.01	1.2	Stand adjacent to non-capable habitat (pasture); no trees within the presumed occupied stand would be removed.
WC1A-G	Presumed (No Permission)	8.79R-8.85R	Private	None	3.11	307.92	0.06	0	0.62	19.9	Habitat on edge of 100' powerline corridor and surrounded by recent clearcut (habitat previously considered a part of the presumed occupied stand) and early regenerating forest; ROW follows existing road ~ 50-100 feet from powerline corridor; would remove habitat either side of two-track road, generally reducing or removing all potential habitat in WC1A-G between road and powerline corridor; other permitted 'gray' habitat around stand determined "not suitable'; no new edge created.
C1027*	Occupied (Coos Bay BLM)	12.83BR - 13.17BR	Coos Bay BLM	LSR	43.40	153.18	0.03	2	2.22	5.1	ROW follows edge of one lobe of occupied stand following a two-track road between late seral and early seral forested habitat; ROW continues to follow road (EAR 13.15BR-13.66BR) between two lobes of occupied stand. Does not fragment stand but would increase fragmentation along existing access road, essentially creating two lobes (17.5 acres and 23.6 acres after construction).
C1042	Occupied (Coos Bay BLM)	13.17BR - 13.31BR 13.46BR - 13.58BR	Coos Bay BLM	LSR	76.61	1,006.33	0.19	1	1.55	2.0	ROW generally follows an existing road (EAR 13.15BR-13.66BR; BLM 26-12-4.1) through outer portion of northern lobe of the occupied stand and then skirts the outer edge of southern lobe of the occupied stand. ROW increases existing edge along road within the northern lobe of stand and creates a harder edge along southern lobe between early regen and late seral forest in the stand.
G102	Presumed (Ground Survey)	TEWA 13.79BR	Private	None	4.01	0	0	1	<0.01	<0.1	The ROW and TEWA are located on the edge of the presumed occupied stand and generally occur within existing roads and adjacent early seral habitat; it is not expected that suitable MAMU habitat would be removed from the delineated stand. The project would not fragment the stand but would create a hard edge.
C1040	Occupied (Coos Bay BLM)	13.46BR - 13.78BR	Coos Bay BLM	LSR	72.87	856.55	0.16	1	2.14	2.9	This occupied stand is adjacent to occupied stand C1042. The ROW follows existing Road (EAR 13.15BR-13.66BR, BLM 26-12-4.1) for approximately 1,290 feet on the north edge of the stand, between late seral and early regenerating forest. The ROW would not fragment the stand but would create a hard edge along the north edge of the stand between late seral habitat in the Stand and early regeneration forests.
BR 01	Presumed (Presence – 2015)	14.06BR - 14.15BR	Coos Bay BLM	Other	1.88	0.76	<0.01	1	0.64	34.0	Small stand adjacent to EAR 13.83BR-14.42BR (BLM 26-12-4.4) and surrounded by early seral forest. The ROW would follow the existing road on the edge of the stand. Does not fragment stand but would create a harder edge between stand and early seral forest. Although trees greater than 107 feet that could provide suitable habitat would be removed by the Project (LiDAR coverage), the stand would continue to provide potentially suitable nesting habitat including within at least four trees greater than 200 feet.
G109	Presumed (No Permission)	15.40BR-15.50BR	Private	None	3.17	384.37	0.07	1	1.00	31.5	The ROW removes habitat from eastern portion of small presumed occupied stand and would create a hard edge between early seral forest and the remaining late seral forest in the delineated stand. Based on LiDAR coverage, the Project could remove potentially suitable nesting habitat (trees > 107 feet); however, at least three additional trees greater than 107 feet within the delineated stand would remain.
BR 02A*	Presumed (Ground Survey)	16.44BR - 16.71BR	Coos Bay BLM / Private	LSR / None	81.94	1,456.47	0.28	2	3.78	4.6	ROW generally follows an existing access road (EAR 16.09BR-16.97BR, BLM 26-12-15.2) through the middle of the presumed occupied stand. The ROW generally occurs in smaller trees within the stand but would fragment the stand where it deviates from the existing road; two resulting lobes = 45.9 acres and 32.2 acres. The project would also increase fragmentation along the existing access road.
BR 03*	Presumed (Presence – 2015)	17.13BR - 17.56BR	Coos Bay BLM	LSR	70.29	2,263.56	0.43	2	4.78	6.8	ROW generally follows or parallels an existing road (EAR 16.97BR-18.14BR, Blue Ridge Road) through the stand and would remove forested habitat either side of road. Where the ROW deviates from the existing road, additional edge in the stand would be created; resulting two lobes = 50.85 acres and 14.09 acres. Stand is surrounded by clearcut and early seral forest.
BR 04	Presumed (Presence – 2015)	17.60BR-17.90BR	Coos Bay BLM	LSR	32.13	0	0	1	0.17	0.5	ROW parallels existing access road (EAR 16.97BR-18.14BR, Blue Ridge Road) and removes potential habitat within extreme point of finger-like lobe of presumed occupied stand. Project does not fragment stand but creates harder edge on the narrow stand finger between stand and early seral habitat that surrounds stand.
G120	Presumed (Presence – 2015)	18.86BR - 19.02BR	Coos Bay BLM	LSR	13.06	861.69	0.16	1	2.16	16.5	Stand consists of two lobes separated by existing access road (EAR 10.20BR-19.61BR, Blue Ridge Road). Project generally parallels Blue Ridge Road within the larger, eastern lobe of G120, where habitat is removed on the edge of the lobe between the road and the stand and creates a hard edge.

TABLE 3.3.3-13 (continued)

Suitable Nesting Habitat Removed from Occupied and Presumed Occupied Stands Affected by the Pipeline Project

MSNO or Site ID a/	Status b/	Project Location (MP range in stand)	Landowner	Land Allocation c/	Overall Acres in the Stand	Length Crossed		Edge Created	Suitable Habitat Affected in MAMU Stand d/		Additional Description (see Maps in appendix Z1)
BR 05	Presumed (Presence – 2015)	19.02BR - 19.13BR 19.18BR - 19.25BR	Coos Bay BLM	LSR	51.00	0	0	1	0.87	1.7	Large stand consists of three lobes separated by Blue Ridge Road. ROW generally parallels Blue Ridge Road and removes habitat between early/mid-seral forest and far eastern edge of two lobes of the presumed occupied stand. Project does not further fragment stand but creates harder edge from stand and access road and/or early/mid-seral forest.
BR 06	Presumed (Presence – 2015)	19.50BR - 19.62BR	Coos Bay BLM Bay	LSR	60.79	0	0	0	0.01	<0.1	Large stand consists of two lobes. ROW is generally located over 300 feet west of presumed occupied stand, but is adjacent to the southern edge of the stand for approximately 670 feet where the ROW follows existing access road (EAR 19.20BR-19.61BR, Blue Ridge Road). Although the ROW intersects the Stand at this location, it is not expected that the project would remove suitable nesting habitat – only early regenerating forest along the edge of the existing road.
G122*	Presumed (Presence – 2015)	19.63BR - 20.2BR	Coos Bay BLM	LSR	42.11	1,956.49	0.37	2	5.64	13.4	ROW divides stand for approximately 0.25 mile and then follows the edge of the stand, following an existing access road (EAR 19.88BR-20.05BR) for a portion. Project would fragment the stand and would also create a harder edge along the edge of the stand; resulting two lobes = 9.79 acres and 26.42 acres. Based on LiDAR coverage, the Project could remove potentially suitable nesting habitat (trees > 107 feet); however, the remaining portion of the stand would continue to provide potential nesting habitat (trees > 107 feet).
G128	Presumed (Presence – 2015)	22.69BR - 22.95BR	Coos Bay BLM	LSR	11.34	17.39	<0.01	1	0.25	2.2	ROW traverses the western edge of the presumed occupied stand. Project would not fragment stand but create a harder edge between early seral forest and delineated stand. Although project removes a small amount of habitat from the edge of the stand, it is not expected to remove the larger, potentially suitable trees.
G129	Presumed (Presence – 2015)	23.06BR - 23.08BR	Coos Bay BLM	LSR	1.42	0	0	0	<0.01	<0.1	ROW traverses the western edge of a small presumed occupied stand. Although the ROW is adjacent to the stand and just intersects the delineated stand, the project is not expected to remove suitable MAMU habitat.
G133*	Presumed (No Permission)	24.49BR - 24.5BR	Private	None	1.87	77.90	0.01	2	0.17	9.1	This presumed occupied stand incorporates potentially suitable habitat within a strip of habitat adjacent to an existing access road (EAR 24.50BR) and early regenerating forest. The ROW would bisect the stand in two lobes creating two additional edges; resulting lobes = 1.21 acres and 0.49 acre. Based on available LiDAR, no trees greater than 107 feet would be removed and potential nest trees would remain in the existing stand.
G134*	Presumed (No Permission)	24.58BR - 24.72BR	Private	None	12.84	736.65	0.14	2	1.62	12.6	The ROW bisects this presumed occupied stand that is adjacent and/or near early seral/clearcut forest; resulting two lobes = 5.02 acres and 6.20 acres. One existing road (EAR 24.72BR) traverses across the south eastern portion of the stand. Based on LiDAR coverage, the Project could remove potentially suitable nesting habitat (trees > 107 feet); however, the remaining portion of the stand would continue to provide potential nesting habitat (trees > 107 feet).
G38	Presumed (No Permission)	23.08-23.17	Private	None	3.80	292.75	0.06	1	0.46	12.1	Habitat 'mid-seral' as delineated; LiDAR indicated some taller trees; does not fragment stand but creates new edge - removes habitat from edge; however, contiguous with other older habitat around delineated stand; adjacent "gray habitat" determined not suitable.
C1080* (B02)	Occupied (PCGP – 2013)	27.14 - 27.47	Coos Bay BLM	LSR (PCGP-delineated)	135.87	1,761.62	0.33	2	3.99	2.9	Project would bisect stand - no other existing fragmentation; resulting two lobes = 15.58 acres and 116.30 acres; approximately 93 potential nest trees were identified in the vicinity of the Project, of which 75 would likely be removed during construction (R&A and SBS 2014).
C3098*	Occupied (PCGP – 2007)	32.04 - 32.47	Coos Bay BLM	LSR / CHU	128.40	2,294.41	0.43	2	4.98	3.9	Project would bisect stand increasing fragmentation of stand- existing road crosses stand; resulting two lobes = 106.95 acres and 16.47 acres; occupied behavior detected ~625 feet north of habitat removal; 5 potential nest trees were identified in the vicinity of the Project, of which 3 trees would likely be removed during construction (R&A and SBS 2014).
C3042	Occupied (Coos Bay BLM)	33.84-33.90	Coos Bay BLM	LSR	249.13	325.80	0.06	0	0.87	0.3	Habitat removed adjacent to regenerating forest from edge/small lobe of large stand; generally mid-seral even age forest - within groups of larger older trees outside of project area; 7 potential nest trees were identified within the vicinity of the Project, of which 1 potential nest tree could be removed during construction (R&A and SBS 2014).
C3075	Occupied (Coos Bay BLM)	33.76 - 33.86 33.94 - 34.00	Coos Bay BLM	LSR	43.36	195.77	0.04	0	1.19	2.7	Remove one lobe of delineated stand adjacent to roads and other stand (C3042); no habitat (large trees) would be removed from other lobe of stand - adjacent to regenerating forest; approximately 4 potential nest trees were identified within the vicinity of the Project that could be removed during construction (R&A and SBS 2014).
C3093	Occupied (PCGP – 2007)	35.12 - 35.24 35.34 - 35.79	Coos Bay BLM	LSR	326.96	1,215.34	0.23	0	2.01	0.6	Project travels along roads - in-road construction; approximately 5 potential nest trees were identified on edge of road in delineated stand (R&A and SBS 2014).

TABLE 3.3.3-13 (continued)

Suitable Nesting Habitat Removed from Occupied and Presumed Occupied Stands Affected by the Pipeline Project

MSNO or Site ID a/	Status b/	Project Location (MP range in stand)	Landowner	Land Allocation c/	Overall Acres in the Stand	Length Crossed		Edge Created	Suitable Habitat Affected in MAMU Stand d/		Additional Description (see Maps in appendix Z1)
C3165 (B07)	Occupied (PCGP – 2013)	35.89 - 36.12	Coos Bay BLM	LSR	67.11	6.05	<0.01	0	0.05	0.1	Project follows road; habitat removed from stand would be immediately adjacent to an existing access road [Elk Creek Rd (BLM 28-11-29)]; 3 potential nest trees were identified on edge of road that could be removed during construction (R&A and SBS 2014).
C3073*	Occupied (Coos Bay BLM)	36.49 - 36.63 36.65 - 37.16	Coos Bay BLM	LSR	174.56	1,485.85	0.28	2	3.21	1.8	Project bisects narrow area of large delineated stand and follows existing road/regenerating forest along one lobe of stand and increases fragmentation in the stand; resulting two lobes = 119.64 acres and 51.70 acres; 22 potential nest trees were identified within the vicinity of the Project, of which 15 potential nest trees could be removed during construction (R&A and SBS 2014).
C3090*	Occupied (PCGP – 2007)	37.14 - 37.16 37.32 - 38.09	Coos Bay BLM	LSR	320.50	3,991.22	0.76	2	9.15	2.9	Project would bisect stand - no other existing fragmentation; resulting two lobes = 199.07 acres and 112.27 acres; 106 potential nest trees were identified within the vicinity of the Project, of which 72 potential nest trees could be removed during construction (R&A and SBS 2014).
C3094	Occupied (PCGP – 2007)	38.09-38.18	Coos Bay BLM	LSR	76.56	489.10	0.09	0	0.94	1.2	Habitat removed from southern edge of delineated occupied stand between recent clearcut and delineated stand – no additional edge created; in 2008 occupied behavior detected ~1,000 feet north of the proposed ROW.
C3095	Occupied (PCGP – 2007)	38.82-38.92	Coos Bay BLM	LSR	21.82	0	0	0	0.52	2.4	Pipeline travels along a road that currently divides the stand - in-road construction; any habitat removed would be along existing stand edges adjacent to Weaver Sitkum Tie Road (BLM 28-10-9.4).
G55	Presumed (No permission)	40.47 - 40.50; TEWA 40.37-N; north and south of ROW; two stands	Private	None	4.20	0	0	1	0.07	1.7	Habitat 'mid-seral' as delineated; LiDAR indicated some taller trees which was used to delineate "potential suitable habitat" in two areas; the Pipeline traverses between the two areas. Habitat is removed by TEWA from edge of smaller delineated lobe that is adjacent to existing access road (EAR 40.27-40.37, Weaver Sitkum Tie Road).
C3070	Occupied (Coos Bay BLM)	41.89-41.97	Coos Bay BLM	LSR/CHU	123.44	413.48	0.08	2	1.02	0.8	One of the three areas delineated for this stand is clipped by the Pipeline; 10 potential nest trees were identified within the vicinity of the Pipeline, of which 8 potential nest trees could be removed during construction (R&A and SBS 2014).
G58	Presumed (No Permission)	43.92 - 44.06	Private	None	4.29	393.43	0.07	0	0.67	15.6	ROW generally occurs in early regen adjacent to presumed occupied stand; ROW would remove the majority of potential suitable habitat on the eastern portion of the stand. Although the project would remove habitat from the edge of the stand, it is currently adjacent to early regenerating habitat and would not expect to increase edge effect.
C3092	Occupied (PCGP – 2007)	45.40-45.47	Coos Bay BLM	LSR	173.05	376.60	0.07	1	0.86	0.5	Habitat along a ridge of a very large stand would be removed; stand would not be fragmented; trees in the northern portion of stand do not provide suitable nesting structures; one hard edge created.
R3035* (EAR 46.51_A)	Occupied (PCGP – 2013)	46.90-47.10	Roseburg BLM	LSR/CHU	201.26	1,038.97	0.20	2	2.47	1.2	Pipeline would bisect stand - existing roads through stand; resulting two lobes = 188.31 acres and 10.46 acres; 31 potential nest trees were identified within the vicinity of the Pipeline, of which 24 potential nest trees could be removed during construction (R&A and SBS 2014).
ALTR-A*	Presumed (No Permission)	50.83 - 51.04	Private	None	14.17	1,093.17	0.21	2	2.40	16.9	Pipeline would bisect presumed occupied stand adjacent to R3036; resulting two lobes = 5.56 acres and 6.20 acres.
R3036* (ALTR-A)	Occupied (PCGP – 2013)	51.04-51.29	Roseburg BLM	LSR	41.58	1,346.14	0.25	2	2.94	7.1	Pipeline would bisect stand; resulting two lobes = 30.78 acres and 7.83 acres; 3 potential nest trees were identified within the vicinity of the Pipeline and could be removed during construction (R&A and SBS 2014) .
			Marbled Murrelet Zone 1 - Stands		**2,694.76**	***26,966.32***	***5.11***	***N/A***	**65.43**	2.4	
Marbled Murrelet Zone 2											
R3052 (B13)	Occupied (PCGP – 2014)	53.11 - 53.64 53.66 - 53.76 54.31 - 54.44	Roseburg BLM/Private	LSR/CHU	206.85	455.46	0.09	0	2.45	1.2	Pipeline is adjacent to stand and occurs within existing road and clearcut/regenerating forest north of stand; no new edge created; 15 potential nest trees were identified within the vicinity of the Pipeline, of which 14 could be removed during construction (R&A and SBS 2014).
R3051* (B14)	Occupied (PCGP – 2014)	60.85-61.66	Roseburg BLM	LSR	219.42	4,287.75	0.81	2	12.31	5.6	Pipeline would bisect stand along a ridgeline - no other existing fragmentation; resulting two lobes = 124.05 acres and 83.06 acres; 34 potential nest trees were identified within the vicinity of the Pipeline, of which 20 could be removed during construction (R&A and SBS 2014) along the ridgeline alignment.
			Marbled Murrelet Zone 2 - Stands		426.2	*4,575.88*	*0.87*	*N/A*	14.76	3.5	
			Total Marbled Murrelet Stands		**3,121.03**	**31,542.20**	**5.97**	**N/A**	**80.19**	**2.6**	

a/ Underlined MSNO or Site ID indicates that the project is not expected to remove suitable nesting habitat from the stand. Asterisk (*) indicates Pipeline would bisect stand and create at least two new edges.
b/ "Occupied" – areas/stands delineated that occupied marbled murrelet behavior has been documented. Stands have been provided by BLM Coos Bay and Roseburg districts (BLM 2017). ""Presumed" – these are areas that may provide suitable MAMU nesting habitat as determined through 1) LiDAR, 2) identified by Coos Bay and/or Roseburg BLM Districts, 3) suitable habitat modeling (Raphael 2015; habitat value 4), or 4) ground-truthed by SBS/PCGP (Pacific Connector).
c/ Land Allocation: LSR = late-successional reserves; CHU = Marbled Murrelet Critical Habitat Unit OR-06-d; Other = other BLM land use allocations except for LSR; None = marbled murrelet stand on Private or Native American lands and do not have BLM LUA or designated CHU.
d/ MAMU Habitat includes suitable, recruitment, and/or capable habitat affected in the MAMU Stand; non-capable habitat is not tallied. Overall, 78.04 acres of suitable habitat is removed from occupied and presumed occupied stands (see table 3.3.3-11).

Table Q-1 in appendix Q, as well as the MAMU Impact Categorization for each MAMU stand in appendix Z.1, identifies the suitable, recruitment, and/or capable MAMU habitat that would be removed within the 300-foot buffer of each MAMU Stand outside of the MAMU breeding season (see also maps of each MAMU stand located within appendix Z.1). The Pipeline occurs in MAMU recovery plan Conservation Zones 3 and 4, of which the recommended management to aid in recovery includes maintaining designated occupied sites and minimizing loss of unoccupied but suitable habitat (FWS 1997b). Pacific Connector has adjusted the proposed route to minimize impact to MAMU stands by 1) rerouting the Pipeline to avoid occupied stands documented during 2007 and 2008 survey efforts, 2) incorporating minor alignment adjustments to reduce habitat removed in occupied stands, 3) modifying or moving temporary extra work areas, and 4) restricting the construction right-of-way to roads within occupied and presumed occupied stands. Approximately 78.04 acres of suitable habitat would be removed from occupied and presumed occupied stands, removing a total of 0.5 percent from available suitable habitat within the analysis area (14,345 acres; see table 3.3.3-11, above). Overall, 2.6 percent of MAMU habitat (suitable, recruitment, and capable) within delineated MAMU stands would be removed as a result of construction (see table 3.3.3-13).

Pacific Connector surveyed 17 occupied and presumed occupied stands located on BLM lands in fall 2013 to identify potential nest trees that may occur within proximity of the Pipeline (see R&A and SBS 2014). Trees with adequate nesting platform structures, as outlined in the Pacific Seabird Group protocol (Mack et al. 2003) were considered "potential nest trees" and included: 1) mature (with or without an old-growth component) and old-growth coniferous trees, or 2) younger coniferous trees that have platforms. A nesting platform consists of a relatively flat surface (at least 4 inches in diameter) that occurs at least 33 feet from the ground in the live crown of a coniferous tree and can include a wide bare branch, moss or lichen covered a branch, mistletoe, witches brooms, or other deformities (i.e., squirrel nests).

In October 2013, Pacific Connector cruised/surveyed nine stands that would be affected by the Pipeline, where permitted, of which six stands would be bisected by the Pipeline. LiDAR was available for the stands located in Coos Bay, and based on height of trees (> 107 feet, > 200 feet), there are several potential nest trees within the stands, both within and outside of the right-of-way. Potential nest trees (large trees with deformities) were documented within the construction right-of-way.

The "Additional Description" column in table 3.3.3-13 describes the potential nest trees that were identified within the proposed construction area, if any. Additional maps have been prepared and included in appendix Z1 for the 39 MAMU stands that would potentially have suitable habitat removed by construction. The maps include locations of potential nest trees located within the vicinity of the Pipeline during survey efforts in fall 2013, and where available (23 of 37 MAMU stands), are produced with a LiDAR background that depicts the structure and height of the MAMU stand. Based on these maps and the potential nest trees documented within the vicinity of the Pipeline right-of-way, it can be assumed that each stand contains trees outside of the Pipeline Project area that could provide suitable nesting habitat (i.e., trees greater than 200 feet in height). Although Pacific Connector would remove potential nesting trees, it is expected that the biological viability would remain intact after construction activities have occurred because remaining habitat in the stands adjacent to the Pipeline would continue to provide potentially suitable nesting structures that could be used by the MAMU. In close proximity to the coast (within 20 miles), only one potential nest tree within a stand is considered necessary to provide nesting habitat for

MAMU, whereas further from the coast (greater than 20 miles), at least six potential nest trees within a forested stand is considered necessary to be suitable for nesting MAMU. Pacific Connector would evaluate the following possible opportunities during the detailed design phase that would further reduce impact to MAMU nesting habitat and reduce fragmentation, in particular where the proposed Pipeline route traverses Blue Ridge: 1) in-road construction where the right-of-way occurs on an edge of a MAMU stand in an existing road, or 2) reduce the width of the construction right-of-way, similar to wetland minimization measures.

The conversion of large tracts of old-growth forest to small, isolated forest patches with large edge areas can create changes in microclimate, vegetation species, and predator-prey dynamics. In general, microclimates along edges differ from those in forest interiors. Two main physical factors affecting and creating an edge microclimate are sun and wind (Forman 1995; Chen et al. 1995; Harper et al. 2005). Compared to the forest interior, areas near edges receive more direct solar radiation during the day, lose more long-wave radiation at night, have lower humidity, and receive less short-wave radiation. Other physical factors affecting edge includes edge orientation (Chen et al. 1995). For example, the general orientation of the Pipeline Project is from northwest to southeast. Therefore, edge effects would be most pronounced on the southwest-facing edges and weakest along the northeast-facing edges (see discussion in Chen et al. 1995). Harper et al. (2005) reported that the mean distance of edge influence could occur to approximately 100 meters (328 feet) and result, on average, in 1) increased tree mortality and damage, increased recruitment, increased growth rate, decreased canopy foliage, increased understory foliage, and increased seedling mortality; 2) decreased amounts of canopy trees, reduced canopy cover, increased abundance of snags and logs, increased understory tree density, increased herbaceous cover, and increased shrub cover; and 3) increased stand composition metrics such as species, exotics, individual species, and species diversity. In other younger coniferous forests or mixed forests with deciduous species, edge effects compared to interior forests have been much less pronounced (Heithecker and Halpern 2007; Harper and Macdonald 2002). The importance of interior forest habitat to MAMUs is unclear. Suitable nest trees may be present within interior forest but reproductive success may be lower than at forest edges if access to interior forest nest trees is problematic, decreasing site suitability (Bradley 2002).

To determine indirect effects to MAMU habitat (suitable, recruitment, capable) from construction of the Pipeline Project, Pacific Connector assessed effects to MAMU habitat within 100 meters (328 feet) of proposed habitat removal, including effects to interior forest. This distance has been recommended by FWS (2014c), and is similar to the 300 feet considered in discussions within the Habitat Quality subtask force to analyze effects to interior forests (2007 and 2008), and the 295 feet used as an edge assessment by Raphael et al. (2011) within the NWFP 15-Year Monitoring Report for nesting MAMU habitat. This assessment considers the indirect effects of the newly constructed right-of-way on MAMU habitat within 100 meters (328 feet) of habitat removal, including interior forest. To determine which tracts of forested land (late regenerating, mid-seral, late successional, and old-growth) should be considered interior forest, existing edges, such as wide-surface roads, large rivers, early seral forest, and nonforested habitat were buffered by 100 meters (328 feet), and forested habitat included in the buffered area was identified as forested habitat currently affected by existing edge (FWS 2014c). Smaller roads with existing canopy cover were buffered by 50 feet per direction of FWS (2014c). Forested habitat (late regenerating to old-growth forest) that was not included in buffered "currently affected" area was classified as "interior forest" and incorporated into an interior forest GIS layer created for analysis of the Pipeline Project.

Table 3.3.3-14 identifies the distance that MAMU habitat is crossed by the Pipeline within and outside of interior habitat, summarizes the acreage of MAMU habitat directly removed and indirectly affected within 100 meters (328 feet) of the Pipeline Project (habitat removal) by Marbled Murrelet Inland Zones 1 and 2, landowner, and within and outside of SHUs (summarized from table Q-3 in appendix Q). Approximately 5,163 acres of MAMU habitat (656 acres of suitable habitat, 2,058 acres of recruitment habitat, and 2.449 acres of capable habitat) occur within 100 meters (328 feet) of habitat removal, of which 1,455 acres (28.2 percent) of interior MAMU habitat would be indirectly affected (364 acres of suitable habitat, 644 acres of recruitment habitat, and 447 acres of capable habitat; table 3.3.3-14). The majority of MAMU habitat indirectly affected occurs outside of SHUs: 3,762 acres (72.8 percent) of all MAMU habitat within 100 meters (328 feet) of habitat removal, which includes 840 acres of interior MAMU habitat and 2,922 acres of MAMU habitat currently affected by existing edge.

Table Q-3 in appendix Q identifies the acres of MAMU habitat affected 100 meters (328 feet) from habitat removal by Marbled Murrelet Inland Zone, Recovery Plan Conservation Zone, land allocations (critical habitat and LSR effects), and landowner within SHUs and interior forest. Effects to MAMU habitat adjacent to the construction right-of-way would decrease as the forested area (a maximum of approximately 483 acres; table 3.3.3-14) outside of the 30-foot maintenance corridor are replanted with trees and return to early regenerating stands, except for those habitats on non-federal or Matrix/Harvest Land Base lands where there is less certainty that replanting would occur or be maintained on the landscape. Additionally, if allowed to regrow, these areas would provide minimal benefit to MAMUs because it would take decades at a minimum to restore replanted forests to recruitment or suitable habitat conditions.

Based on table 3.3.3-14, it can be assumed that at least 15.1 miles of interior forest would experience fragmentation as a result of construction and operation of the Pipeline, creating at least 30.2 miles (15.1 miles x 2) of additional edge in approximately 53 miles of MAMU habitat crossed by the Pipeline; this considers interior forest crossed by the Pipeline within older regenerating forest to old-growth forest (see FWS 2014c). Additional fragmentation of approximately 10.3 miles within forest currently affected by existing disturbance ("other" forest in table 3.3.3-14) could occur because approximately 40 percent (30.5 miles) of the Pipeline within the range of MAMU occurs within or is adjacent to/parallels existing disturbance (see co-locate table Q-4 in appendix Q; 40.8 miles minus 30.5 miles), creating approximately 20.6 miles of additional edge in forest already affected by existing disturbance. In addition to MAMU habitat crossed and affected within the MAMU range, approximately 24.3 miles of non-capable habitat would be crossed and remove approximately 676 acres (see table Q-3 in appendix Q). Figure 3.3.3-8 below provides an example of how indirect effects to MAMU habitat, both within and outside of interior forest are considered within the range of the MAMU.

Predation and Edge

A long-held tenet of bird conservation is that habitat fragmentation with concomitant exposure of nests at habitat edges increases risks of nest predation and/or nest parasitism and ultimately affects species' population growth. While various reviews of available literature have supported that relationship (Paton 1994), other reviews have found no relationships or ambiguous associations between fragmentation and nest predation (Murcia 1995; Lahti 2001). A common theme among reviews is poor representation of studies with tested hypotheses on the edge-predator hypothesis (Chalfoun et al. 2002). Some of the disparate results among studies come from forest characteristics, predator species, and predated species which makes generalizations about effects of fragmentation difficult; in western forests, fragmentation may reduce the abundance of some nest predating species while increasing the abundance of others (Tewksbury et al. 1998).

Early studies of fragmentation effects on predation of MAMU nests yielded mixed results (Meyer and Miller 2002). In British Columbia, MAMU nests greater than 150 meters (492 feet) from the edge of fragmented nest stands did not fail because of nest predation (Manley and Nelson 1999 in Nelson 2005). Nelson and Hamer (1995) found that MAMU nest success was higher for nests greater than 50 meters (164 feet) from forest edge. However, an experimental study using artificial nests in Washington did not detect differences in nest predation within fragmented or continuous forest stands (Marzuluff and Restani 1999 cited in Meyer and Miller 2002).

TABLE 3.3.3-14

Summary of Other Indirect Effects from Construction of the Project to Marbled Murrelet Habitat (Suitable, Recruitment, Capable), Including Interior Forest within and outside Marbled Murrelet SHUs by Landowner

Landowner a/	General Location b/	Interior Forest c/	Suitable Habitat d/					Recruitment Habitat e/					Capable Habitat f/					Total MAMU Habitat				
				Construction			Operation		Construction			Operation		Construction			Operation		Construction			Operation
			Miles Crossed	Removed g/ (acres)	Indirect i/ (acres)	UCSA j/ (acres)	30-foot Corridor k/ (acres)	Miles Crossed	Removed g/ (acres)	Indirect i/ (acres)	UCSA j/ (acres)	30-foot Corridor k/ (acres)	Miles Crossed	Removed g/ (acres)	Indirect i/ (acres)	UCSA j/ (acres)	30-foot Corridor k/ (acres)	Miles Crossed	Removed g/ (acres)	Indirect i/ (acres)	UCSA j/ (acres)	30-foot Corridor k/ (acres)
Marbled Murrelet Inland Zone 1																						
Conservation Zone 3																						
Federal	Within SHU	Interior		0.13	7.00	0.71				0.00			0.06	0.66	8.99	0.98	0.22	0.06	0.78	15.99	1.69	0.22
		Other	0.02	2.09	7.63	0.87	0.08		0.00	0.00		0.00	0.30	2.34	2.61	0.35	1.09	0.32	4.43	10.24	1.22	1.17
		Subtotal	0.02	2.22	14.63	1.57	0.08		0.00	0.00		0.00	0.36	2.99	11.60	1.33	1.30	0.38	5.21	26.23	2.91	1.38
	Outside SHU	Interior											0.10	1.39	10.18	0.37	0.37	0.10	1.39	10.18	0.37	0.37
		Other											0.18	2.46	12.34	0.51	0.65	0.18	2.46	12.34	0.51	0.65
		Subtotal											0.28	3.84	22.52	0.89	1.03	0.28	3.84	22.52	0.89	1.03
	Total	Interior	0.00	0.13	7.00	0.71	0.00	0.00	0.00	0.00	0.00	0.00	0.16	2.04	19.17	1.35	0.59	0.16	2.17	26.17	2.06	0.59
		Other	0.02	2.09	7.63	0.87	0.08	0.00	0.00	0.00	0.00	0.00	0.48	4.79	14.95	0.86	1.74	0.50	6.88	22.57	1.73	1.82
		Subtotal	0.02	2.22	14.63	1.57	0.08	0.00	0.00	0.00	0.00	0.00	0.65	6.84	34.12	2.22	2.33	0.66	9.06	48.75	3.79	2.41
Non-Federal	Within SHU	Interior																				0.00
		Other	0.06	0.62	5.22		0.21	0.10	1.45	7.66		0.35	0.22	3.28	16.06		0.80	0.38	5.35	28.94		1.35
		Subtotal	0.06	0.62	5.22		0.21	0.10	1.45	7.66		0.35	0.22	3.28	16.106		0.80	0.38	5.35	28.94		1.35
	Outside SHU	Interior						0.08	1.29	4.02		0.30	0.91	13.77	107.38		3.29	0.99	15.06	111.39		3.59
		Other						0.19	5.97	49.06		0.75	2.51	42.35	242.58	1.39	9.30	2.71	48.31	291. 64	1.39	10.06
		Subtotal						0.27	7.26	53.07		1.05	3.42	56.12	349.96	1.39	12.59	3.69	63.38	403.03	1.39	13.64
	Total	Interior	0.00	0.00	0.00	0.00	0.00	0.08	1.29	4.02	0.00	0.30	0.91	13.77	107.38	0.00	3.29	4.07	15.06	111.39	0.00	3.59
		Other	0.06	0.62	5.22	0.00	0.21	0.29	7.42	56.72	0.00	1.10	2.73	45.62	258.64	1.39	10.10	3.08	53.66	320.58	1.39	11.41
		Subtotal	0.06	0.62	5.22	0.00	0.21	0.37	8.71	60.73	0.00	1.40	3.64	59.40	366.02	1.39	13.39	4.07	68.73	431.97	1.39	15.00
Total Conservation Zone 3	Within SHU	Interior	0.00	0.13	7.00	0.71	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.66	8.99	0.98	0.22	0.06	0.78	15.99	1.69	0.22
		Other	0.08	2.71	12.85	0.87	0.29	0.10	1.45	7.66	0.00	0.35	0.53	5.61	18.67	0.35	1.88	0.70	9.78	39.18	1.22	2.52
		Subtotal	0.08	2.84	19.85	1.57	0.29	0.10	1.45	7.66	0.00	0.35	0.58	6.27	27.66	1.33	2.10	0.76	10.56	55.17	2.91	2.74
	Outside SHU	Interior	0.00	0.00	0.00	0.00	0.00	0.08	1.29	4.02	0.00	0.30	1.01	15.16	117.56	0.37	3.67	1.09	16.45	121.58	0.37	3.96
		Other	0.00	0.00	0.00	0.00	0.00	0.19	5.97	49.06	0.00	0.75	2.69	44.80	254.92	1.90	9.95	2.88	50.77	303.97	1.90	10.71
		Subtotal	0.00	0.00	0.00	0.00	0.00	0.27	7.26	53.07	0.00	1.05	3.70	59.96	372.48	2.27	13.62	3.97	67.22	425.55	2.27	14.67
	Total	Interior	0.00	0.13	7.00	0.71	0.00	0.08	1.29	4.02	0.00	0.30	1.07	15.82	126.55	1.35	3.89	4.23	17.24	137.57	2.06	4.18
		Other	0.08	2.71	12.85	0.87	0.29	0.29	7.42	56.72	0.00	1.10	3.22	50.42	273.58	2.25	11.83	3.58	60.55	343.15	3.12	13.23
		Subtotal	0.08	2.84	19.85	1.57	0.29	0.37	8.71	60.74	0.00	1.40	4.29	66.23	400.13	3.61	15.72	4.73	77.78	480.72	5.18	17.41
Marbled Murrelet Inland Zone 1																						
Conservation Zone 4																						
Federal	Within SHU	Interior	1.48	19.85	236.22	6.23	5.52	1.23	15.51	92.94	4.57	4.45	0.58	9.95	59.91	2.30	2.11	3.30	45.32	389.08	13.10	12.08
		Other	2.28	27.86	191.21	6.52	8.34	1.19	16.67	102.72	2.51	4.34	1.38	29.10	107.53	6.40	5.06	4.86	73.62	401.46	15.43	17.74
		Subtotal	3.77	47.71	427.43	12.74	13.85	2.42	32.18	195.67	7.08	8.80	1.97	39.06	167.44	8.71	7.17	8.15	118.95	790.54	28.53	29.82
	Outside SHU	Interior						1.17	18.16	148.30	1.15	4.28	0.38	5.66	59.43	0.55	1.36	1.55	23.82	207. 72	1.69	5.64
		Other						3.31	46.99	259.83	4.09	12.06	1.38	20.81	126.21	3.14	5.08	4.70	67.80	386.05	7.23	17.13
		Subtotal						4.48	65.15	408.13	5.24	16.34	1.76	26.47	185.64	3.69	6.44	6.25	91.61	593.77	8.93	22.78
	Subtotal	Interior	1.48	19.85	236.22	6.23	5.52	2.40	33.67	241.24	5.72	8.74	0.96	15.61	119.34	2.85	3.47	4.85	69.14	596.80	14.79	17.72
		Other	2.28	27.86	191.21	6.52	8.34	4.50	63.66	362.56	6.60	16.40	2.77	49.91	233.74	9.55	10.13	9.55	141.42	787.51	22.67	34.87
		Subtotal	3.77	47.71	427.43	12.74	13.85	6.90	97.32	603.80	12.32	25.14	3.73	65.53	353.08	12.40	13.60	14.40	210.56	1,384.31	37.46	52.59
Non-Federal	Within SHU	Interior	0.16	2.74	36.97	0.95	0.60	0.24	4.64	27.37	1.45	0.89	0.19	3.41	38.28	1.84	0.69	0.60	10.79	102.62	4.25	2.19
		Other	0.47	4.99	29.27	1.88	1.69	0.95	14.05	38. 25	1.92	3.48	1.63	26.88	130. 27	7.54	5.97	3.05	45.92	197.79	11.33	11.14
		Subtotal	0.63	7.73	66.24	2.83	2.29	1.19	18.69	65. 62	3.37	4.38	1.83	30.28	168. 55	9.38	6.67	3.65	56.71	300. 42	15.58	13.34
	Outside SHU	Interior						0.29	4.38	43.15	1.06	1.02	0.86	13.46	119.25	2.89	3.16	1.15	17.83	162.39	3.95	4.17
		Other						0.78	18.95	152. 88	2.81	3.05	11.44	188.38	1019.09	26.08	41.58	12.23	207.33	1,171. 97	28.89	44.63
		Subtotal						1.07	23.33	196.03	3.87	4.07	12.30	201.84	1,138. 33	28.96	44.74	13.37	225.17	1,334.36	32.83	48.80
	Total	Interior	0.16	2.74	36.97	0.95	0.60	0.53	9.02	70.52	2.52	1.91	1.05	16.86	157.53	4.73	3.85	1.75	28.63	265.01	8.19	6.37
		Other	0.47	4.99	29.27	1.88	1.69	1.73	33.00	191.13	4.72	6.53	13.08	215.26	1,149.36	33.62	47.55	15.28	253.25	1,369.76	40.22	55.77
		Subtotal	0.63	7.73	66.24	2.83	2.29	2.27	42.02	261.65	7.24	8.44	14.13	232.12	1,306.89	38.34	51.40	17.02	281.88	1,634.78	48.41	62.14
Total Conservation Zone 4	Within SHU	Interior	1.65	22.60	273.19	7.18	6.12	1.48	20.16	120. 31	6.02	5.35	0.78	13.36	98.20	4.14	2.80	3.90	56.12	491.70	17.35	14.27
		Other	2.75	32.85	220.48	8.40	10.02	2.14	30.72	140.98	4.43	7.83	3.02	55.98	237.80	13.94	11.03	7.91	119.54	599.25	26.76	28.88
		Subtotal	4.40	55.44	493.67	15.58	16.14	3.62	50.87	261.29	10.45	13.18	3.79	69.34	335.99	18.08	13.83	11.81	175.66	1,090.95	44.11	43.15
	Outside SHU	Interior	0.00	0.00	0.00	0.00	0.00	1.46	22.53	191.44	2.21	5.30	1.24	19.12	178.67	3.43	4.52	2.69	41.65	370.12	5.64	9.82
		Other	0.00	0.00	0.00	0.00	0.00	4.10	65.94	412.72	6.90	15.11	12.83	209.19	1,145.30	29.22	46.66	16.93	275.13	1,558.02	36.12	61.76
		Subtotal	0.00	0.00	0.00	0.00	0.00	5.55	88.48	604.16	9.11	20.40	14.07	228.31	1,323.97	32.65	51.17	19.62	316.78	1,928.13	41.76	71.58

TABLE 3.3.3-14 (continued)

Summary of Other Indirect Effects from Construction of the Project to Marbled Murrelet Habitat (Suitable, Recruitment, Capable), Including Interior Forest within and outside Marbled Murrelet SHUs by Landowner

			Suitable Habitat d/					**Recruitment Habitat e/**					**Capable Habitat f/**					**Total MAMU Habitat**				
				Construction			**Operation**		**Construction**			**Operation**		**Construction**			**Operation**	**Miles Crossed**	**Construction**			**Operation**
Landowner a/	**General Location b/**	**Interior Forest c/**	**Miles Crossed**	**Removed g/ (acres)**	**Indirect i/ (acres)**	**UCSA j/ (acres)**	**30-foot Corridor k/ (acres)**	**Miles Crossed**	**Removed g/ (acres)**	**Indirect i/ (acres)**	**UCSA j/ (acres)**	**30-foot Corridor k/ (acres)**	**Miles Crossed**	**Removed g/ (acres)**	**Indirect i/ (acres)**	**UCSA j/ (acres)**	**30-foot Corridor k/ (acres)**		**Removed g/ (acres)**	**Indirect i/ (acres)**	**UCSA j/ (acres)**	**30-foot Corridor k/ (acres)**
		Interior	1.65	22.60	273.19	7.18	6.12	2.93	42.69	311.76	8.23	10.65	2.01	32.48	276.87	7.58	7.32	6.59	97.77	861.81	22.99	24.09
	Total	Other	2.75	32.85	220.48	8.40	10.02	6.24	96.66	553.69	11.33	22.93	15.84	265.17	1,383.10	43.16	57.69	24.83	394.67	2,157.27	62.89	90.64
		Subtotal	4.40	55.44	493.67	15.58	16.14	9.17	139.35	865.45	19.56	33.58	17.86	297.65	1,659.97	50.74	65.01	31.43	492.44	3,019.08	85.87	114.73
Marbled Murrelet Inland Zone 1																						
No Recovery Conservation Zone																						
Federal	Within SHU	Interior	0.19	2.24	14.07		0.70	0.09	1.17	6.20		0.34	0.01	0.08	2.22		0.02	0.29	3.49	22.49		1.07
		Other	0.08	1.96	31.02	1.64	0.29	0.02	0.30	2.22	0.02	0.06	0.63	7.94	34.48	0.14	2.32	0.72	10.20	67.71	1.80	2.68
		Subtotal	0.27	4.20	45.08	1.64	0.99	0.11	1.47	8.42	0.02	0.41	0.63	8.02	36.70	0.14	2.35	1.02	13.69	90.21	1.80	3.75
	Outside SHU	Interior						0.06	1.30	21.29		0.22		0.00	0.01			0.06	1.30	21.29		0.22
		Other						0.82	11.80	40.13		3.03	0.02	0.15	0.66		0.07	0.84	11.95	40.80		3.10
		Subtotal						0.88	13.10	61.42		3.25	0.02	0.15	0.67		0.07	0.90	13.25	62.09		3.32
	Subtotal	Interior	0.19	2.24	14.07	0.00	0.70	0.15	2.47	27.49	0.00	0.56	0.01	0.08	2.23	0.00	0.02	0.35	4.79	43.79	0.00	1.28
		Other	0.08	1.96	31.02	1.64	0.29	0.84	12.10	42.36	0.02	3.10	0.65	8.09	35.14	0.14	2.39	1.56	22.15	108.51	1.80	5.78
		Subtotal	0.27	4.20	45.08	1.64	0.99	0.99	14.57	69.85	0.02	3.66	0.65	8.17	37.37	0.14	2.42	1.92	26.94	152.30	1.80	7.06
Non-Federal	Within SHU	Interior	0.10	1.27	4.53		0.38	0.00	0.01	2.46		0.00						0.10	1.28	7.00		0.38
		Other	0.10	1.13	7.09	0.00	0.37	0.05	0.43	5. 40	0.00	0.18	0.25	3.51	16.89	0.89	0.90	0.40	5.07	29.37	0.89	1.45
		Subtotal	0.21	2.40	11.62	0.00	0.75	0.05	0.44	7. 87	0.00	0.18	0.25	3.51	16.89	0.89	0.90	0.50	6.35	36.37	0.89	1.83
	Outside SHU	Interior						0.24	3.35	27.95		0.89	0.09	1.21	4.95		0.32	0.33	4.56	32.90		1.21
		Other						0.57	7.22	95.82		2.09	0.96	13.85	99.51	3.75	3.48	1.53	21.07	195.34	3.75	5.57
		Subtotal						0.81	10.57	123.77		2.98	1.05	15.06	104.46	3.75	3.80	1.86	25.63	228.24	3.75	6.78
	Subtotal	Interior	0.10	1.27	4.53	0.00	0.38	0.25	3.36	30.42	0.00	0.89	0.09	1.21	4.95	0.00	0.32	0.44	5.84	39.90	0.00	1.59
		Other	0.10	1.13	7.09	0.00	0.37	0.62	7.64	101.23	0.00	2.26	1.20	17.36	116.40	4.64	4.38	1.92	26.14	224.71	4.64	7.02
		Subtotal	0.21	2.40	11.62	0.00	0.75	0.86	11.01	131.64	0.00	3.16	1.29	18.57	121.35	4.64	4.70	2.36	31.98	264.61	4.64	8.60
Total MAMU Zone 1 - No Conservation Recovery Zone	Within SHU	Interior	0.30	3.50	18.60	0.00	1.08	0.10	1.18	8.67	0.00	0.35	0.01	0.08	2.22	0.00	0.02	0.40	4.77	29.49	0.00	1.45
		Other	0.18	3.09	38.10	1.64	0.66	0.07	0.73	7.63	0.02	0.24	0.87	11.45	51.37	1.03	3.22	1.12	15.27	97.09	2.69	4.13
		Subtotal	0.48	6.60	56.70	1.64	1.74	0.16	1.91	16.29	0.02	0.59	0.88	11.53	53.59	1.03	3.24	1.52	20.04	126.58	2.69	5.57
	Outside SHU	Interior	0.00	0.00	0.00	0.00	0.00	0.30	4.65	49.24	0.00	1.11	0.09	1.21	4.96	0.00	0.32	0.39	5.86	54.20	0.00	1.42
		Other	0.00	0.00	0.00	0.00	0.00	1.39	19.02	135.95	0.00	5.12	0.98	14.00	100.17	3.75	3.55	2.36	33.02	236.14	3.75	8.67
		Subtotal	0.00	0.00	0.00	0.00	0.00	1.69	23.67	185.19	0.00	6.23	1.07	15.21	105.13	3.75	3.87	2.76	38.88	290.33	3.75	10.10
	Total	Interior	0.30	3.50	18.60	0.00	1.08	0.40	5.83	57.91	0.00	1.45	0.09	1.29	7.18	0.00	0.34	0.79	10.63	83.69	0.00	2.87
		Other	0.18	3.09	38.10	1.64	0.66	1.45	19.74	143.58	0.02	5.36	1.85	25.45	151.54	4.77	6.77	3.48	48.29	333.22	6.43	12.80
		Subtotal	0.48	6.60	56.70	1.64	1.74	1.85	25.57	201.49	0.02	6.81	1.94	26.74	158.72	4.77	7.11	4.28	58.92	416.91	6.43	15.67
TOTAL Marbled Murrelet Inland Zone 1																						
Federal	Within SHU	Interior	1.68	22.22	257.29	6.93	6.22	1.33	16.69	99.15	4.57	4.80	0.65	10.69	71.12	3.29	2.35	3.65	49.60	427.56	14.79	13.36
		Other	2.38	31.91	229.85	9.03	8.71	1.21	16.97	104.95	2.53	4.41	2.31	39.37	144.61	6.89	8.47	5.90	88.25	479.41	18.45	21.58
		Subtotal	4.06	54.13	487.14	15.96	14.93	2.53	33.65	204.09	7.10	9.21	2.96	50.07	215.74	10.17	10.81	9.55	137.85	906.97	33.24	34.95
	Outside SHU	Interior	0.00	0.00	0.00	0.00	0.00	1.23	19.45	169. 59	1.15	4.50	0.48	7.05	69.61	0.92	1.74	1.71	26.50	239.20	2.06	6.23
		Other	0.00	0.00	0.00	0.00	0.00	4.13	58.79	299.97	4.09	15.09	1.58	23.42	139.21	3.66	5.80	5.72	82.21	439.18	7.75	20.89
		Subtotal	0.00	0.00	0.00	0.00	0.00	5.36	78.24	469.55	5.24	19.59	2.06	30.47	208.83	4.57	7.53	7.43	108.71	678.38	9.81	27.12
	Subtotal	Interior	1.68	22.22	257.29	6.93	6.22	2.56	36.14	268.73	5.72	9.30	1.13	17.74	140.74	4.20	4.08	5.36	76.10	666.76	16.85	19.60
		Other	2.38	31.91	229.85	9.03	8.71	5.34	75.76	404.92	6.62	19.50	3.90	62.79	283.83	10.55	14.27	11.62	170.46	918.59	26.19	42.47
		Subtotal	4.06	54.13	487.14	15.96	14.93	7.90	111.90	673.65	12.33	28.79	5.03	80.53	424.57	14.75	18.35	16.98	246.56	1,585.35	43.05	62.07
Non-Federal	Within SHU	Interior	0.27	4.01	41.50	0.95	0.98	0.25	4.65	29.84	1.45	0.90	0.19	3.41	38.28	1.84	0.69	0.70	12.07	109.62	4.25	2.57
		Other	0.63	6.74	41.58	1.88	2.27	1.10	15.93	51.32	1.92	4.01	2.10	33.67	163.22	8.43	7.66	3.82	56.34	256.10	12.22	13.94
		Subtotal	0.89	10.75	83.08	2.83	3.25	1.34	20.58	81.15	3.37	4.91	2.29	37.07	201.50	10.27	8.36	4.53	68.41	365.72	16.47	16.52
	Outside SHU	Interior	0.00	0.00	0.00	0.00	0.00	0.61	9.02	75.11	1.06	2.20	1.85	28.44	231.58	2.89	6.77	2.46	37.46	306.69	3.95	8.97
		Other	0.00	0.00	0.00	0.00	0.00	1.54	32.13	297.76	2.81	5.89	14.92	244.58	1,361.18	31.21	54.36	16.46	276.71	1,658.95	34.02	60.25
		Subtotal	0.00	0.00	0.00	0.00	0.00	2.16	41.16	372.87	3.87	8.09	16.77	273.02	1,592.75	34.10	61.13	18.92	314.17	1,965.63	37.97	69.22
	Subtotal	Interior	0.27	4.01	41.50	0.95	0.98	0.86	13.68	104.95	2.52	3.10	2.04	31.84	269.86	4.73	7.46	6.25	49.53	416.31	8.19	11.54
		Other	0.63	6.74	41.58	1.88	2.27	2.64	48.06	349.08	4.72	9.90	17.02	278.25	1,524.39	39.64	62.03	20.28	333.05	1,915.05	46.24	74.20
		Subtotal	0.89	10.75	83.08	2.83	3.25	3.50	61.74	454.02	7.24	13.00	19.06	310.09	1,794.25	44.36	69.49	23.45	382.58	2,331.36	54.44	85.74
Total MAMU Inland Zone 1	Within SHU	Interior	1.94	26.23	298.79	7.89	7.20	1.57	21.34	129.98	6.02	5.70	0.84	14.10	109.41	5.13	3.04	4.36	61.67	537. 18	19.04	15.94
		Other	3.01	38.65	271.43	10.91	10.98	2.30	32.90	156.26	4.44	8.42	4.41	73.04	307.83	15.32	16.13	9.73	144.59	735.52	30.67	35.53
		Subtotal	4.95	64.88	570.22	18.80	18.18	3.87	54.24	85.25	10.47	14.11	5.25	87.14	417.24	20.44	19.17	14.08	206.26	72.69	49.70	51.46
	Outside SHU	Interior	0.00	0.00	0.00	0.00	0.00	1.84	28.47	244.70	2.21	6.70	2.33	35.49	301.19	3.80	8.50	4.18	63.96	545. 89	6.01	15.20
		Other	0.00	0.00	0.00	0.00	0.00	5.68	90.93	597.73	6.90	20.98	16.50	268.00	1,500.39	34.87	60.16	22.17	358.92	2,098.13	41.77	81.14
		Subtotal	0.00	0.00	0.00	0.00	0.00	7.52	119.40	842.43	9.11	27.68	18.83	303.48	1,801.58	38.67	68.67	26.35	422.88	2,644.02	47.78	96.35

TABLE 3.3.3-14 (continued)

Summary of Other Indirect Effects from Construction of the Project to Marbled Murrelet Habitat (Suitable, Recruitment, Capable), Including Interior Forest within and outside Marbled Murrelet SHUs by Landowner

			Suitable Habitat d/					Recruitment Habitat e/					Capable Habitat f/					Total MAMU Habitat				
				Construction			Operation		Construction			Operation		Construction			Operation	Miles Crossed	Construction			Operation
Landowner a/	General Location b/	Interior Forest c/	Miles Crossed	Removed g/ (acres)	Indirect i/ (acres)	UCSA j/ (acres)	30-foot Corridor k/ (acres)	Miles Crossed	Removed g/ (acres)	Indirect i/ (acres)	UCSA j/ (acres)	30-foot Corridor k/ (acres)	Miles Crossed	Removed g/ (acres)	Indirect i/ (acres)	UCSA j/ (acres)	30-foot Corridor k/ (acres)		Removed g/ (acres)	Indirect i/ (acres)	UCSA j/ (acres)	30-foot Corridor k/ (acres)
		Interior	1.94	26.23	298.79	7.89	7.20	3.41	49.81	373.68	8.23	12.40	3.18	49.59	410.60	8.93	11.55	11.61	125.63	1,083.07	25.05	31.14
	Total	Other	3.01	38.65	271.43	10.91	10.98	7.98	123.82	753.99	11.34	29.40	20.91	341.04	1,808.22	50.19	76.29	31.90	503.51	2,833.64	72.44	116.67
		Subtotal	4.95	64.88	570.22	18.80	18.18	11.39	173.64	1,127.67	19.57	41.79	24.09	390.63	2,218.82	59.11	87.84	40.43	629.14	3,916.71	97.48	147.81
Marbled Murrelet Inland Zone 2 (No Recovery Conservation Zone)																						
Federal	Within SHU	Interior	0.80	12.30	64.87	4.46	2.91											0.80	12.30	64.87	4.46	2.91
		Other	0.06	0.81	20.83	0.22	0.23			0.12					5.80			0.06	0.81	26.75	0.22	0.23
		Subtotal	0.86	13.11	85.69	4.68	3.14			0.12					5.80			0.86	13.11	91.62	4.68	3.14
	Outside SHU	Interior						0.92	12.82	81.57	1.42	3.35		0.01	0.45	0.02		0.92	12.83	82.02	1.43	3.35
		Other						0.43	5.45	25.57	0.41	1.55	0.01	0.16	2.50	0.19	0.04	0.44	5.61	28.07	0.60	1.59
		Subtotal						1.35	18.27	107.14	1.83	4.90	0.01	0.17	2.95	0.21	0.04	1.36	18.44	110.09	2.04	4.94
	Subtotal	Interior	0.80	12.30	64.87	4.46	2.91	0.92	12.82	81.57	1.42	3.35	0.00	0.01	0.45	0.02	0.00	1.72	25.13	146.89	5.89	6.26
		Other	0.06	0.81	20.83	0.22	0.23	0.43	5.45	25.70	0.41	1.55	0.01	0.16	8.30	0.19	0.04	0.50	6.42	54.83	0.83	1.82
		Total	0.86	13.11	85.69	4.68	3.14	1.35	18.27	107.26	1.83	4.90	0.01	0.17	8.76	0.21	0.04	2.22	31.55	201.71	6.72	8.08
Non-Federal	Within SHU	Interior	0.00	0.02	0.11	0.02	0.00	0.18	2.31	8.39	2.26	0.65	0.18	2.08	3.87		0.66	0.36	4.42	12.37	2.28	1.32
		Other	0.00	0.03	0.16	0.01	0.01	0.13	1.17	7.22	0.65	0.43	0.28	3.04	9.04	1.38	0.99	0.41	4.23	16.42	2.04	1.43
		Subtotal	0.00	0.05	0.27	0.03	0.01	0.31	3.48	15.61	2.90	1.08	0.46	5.12	12.91	1.38	1.66	0.77	8.65	28.79	4.32	2.75
	Outside SHU	Interior						1.20	16.27	180.24	7.66	4.39	0.18	2.92	32.34	1.27	0.67	1.38	19.19	212.58	8.94	5.06
		Other						6.50	95.27	626.97	32.12	23.48	1.53	22.65	175.96	7.55	5.53	8.03	117.92	802.93	39.67	29.02
		Subtotal						7.70	111.54	807.21	39.78	27.88	1.71	25.57	208.30	8.83	6.20	9.41	137.11	1,015.51	48.61	34.08
	Subtotal	Interior	0.00	0.02	0.11	0.02	0.00	1.38	18.58	188.63	9.92	5.05	0.36	5.00	36.22	1.27	1.33	1.74	23.61	224.95	11.21	6.37
		Other	0.00	0.03	0.16	0.01	0.01	6.63	96.44	634.18	32.77	23.91	1.80	25.69	185.00	8.94	6.53	8.44	122.15	819.34	41.71	30.45
		Total	0.00	0.05	0.27	0.03	0.01	8.01	115.02	822.82	42.68	28.96	2.17	30.69	221.21	10.21	7.85	10.18	145.76	1,044.30	52.93	36.82
Subtotal Marbled Murrelet Zone2	Within SHU	Interior	0.80	12.33	64.97	4.48	2.91	0.18	2.31	8.39	2.26	0.65	0.18	2.08	3.87	0.00	0.66	1.16	16.72	77.24	6.73	4.22
		Other	0.07	0.84	20.99	0.24	0.24	0.13	1.17	7.34	0.65	0.43	0.28	3.04	14.84	1.38	0.99	0.47	5.04	43.17	2.26	1.66
		Subtotal	0.87	13.16	85.96	4.71	3.15	0.31	3.48	15.73	2.90	1.08	0.46	5.12	18.71	1.38	1.66	1.63	21.76	120.41	9.00	5.89
	Outside SHU	Interior	0.00	0.00	0.00	0.00	0.00	2.12	29.09	261.81	9.08	7.75	0.18	2.93	32.80	1.29	0.67	2.31	32.02	294.60	10.37	8.41
		Other	0.00	0.00	0.00	0.00	0.00	6.93	100.72	652.54	32.53	25.03	1.54	22.81	178.46	7.74	5.57	8.47	123.53	831.00	40.28	30.60
		Subtotal	0.00	0.00	0.00	0.00	0.00	9.05	129.81	914.35	41.61	32.78	1.72	25.74	211.25	9.04	6.24	10.77	155.55	1,125.60	50.65	39.02
	Subtotal	Interior	0.80	12.33	64.97	4.48	2.91	2.30	31.40	270.20	11.33	8.40	0.36	5.01	36.67	1.29	1.33	3.47	48.74	371.84	17.10	12.64
		Other	0.07	0.84	20.99	0.24	0.24	7.06	101.89	659.88	33.18	25.46	1.81	25.85	193.30	9.13	6.56	8.94	128.58	874.17	42.54	32.27
		Total	0.87	13.16	85.96	4.71	3.15	9.36	133.29	930.08	44.51	33.86	2.18	30.86	229.97	10.42	7.89	12.40	177.31	1,246.01	59.64	44.90
Total Marbled Murrelet Range																						
Federal	Within SHU	Interior	2.48	34.52	322.15	11.39	9.13	1.33	16.69	99. 15	4.57	4.80	0.65	10.69	71.12	3.29	2.35	4.45	61.90	492. 42	19.25	16.27
		Other	2.45	32.72	250.68	9.25	8.94	1.21	16.97	105.07	2.53	4.41	2.31	39.37	150.42	6.89	8.47	5.97	89.06	506.17	18.67	21.81
		Subtotal	4.92	67.24	572.83	20.64	18.07	2.53	33.65	204.22	7.10	9.21	2.96	50.07	221.54	10.17	10.81	10.42	150.96	998.59	37.92	38.09
	Outside SHU	Interior	0.00	0.00	0.00	0.00	0.00	2.15	32.27	251.15	2.56	7.85	0.48	7.06	70.07	0.94	1.74	2.63	39.33	321.22	3.50	9.59
		Other	0.00	0.00	0.00	0.00	0.00	4.56	64.25	325.54	4.51	16.64	1.59	23.58	141.71	3.85	5.84	6.15	87.82	467.25	8.35	22.48
		Subtotal	0.00	0.00	0.00	0.00	0.00	6.71	96.52	576.69	7.07	24.49	2.08	30.63	211.78	4.78	7.57	8.79	127.15	788.47	11.85	32.06
	Subtotal	Interior	2.48	34.52	322.15	11.39	9.13	3.48	48.96	350.30	7.13	12.65	1.13	17.75	141.19	4.22	4.08	7.09	101.23	813.65	22.74	25.86
		Other	2.45	32.72	250.68	9.25	8.94	5.77	81.21	430.61	7.03	21.05	3.91	62.95	292.13	10.74	14.30	12.12	176.88	973.42	27.02	44.29
		Total	4.92	67.24	572.83	20.64	18.07	9.24	130.17	780.91	14.16	33.70	5.04	80.70	433.32	14.96	18.39	19.20	278.11	1,787.06	49.77	70.15
Non-Federal	Within SHU	Interior	0.27	4.04	41.61	0.97	0.98	0.42	6.97	38.23	3.71	1.55	0.37	5.49	42.16	1.84	1.36	1.07	16.49	121.99	6.52	3.89
		Other	0.63	6.77	41.74	1.89	2.28	1.22	17.10	58.53	2.56	4.43	2.38	36.70	172.26	9.81	8.66	4.23	60.57	272.52	14.26	15.38
		Subtotal	0.90	10.80	83.35	2.86	3.27	1.65	24.06	96.76	6.27	5.98	2.75	42.19	214.41	11.65	10.02	5.30	77.06	394.51	20.78	19.27
	Outside SHU	Interior	0.00	0.00	0.00	0.00	0.00	1.81	25.29	255.35	8.73	6.59	2.03	31.36	263.92	4.16	7.44	3.85	56.65	519.27	12.89	14.03
		Other	0.00	0.00	0.00	0.00	0.00	8.05	127.40	924. 73	34.93	29.38	16.44	267.23	1,537.14	38.77	59.89	24.49	394.63	2,461.87	73.69	89.27
		Subtotal	0.00	0.00	0.00	0.00	0.00	9.86	152.69	1,180.08	43.65	35.97	18.48	298.59	1,801.05	42.93	67.33	28.34	451.28	2,981.14	86.58	103.30
	Subtotal	Interior	0.27	4.04	41.61	0.97	0.98	2.24	32.25	293.58	12.43	8.15	2.41	36.85	306.08	6.00	8.79	7.99	73.14	641.26	19.41	17.92
		Other	0.63	6.77	41.74	1.89	2.28	9.27	144.50	983.26	37.49	33.81	18.82	303.93	1,709.39	48.58	68.55	28.72	455.20	2,734.39	87.95	104.65
		Total	0.90	10.80	83.35	2.86	3.27	11.51	176.76	1,276.84	49.92	41.95	21.23	340.78	2,015.47	54.58	77.35	33.63	528.34	3,375.65	107.36	122.56

TABLE 3.3.3-14 (continued)

Summary of Other Indirect Effects from Construction of the Project to Marbled Murrelet Habitat (Suitable, Recruitment, Capable), Including Interior Forest within and outside Marbled Murrelet SHUs by Landowner

			Suitable Habitat d/					**Recruitment Habitat e/**					**Capable Habitat f/**					**Total MAMU Habitat**				
				Construction			**Operation**		**Construction**			**Operation**		**Construction**			**Operation**		**Construction**			**Operation**
Landowner a/	**General Location b/**	**Interior Forest c/**	**Miles Crossed**	**Removed g/ (acres)**	**Indirect i/ (acres)**	**UCSA j/ (acres)**	**30-foot Corridor k/ (acres)**	**Miles Crossed**	**Removed g/ (acres)**	**Indirect i/ (acres)**	**UCSA j/ (acres)**	**30-foot Corridor k/ (acres)**	**Miles Crossed**	**Removed g/ (acres)**	**Indirect i/ (acres)**	**UCSA j/ (acres)**	**30-foot Corridor k/ (acres)**	**Miles Crossed**	**Removed g/ (acres)**	**Indirect i/ (acres)**	**UCSA j/ (acres)**	**30-foot Corridor k/ (acres)**
Total Marbled Murrelet Range	Within SHU	Interior	2.74	38.56	363.76	12.36	10.11	1.75	23.65	99.15	8.28	6.35	1.02	16.18	113.28	5.13	3.70	5.52	78.39	614. 42	25.77	20.16
		Other	3.08	39.49	292.42	11.14	11.22	2.43	34.07	105.07	5.09	8.84	4.69	76.08	322.67	16.70	17.13	10.20	149.63	778.69	32.93	37.19
		Subtotal	5.82	78.04	656.18	23.51	21.33	4.18	57.72	204.22	13.37	15.19	5.71	92.26	435.95	21.82	20.83	15.71	228.02	1, 393.10	58.70	57.35
	Outside SHU	Interior	0.00	0.00	0.00	0.00	0.00	3.97	57.56	251.15	11.29	14.45	2.52	38.42	333.99	5.10	9.17	6.48	95.98	840.49	16.38	23.62
		Other	0.00	0.00	0.00	0.00	0.00	12.60	191.65	325.54	39.43	46.01	18.04	290.81	1,678.85	42.61	65.73	30.64	482.46	2, 929.12	82.05	111.75
		Subtotal	0.00	0.00	0.00	0.00	0.00	16.57	249.21	576.69	50.72	60.46	20.55	329.22	2,012.83	47.71	74.90	37.12	578.43	3, 769.62	98.43	135.36
	Subtotal	Interior	2.74	38.56	363.76	12.36	10.11	5.72	81.21	643.88	19.57	20.80	3.54	54.60	447.27	10.22	12.87	15.08	174.37	1,454.91	42.15	43.78
		Other	3.08	39.49	292.42	11.14	11.22	15.04	225.72	1,413.87	44.52	54.86	22.73	366.88	2,001.52	59.31	82.86	40.84	632.09	3,707.81	114.98	148.94
		Total	5.82	78.04	656.18	23.51	21.33	20.75	306.93	2,057.75	64.09	75.65	26.27	421.48	2,448.79	69.53	95.73	52.84	806.45	5,162.72	157.13	192.71

a/ Landowner: Federal includes Coos Bay and Roseburg BLM Districts; Non-federal includes state and private lands.
b/ General Location identifies areas within Marbled Murrelet SHUs—occupied and presumed occupied—and areas outside of Marbled Murrelet SHUs but within the range of the marbled murrelet.
c/ Interior Forest: forested habitat farther than 100 meters (328 feet) from existing disturbance (i.e., wide-surface roads, existing corridors) or adjacent land use/vegetation type (i.e., agriculture, non-forest, early regenerating forest), and/or farther than 50 feet from smaller roads with existing canopy cover (FWS 2014c). Other Forest Type includes forested habitat that is currently affected by existing disturbance or adjacent land use/vegetation types within 100 meters (328 feet) of disturbance
d/ Suitable Habitat: generally late-seral forested stands that provide or are presumed to provide nesting structures for marbled murrelet based on modeling and other available GIS data.
e/ Recruitment Habitat: forested land not currently suitable for marbled murrelet nesting that may be capable of becoming suitable marbled murrelet habitat within the next 25 years (FWS 2006c; BLM 1995a, 1995b); generally forested stands 60 years or greater (FWS 2014c).
f/ Capable Habitat: forested land that has the capability of becoming suitable nesting marbled murrelet habitat, generally includes forest stand age 0 to 60 years (FWS 2014c).
g/ Total Habitat: only includes forested MAMU habitat
h/ Pipeline Project components considered in calculation of habitat "Removed:" construction right-of-way, temporary extra work areas, aboveground facilities, permanent and temporary access roads (PAR, TAR), pipe storage yards, and rock source and disposal site.
i/ Acres identified as UCSAs have been incorporated into the 100-meter indirect effects. Indirect Effects considers habitat within 100-meters (328 feet) of habitat removal as measured from the edge of habitat removal/edge of right-of-way/TEWA.
j/ UCSAs would not be cleared of trees during construction and would not affect nesting structures or characteristics. These areas would be used to store forest slash, stumps and dead and downed log materials that would be removed and scattered across the right-of-way after construction during restoration and are considered as temporary insignificant understory habitat effects.
k/ 30-foot-wide Maintenance Corridor would be kept in a shrub/sapling state for the life of the project; all other habitat outside of the 30-foot maintenance corridor would be revegetated, except for those habitats on non-federal or Matrix/Harvest Land Base lands where there is less certainty that replanting would occur or be maintained on the landscape.
Note: Table summarized from table Q-3 in appendix Q, which includes effects by general landowner, by Conservation Zones 3 and 4 and Marbled Murrelet Inland Zones 1 and 2. Habitat effects are also broken out marbled murrelet habitat type and within and outside of marbled murrelet SHUs (occupied and presumed).

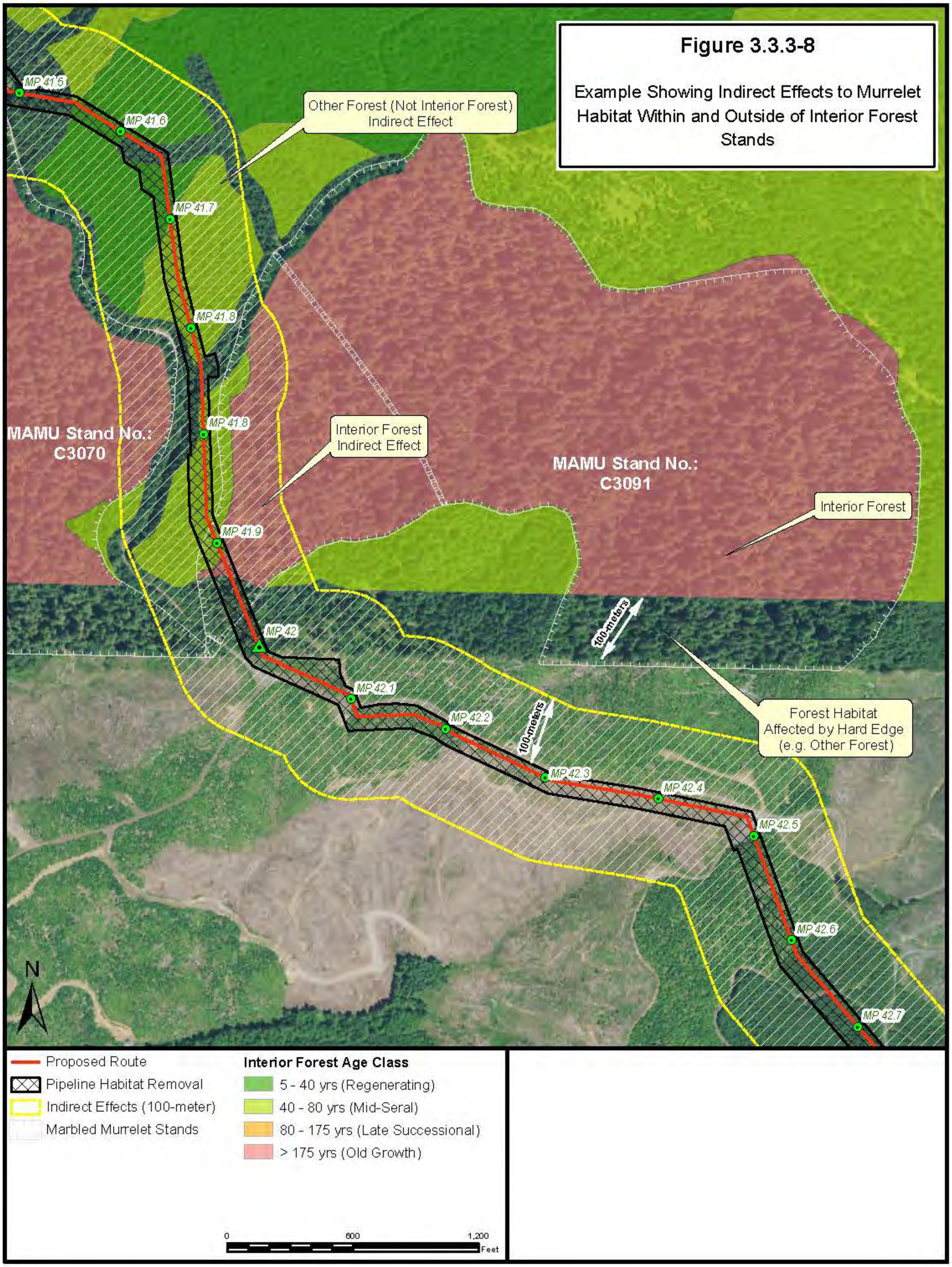


Figure 3.3.3-8
Example Showing Indirect Effects to Murrelet Habitat Within and Outside of Interior Forest Stands
Other Forest (Not Interior Forest) Indirect Effect
Interior Forest Indirect Effect
Interior Forest
Forest Habitat Affected by Hard Edge (e.g. Other Forest)
MAMU Stand No.: C3070
MAMU Stand No.: C3091
100-meters
100-meters
MP 41.5
MP 41.6
MP 41.7
MP 41.8
MP 41.8
MP 41.9
MP 42
MP 42.1
MP 42.2
MP 42.3
MP 42.4
MP 42.5
MP 42.6
MP 42.7
N
Proposed Route
Pipeline Habitat Removal
Indirect Effects (100-meter)
Marbled Murrelet Stands
Interior Forest Age Class
5 - 40 yrs (Regenerating)
40 - 80 yrs (Mid-Seral)
80 - 175 yrs (Late Successional)
> 175 yrs (Old Growth)
0
600
1,200
Feet

More recent investigations have given new support for the relationship between fragmentation, edges, and predation on MAMU nests. Predation at experimental MAMU nests located at fragment edges and at forest interiors was recorded by cameras. Disturbances by avian predators (Steller's jay, *Cyanocitta stelleri*) were more frequent at hard edges (between old-growth and clearcut forest) relative to interiors, but less frequent at soft edges (between old-growth and regenerating forest). There were no edge effects at natural-edged sites associated with riparian forest (Malt and Lank 2007).

Nest disturbance probability at hard edges was 2.5 times that of interior sites, but soft edges had less than half the disturbance probability of interiors (Malt and Lank 2009). The study also showed that the negative effects of fragmentation decrease over time as managed forests regenerate, changing edge characteristics from hard to soft contrasts with older forest stands. Further, the study found Steller's jay to be the dominant avian predator of simulated nests and abundance of Steller's jay increased across the landscape as old-growth forest cover declined (Malt and Lank 2009). That study and another by Marzluff et al. (2004) demonstrated that Steller's jays prefer fragmented habitat and high contrast edges, often sites associated with residential sites and campgrounds, locations where jays are more likely to successfully forage and fledge young. Study results reported by Malt and Lank (2009) suggested that larger areas of habitat would lessen negative effects of hard edges, including surrounding or embedding small reserves of suitable MAMU nesting habitat within a protective matrix of surrounding regenerating forest that would reduce predation risks to nesting MAMUs as well as to the conservation of other old-growth associated bird species (Malt and Lank 2009). However in Oregon, Luginbuhl et al. (2001) found that predator densities and rates of nest predation are higher in areas with a variety of tree ages, so nest success is reduced in areas intermixed with young trees or brush habitat (Raphael 2006).

In addition to Steller's jay, common ravens (*Corvus corax*) have been observed preying on MAMU nestings and eggs (Nelson and Hamer 1995; Peery and Henry 2010). Statistically significant increasing regional trends of corvids within the Pipeline vicinity, specifically Steller's jay and common ravens, have been observed during the National Audubon Society CBCs since the early 1990s (see figure 3.3.3-9) and have likely contributed to existing but undocumented nest predation of MAMUs and other bird species (see Liebezeit and George 2002 for a comprehensive review of corvid predation). Population viability modeling of MAMUs in central California included various nest predation rates by corvids (Peery and Henry 2010). With only a 40 percent reduction in predation, the extinction risk was dramatically reduced from 96 percent to 5 percent over 100 years and a 60 percent reduction resulted in a stable MAMU population with assumed modest proportion of breeders, renesting rates, and corvid predation rates. The modeled population viability analysis revealed that nest predation would only need to be reduced by 40 percent to produce a stable population if corvid management was coupled with a modest increase in after-hatch-year survival rate (Peery and Henry 2010). Corvid control resulted in greater gains in MAMU population size when the maximum number of breeders was allowed to increase over time, similar to what would be expected if the amount of old-growth nesting habitat increased over time (Perry and Henry 2010). The authors and others (Liebezeit and George 2002) advocate evaluating local corvid populations, local conditions that may subsidize artificially high population levels (e.g., food, garbage), and MAMU nest site vulnerability to develop a corvid management plan that may or may not include lethal removal if an immediate short-term solution to predation is required (e.g., Liebezeit and George 2002).

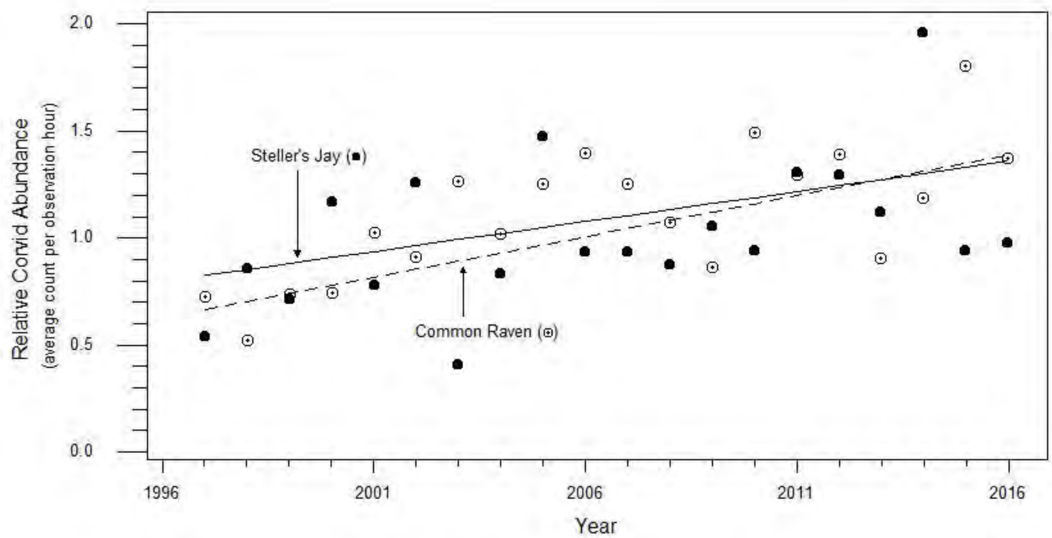


Figure 3.3.3-9 Relative Abundance for Two Species of Corvids Surveyed During the National Audubon Society Christmas Bird Counts within the Pipeline Vicinity, 1997 through 2016, with Significant Increasing Trends (Steller's Jay, P<0.05; Common Raven, <0.001).

Creation of a 30-foot shrub/grass utility corridor could increase current corvid densities and result in reduced nest success, although, where feasible, revegetation (tree planting) outside of the 30-foot maintenance corridor on certain federal lands and non-federal lands and subsequent regrowth may reduce the effects of a hard edge and minimize predation on nesting MAMU. Food enticements associated with human presence during construction activities could also increase predator populations within the vicinity of the Pipeline. All trash, food waste, and other items attractive to ravens, jays, magpies, and other corvids would be picked up and removed from the construction areas on a daily basis to minimize potential predation of MAMU nestlings.

Critical Habitat and Late Successional Reserves

The FWS (1996, 2011b) determined the physical and biological habitat features or PCEs associated with the terrestrial environment that support nesting, roosting, and other normal behaviors essential to the conservation of the MAMU. Within areas essential for successful MAMU nesting, FWS utilized the following physical and biological habitat features to identify critical habitat: PCE 1 – individual trees with potential nest platforms (comparable to suitable habitat within this BA); and PCE 2 – forest lands of at least one half site-potential tree height, within 0.5 mile of individual trees/suitable habitat stand that are recruitment or capable habitat (within a MAMU Group/SHU). Within this analysis, PCE 2 is comparable to recruitment habitat delineated (FWS 2013g).

A variety of ongoing or proposed activities that disturb or remove physical and biological habitat features may adversely affect, remove or modify MAMU critical habitat. Such activities include, but are not limited to: 1) forest management activities that greatly reduce stand canopy closure, appreciably alter the stand structure, or reduce the availability of nesting sites; 2) land disturbance activities such as mining, sand and gravel extraction, and road building; and 3) harvest of certain types of commercial forest products (e.g., moss).

Those activities have the following effects on the PCEs of MAMU critical habitat:

1. Removal or degradation of individual trees with potential nesting platforms, or the nest platforms themselves, that results in a substantial decrease in the value of the trees for future nesting use. Moss may be an important component of nesting platforms in some areas.
2. Removal or degradation of trees adjacent to trees with potential nesting platforms that provide habitat elements essential to the suitability of the potential nest tree or platform, such as trees providing cover from weather or predators.
3. Removal or degradation of forested areas with a canopy height of at least one-half the site-potential tree height and regardless of contiguity, within 0.5 mile of individual trees containing potential nest platforms. This includes removal or degradation of trees currently unsuitable for nesting that contribute to the integrity of the potential nest area (e.g., trees that contribute to the canopy of the forested area). These trees provide the canopy and stand conditions important for MAMU nesting (FWS 1996).

The Pipeline crosses one federally designated CHU (OR-06-d) five times for a total of 2.14 miles, although not all habitat within designated critical habitat is forested MAMU habitat (i.e., listed as "non-capable" in table Q-3 in appendix Q; also see table 3.3.3-15). Additionally five rock source and disposal sites occur within critical habitat: Signal Tree Road Quarry (Section 3, MP 45.86), Signal Tree Road Quarry (Section 15, MP 47.00), Weaver Road Quarry Sites 1 and 2 (MP 47.00), and Signal Tree Road Quarry (Section 35, MP 47.00). These are existing quarries and although GIS indicates the quarries provide recruitment (0.97 acre) and capable (4.90 acres) MAMU habitat, no forested habitat would be removed within these sites. Overall, construction of the Pipeline Project would remove 4.33 acres of suitable MAMU nesting habitat (PCE-1) and 11.77 acres of recruitment (PCE-2) within CHU OR-06-d (see table 3.3.3-15), all within MAMU SHUs. Additionally, approximately 1.64 acres of suitable habitat (PCE-1), and 0.95 acre of recruitment habitat within CHU OR-06-d have been identified for use by the Pipeline Project as UCSAs that may be used to store forest slash, stumps, and dead and downed log materials that would be removed and scattered across the right-of-way after construction during restoration (see UCSA Column, table 3.3.3-15).

Use of the UCSAs would be a short-term disturbance of understory vegetation within suitable and potentially suitable habitat and would not affect potential nesting stand structures or characteristics. After construction, approximately 19.44 acres of MAMU habitat within CHU OR-06-d outside of the 30-foot maintenance corridor would be replanted with tree species and effects of edge would decrease over time. A detailed table of CHU OR-06-d affected by the Pipeline within and outside of MAMU SHUs and interior forest is provided in appendix Q (table Q-3); non-capable habitat that is affected in designated critical habitat can be reviewed in table Q-2, appendix Q.

Designated critical habitat only occurs within MAMU Inland Zone 1. Approximately half (54.1 percent) of forested habitat within CHU OR-06-d affected by the proposed action overlaps with BLM RMP designated LSRs in Coos Bay and Roseburg BLM Districts (see table Q-3 in appendix Q). The Pipeline Project would remove approximately 176.5 acres of MAMU habitat (65.37 acres of suitable, 55.93 acres of recruitment, and 55.19 acres of capable habitat) within LSRs, of which 100.61 acres of forested habitat within LSRs would be replanted with trees outside of the 30-foot maintenance corridor which would reduce the effects of edge over time (see table 3.3.3-16). Table 3.3.3-16 identifies the MAMU habitat that would be affected within LSRs from construction. A detailed table of LSRs affected by the Pipeline Project within and outside of MAMU SHUs and interior forest, as well as non-capable habitat that is affected and occurs in LSRs is provided in table Q-6 in appendix Q. Table Q-3 in appendix Q provides the acres of MAMU habitat affected within Marbled Murrelet Inland Zones 1 and 2 and Recovery Plan Conservation Zones 3 and 4, including landowner, and identifies the area that FWS-designated CHU OR-06-d overlaps with LSRs within and outside of MAMU SHUs.

Within Murrelet Inland Zones 1 and 2 where federal land is checker-boarded, Pacific Connector considered locations of LSRs, occupied MAMU stands, and/or late successional / old-growth forest when routing the Pipeline and tried to avoid those tracts of lands if another constructible route was feasible to minimize impacts to MAMU habitat (see MAMU and NSO Avoidance Plan). Minimizing effects to LSRs also minimizes effects to MAMU designated critical habitat because overlap of MAMU CHU OR-06-d and LSRs occurs. Table 3.3.3-17 summarizes the location of the Pipeline Project and MAMU habitat affected in relation to MAMU designated CHU OR-06-d.

In addition to direct loss of critical habitat and effects to PCEs due to construction, the Pipeline Project's indirect effects to MAMU that were discussed above (fragmentation, edge, and effects to interior forest) indirectly affect designated critical habitats and PCEs. Edge effects and effects to interior forest may induce changes to forest characteristics later in time and would indirectly affect PCEs. Such effects may induce changes at individual nest trees and/or trees with potential nest platforms (PCE-1). Long-term effects on edges and interiors of recruitment habitat (PCE-2) are less well defined and over time, edge effects would diminish as edges evolve from "hard" to "soft" after revegetation occurs in the construction right-of-way, and in particular, trees are planted outside of the 30-foot maintenance corridor (see for example, Peery and Henry 2010).

TABLE 3.3.3-15

Summary of Marbled Murrelet Critical Habitat Unit OR-06d that would be Affected during Construction and Operation of the Project by Recovery Plan Conservation Zones and Landowner

		PCE1 / Suitable Habitat a/					PCE2 / Recruitment Habitat b/					PCE2 / Capable Habitat c/					Total Acres				
			Construction			Operation		Construction			Operation		Construction			Operation		Construction			Operation
Land Owner	**Land Owner**	**Miles Crossed**	**Removed d/ (acres)**	**Indirect e/ (acres)**	**UCSA f/ (acres)**	**30-foot Corridor g/ (acres)**	**Miles Crossed**	**Removed d/ (acres)**	**Indirect e/ (acres)**	**UCSA f/ (acres)**	**30-foot Corridor g/ (acres)**	**Miles Crossed**	**Removed d/ (acres)**	**Indirect e/ (acres)**	**UCSA f/ (acres)**	**30-foot Corridor g/ (acres)**	**Miles Crossed**	**Removed d/ (acres)**	**Indirect e/ (acres)**	**UCSA f/ (acres)**	**30-foot Corridor g/ (acres)**
Marbled Murrelet Inland Zone 1																					
Conservation Zone 4	BLM - Coos Bay	0.08	1.02	32.88	0	0.47	0.70	8.78	59.27	0.93	4.14	0.15	5.76	20.64	0	0.97	0.93	15.57	112.79	0.93	5.59
	BLM - Roseburg	0.19	2.43	18.90	0	1.17	0.06	1.52	21.38	0	0.36	0	1.44	8.67	0	0.01	0.25	5.39	48.95	0	1.54
Total Conservation Zone 4		**0.27**	3.45	51.78	0	1.64	0.76	10.30	80.64	0.93	4.50	0.15	7.20	29.31	0	0.98	**1.19**	20.95	161.73	0.93	7.12
Outside Conservation Zones	BLM - Roseburg	0.02	0.88	22.91	1.64	0.09	0.11	1.47	8.40	0.02	0.68	0.62	7.89	36.38	0.14	3.85	0.75	10.24	67.69	1.80	4.62
Total Critical Habitat		**0.29**	**4.33**	**74.69**	**1.64**	**1.74**	**0.87**	**11.77**	**89.04**	**0.95**	**5.18**	**0.77**	**15.09**	**65.69**	**0.14**	**4.83**	**1.94**	**31.19**	**229.42**	**2.73**	**11.75**

a/ PCE1/Suitable Habitat: individual trees with potential nest platforms, including supporting trees delineated as occupied or suitable (comparable to suitable habitat)
b/ PCE2/Recruitment Habitat: forest lands of at least one half site-potential tree height, within 0.5 miles of individual trees/suitable habitat stand that are recruitment or capable habitat (comparable to recruitment habitat) not currently suitable for marbled murrelet nesting that may be capable of becoming suitable marbled murrelet habitat within the next 25 years (FWS 2006c; BLM 1995a, 1995b); generally forested stands 60 years or greater (FWS 2014c).
c/ PCE2/Capable Habitat: forested land that has the capability of becoming suitable nesting marbled murrelet habitat, generally includes forest stand age 0 to 60 years (FWS 2014c).
d/ Pipeline Project components considered in calculation of habitat "Removed:" construction right-of-way, temporary extra work areas, aboveground facilities, permanent and temporary access roads (PAR, TAR), pipe storage yards, and rock source and disposal sites.
e/ Acres identified as UCSAs have been incorporated into the 100-meter indirect effects. Indirect Effects considers habitat within 100 meters (328 feet) of habitat removal as measured from the edge of habitat removal/edge of right-of-way/TEWA.
f/ UCSAs would not be cleared of trees during construction and would not affect nesting structures or characteristics. These areas would be used to store forest slash, stumps and dead and downed log materials that would be removed and scattered across the right-of-way after construction during restoration and are considered as temporary insignificant understory habitat effects.
g/ 30-foot-wide Maintenance Corridor would be kept in a shrub/sapling state for the life of the project.

Summarized from table Q-5 in appendix Q.

TABLE 3.3.3-16

Summary of MAMU Habitat within Late Successional Reserves within Marbled Murrelet Inland Zones 1 and 2 and Recovery Plan Conservation Zones that Would Be Affected by Construction and Operation of the Project

		Suitable Habitat a/					Recruitment Habitat b/					Capable Habitat c/					Total Acres				
			Construction			Operation		Construction			Operation		Construction			Operation		Construction			Operation
Recovery Plan Conservation Zone	**Land Owner**	**Miles Crossed**	**Removed d/ (acres)**	**Indirect e/ (acres)**	**UCSA f/ (acres)**	**30-foot Corridor g/ (acres)**	**Miles Crossed**	**Removed d/ (acres)**	**Indirect e/ (acres)**	**UCSA f/ (acres)**	**30-foot Corridor g/ (acres)**	**Miles Crossed**	**Removed d/ (acres)**	**Indirect e/ (acres)**	**UCSA f/ (acres)**	**30-foot Corridor g/ (acres)**	**Miles Crossed**	**Removed d/ (acres)**	**Indirect e/ (acres)**	**UCSA f/ (acres)**	**30-foot Corridor g/ (acres)**
Marbled Murrelet Inland Zone 1																					
Conservation Zone 3	BLM - Coos Bay	0.02	2.22	14.61	1.57	0.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	2.22	14.61	1.57	0.22
Total Conservation Zone 3		**0.02**	**2.22**	**14.61**	1.57	**0.22**	**0.00**	**0.00**	**0.00**	0.00	**0.00**	**0.00**	**0.00**	**0.00**	0.00	**0.00**	**0.02**	**2.22**	**14.61**	1.57	**0.22**
Conservation Zone 4	BLM - Coos Bay	3.51	43.40	366.65	12.23	21.65	3.64	50.74	295.34	8.41	22.26	2.90	47.00	187.92	8.36	17.32	10.04	141.15	849.91	29.00	61.23
	BLM - Roseburg	0.20	2.46	18.28	0.00	1.19	0.06	0.40	0.30	0.00	0.33	0.00	0.15	0.96	0.00	0.01	0.25	3.02	19.55	0.00	1.54
Total Conservation Zone 4		3.70	45.87	384.93	12.23	22.84	3.69	51.14	295.64	8.41	22.59	2.90	47.16	188.88	8.36	17.33	10.30	144.17	869.45	29.00	62.76
Outside Recovery Zone	BLM - Roseburg	0.27	4.17	41.88	1.64	1.63	0.11	1.47	8.42	0.02	0.68	0.63	8.03	32.46	0.14	3.91	1.02	13.67	82.76	1.80	6.23
Total MAMU Inland Zone 1		**4.00**	**52.25**	**441.43**	15.45	**24.70**	**3.81**	**52.61**	**304.06**	8.42	**23.27**	**3.53**	**55.19**	**221.33**	8.50	**21.25**	**11.33**	**160.06**	**966.82**	32.38	**69.21**
Marbled Murrelet Inland Zone 2																					
Outside Recovery Zone	BLM - Roseburg	0.86	13.11	83.78	4.68	5.22	0.24	3.32	26.66	26.66	1.44	0.00	0.00	5.11	0.00	0.00	1.10	16.43	115.55	4.69	6.67
Total Marbled Murrelet Range																					
Total Marbled Murrelet Range	BLM - Coos Bay	3.53	45.62	381.26	13.80	21.87	3.64	50.74	295.34	8.41	22.26	2.90	47.00	187.92	8.36	17.32	10.06	143.37	864.52	30.57	61.45
	BLM - Roseburg	1.33	19.74	143.94	6.32	8.04	0.41	5.19	35.38	26.68	2.45	0.63	8.18	38.53	0.14	3.92	2.37	33.12	217.86	6.49	14.44
Total Marbled Murrelet Range		**4.85**	**65.37**	**525.20**	20.12	**29.91**	**4.04**	**55.93**	**330.72**	35.09	**24.71**	**3.53**	**55.19**	**226.45**	8.50	**21.24**	**12.44**	**176.49**	**1082.37**	37.06	**75.88**

a/ Suitable Habitat: generally late-seral forested stands that provide or are presumed to provide nesting structures for marbled murrelet based on modeling and other available GIS data.
b/ Recruitment Habitat: forested land not currently suitable for marbled murrelet nesting that may be capable of becoming suitable marbled murrelet habitat within the next 25 years (FWS 2006c; BLM 1995a, 1995b); generally forested stands 60 years or greater (FWS 2014c).
c/ Capable Habitat: forested land that has the capability of becoming suitable nesting marbled murrelet habitat, generally includes forest stand age 0 to 60 years (FWS 2014c).
d/ Pipeline Project components considered in calculation of habitat "Removed:" construction right-of-way, temporary extra work areas, aboveground facilities, permanent and temporary access roads (PAR, TAR), pipe storage yards, and rock source and disposal sites.
e/ Acres identified as UCSAs have been incorporated into the 100-meter indirect effects. Indirect Effects considers habitat within 100 meters (328 feet) of habitat removal as measured from the edge of habitat removal/edge of right-of-way/TEWA.
f/ UCSAs would not be cleared of trees during construction and would not affect nesting structures or characteristics. These areas would be used to store forest slash, stumps and dead and downed log materials that would be removed and scattered across the right-of-way after construction during restoration and are considered as temporary insignificant understory habitat effects.
g/ 30-foot-wide Maintenance Corridor would be kept in a shrub/sapling state for the life of the project; all other habitat outside of the 30-foot maintenance corridor would be revegetated, except for those habitats on non-federal or Matrix/Harvest Land Base lands where there is less certainty that replanting would occur or be maintained on the landscape.

Summarized from table Q-7 in appendix Q. Non-Capable habitat (not forested and not capable of becoming suitable habitat, or deciduous forest) that occurs in LSRs is included in table Q-7 in appendix Q.

TABLE 3.3.3-17

Summary of Habitat Affected in Marbled Murrelet Designated Critical Habitat Unit OR-06-d from the Project

Critical Habitat Unit	Land Ownership	Land Use Allocation	Total acres of PCE1 that would be removed a/	Total Acres of PCE2/Recruitment removed b/	Total Acres of PCE2/Capable c/	Length of Pipeline through CHU (miles)	Additional Comments
OR-06-d	Coos Bay BLM	LSR / Harvest Land Base	1.02	5.3	2.27	0.67	1st crossing (MPs 41.44-42.01): Pipeline routed through mostly regenerating (capable) and mid-seral (recruitment) forest, with a portion crossing through the edge of an old-growth/occupied (suitable) stand; crosses corner of critical habitat section. Follows or occurs within an existing road for a small portion.
		Harvest Land Base / Riparian Reserve	0.0	3.50	0.0	0.32	2nd crossing (MPs 43.20-43.50): route mostly parallels a road through regenerating (capable) forest.
			0.0	0.0	3.49	N/A	Rock Sources (Signal Tree Road Quarry Section 35 – MP 47.00, Weaver Road Quarry Site 1 and 2 – MP 47.00): within previously disturbed quarries.
OR-06-d	Roseburg BLM	LSR / Harvest Land Base	2.43	0.55	0.04	0.26	3rd crossing (MPs 46.91-47.17) – Weaver Ridge reroute: crosses mosaic of old-growth (suitable) and regenerating (capable) forest; parallels a road for approximately 0.06 mile.
		LSR	0.0	1.32	3.04	0.33	4th crossing (MPs 52.61-52.94): crosses mid-seral (recruitment) and regenerating (capable) forest; crosses corner of critical habitat section.
			0.88	0.15	4.90	0.59	5th crossing (MPs 53.10-53.70): generally follows a road between regenerating (capable) and late successional (suitable) stands.
			0.0	0.97	1.40	N/A	Rock Sources (Signal Tree Road Quarry Section 15 – MP 47.00, Signal Tree Road Quarry Section 3 – MP 45.86): within previously disturbed quarries - no recruitment habitat would be removed.

a/ PCE 1 = suitable habitat
b/ PCE 2 = recruitment habitat
c/ PCE 2 = capable habitat, which includes early mid-seral forest, as well as clearcut and regenerating coniferous forest.

Long-term effects from removal of interior forest within critical habitat, LSRs, and unmapped LSRs by the Pipeline could occur from clearing MAMU habitat. Tables 3.3.3-15 and 3.3.3-16 identify the distance that MAMU habitat is crossed by the Pipeline within and outside of interior habitat, and summarize the acreage of MAMU habitat directly removed and indirectly affected within 100 meters (328 feet) of the Pipeline Project (habitat removal) by Marbled Murrelet Inland Zones 1 and 2, and landowner within CHUs and NWFP LSRs and unmapped LSRs, respectively. Tables Q-5 and Q-6 in appendix Q provide detailed effects to MAMU Habitat within CHU OR-06-d and LSRs, respectively, including MAMU habitat affected within and outside of MAMU SHUs and interior forest. Most indirect effects to forested habitat within 100 meters (328 feet) of habitat removal occur in MAMU habitat that has been previously affected by existing edge, such as roads, waterbodies, early seral forest, and nonforested habitat.

3.3.3.4 Conservation Measures

Pacific Connector and Jordan Cove have implemented or proposed conservation measures including avoidance, minimization, and rehabilitation/restoration, as described below.

Avoidance, Minimization, and Rehabilitation / Restoration

Conservation measures have been proposed by Pacific Connector and Jordan Cove to minimize construction and operations impact to the terrestrial nesting analysis area. Those measures have been compiled in table 2C in appendix N. Specific conservation measures that would benefit MAMUs include those that:

- avoid timber clearing during the breeding and nesting season;
- apply DTRs for construction activities within 0.25 mile of occupied or presumed occupied stands during the critical breeding season (April 1 through August 5);
- route the Pipeline through existing disturbance or previously disturbed forested lands to minimize impact to higher quality MAMU habitat;
- minimize removal of forest by incorporating UCSAs into the project design;
- utilize two-year construction window to minimize the overall TEWAs;
- flag large diameter trees on edges of construction right-of-way or temporary work areas where feasible to save from clearing, as outlined in the POD's *Leave Tree Protection Plan*;
- ensure that all trash, food waste, and other items attractive to crows, jays, and other corvids would be contained and removed from the construction areas on a daily basis to minimize potential predation on MAMU nestlings;
- use logging methods that would minimize damage to adjacent trees when clearing the right-of-way to reduce potential infestation from forest pathogens and insects; and
- minimize potential for establishment of invasive vegetation and establish control of noxious weeds.

Conservation measures have been proposed by Jordan Cove to minimize construction and operation impacts to foraging marbled murrelets in the marine and estuarine analysis areas. Measures to reduce ship speeds once inside the Coos Bay navigation channel to between 4 to 6 knots and within the marine analysis area when pods or large assemblages of cetaceans are observed near an underway ship would provide protection to MAMU as well. Those measures have been compiled in tables 2A and 2B in appendix N. Specific conservation measure that would benefit MAMUs include:

- The contractor would develop and implement a turbidity monitoring and management plan (TMMP) that describes measures to reduce and monitor turbidity impacts resulting from dredging activities. Water quality monitoring would be performed during active in-water work operations in Coos Bay to ensure compliance with federal and state water quality standards.
- Jordan Cove has prepared an SPCCP for both construction and operational phases of the LNG Project to minimize the potential for accidental releases of hazardous materials and to establish proper protocol concerning minimization, containment, remediation, and reporting of any releases that occur.
- All in-water work associated with the LNG Project would be conducted during the ODFW-approved in-water work window for Coos Bay (October 1 to February 15) unless otherwise approved by the appropriate agencies.
- Whenever feasible, a vibratory hammer would be used during in-water piling installation. If not feasible, an appropriately sized drop or impact hammer would be used to complete the job following the manufacturers' recommendations to drive the piling. If an impact hammer is used to drive or proof steel piling within fish-bearing waters, then sound attenuation devices would be used to effectively dampen sound in accordance with the guidance in NMFS and FWS (2006), *Impact Pile Driving Sound Attenuation Specifications*, which is the standard NMFS applies in Oregon.
- Vibratory equipment would be used during installation of land-based sheet pile. Pre-drilling of sheet pile for the Slip and MOF and for pipe pile within a 30 meter setback would also be completed. Installation of piles would use an appropriately sized impact hammer.

Plans included in the appendices of Pacific Connector's POD (see appendix B in this BA) would also minimize effects to MAMU habitat and/or nesting MAMUs. The *Leave Tree Protection Plan* describes the preconstruction surveys that would be completed to clearly mark the boundaries of the Pipeline Project's certificated working limits, and procedures to identify individual trees within and along the edges of the certificated work limits that can be conserved or left standing, as well as BMPs that would be employed to minimize damage to trees within UCSAs and protect trees not removed from the construction right-of-way (see appendix P to the POD). An *Integrated Pest Management Plan* (see Appendix N to the POD) describes BMPs to address the control of noxious weeds, invasive plants, forest pathogens, and soil pests, as well as describes measures to minimize the potential spread of invasive species and potential adverse effects of control treatments. The *Blasting Plan* and *Air Noise and Fugitive Dust Plan* (see Appendices C and B to the POD, respectively) provide mitigation measures and monitoring plans to minimize noise effects to nesting MAMUs during construction of the Pipeline Project.

Pacific Connector prepared an *Avoidance and Minimization Plan for MAMU and NSO* (see appendix V.1) that identifies the additional measures that have been incorporated into the project design to reduce impacts to both MAMUs and NSOs. This avoidance plan was developed through consultations with the FWS and the cooperating agencies (Interagency Habitat Quality Subgroup-

Micro Siting Working Group, June 4, 2008). Application of measures outlined in the plan would minimize potential impacts to suitable MAMU habitat by 1) converting TEWAs to UCSAs to reduce the amount of suitable habitat removed by the Pipeline Project, 2) moving TEWAs to avoid impacts to suitable habitat within occupied or presumed occupied stands, and 3) moving the alignment to avoid MAMU occupied or presumed occupied stands. A "Standard Rules Set" was developed during the meeting to further minimize effects to MAMU, and this Standard Rules Set would be implemented prior to or concurrent with tree felling. The Standard Rules Set measures include:

- identify potential nest trees that would be allowed to remain standing within TEWAs or edge of right-of-way;
- identify TEWAs to be reduced in size or eliminated to reduce removal of suitable habitat;
- identify any additional minor route adjustments that would not alter constructability but further reduce removal of suitable habitat;
- identify any previously unknown nest tree discovered and assure that it is properly protected by applying the appropriate seasonal limitations or daily timing restrictions associated with similar locations along the alignment; and
- EIs would be supported by qualified biologists to identify potential nest trees.

To avoid direct effects to MAMU, Pacific Connector would remove timber outside of the entire MAMU breeding season (after September 15 but before March 31) within 300 feet of MAMU stands to ensure that trees with active MAMU nests and chicks are not felled. Additionally, to minimize disturbance within forested areas, Pacific Connector has designated nearly 165 acres (see table 3.3.3-11) of UCSAs within Marbled Murrelet Inland Zones 1 and 2 that would not be cleared of trees but be used to store forest slash, stumps, and dead and downed log materials during construction that would be scattered across the right-of-way after construction and during restoration. The UCSAs would be used for construction of the Pipeline Project while not requiring removal of trees or understory vegetation, as well as allow the maintenance of suitable or potentially suitable and recruitment habitat function.

Construction of the Pipeline would occur within Marbled Murrelet Inland Zones 1 and 2, including within MAMU occupied stands during the entire breeding season. Construction would occur after timber has been felled outside of the breeding season and would adhere to DTRs (activity limited to 2 hours after sunrise and 2 hours before sunset) within 0.25 mile of MAMU stands (occupied and presumed occupied) at least through the critical breeding season to minimize risk of disturbance to adult MAMUs entering and leaving the stand, as well as possible dispersal of juveniles. DTRs would continue to be applied to large transport helicopter use in the late breeding season within 0.25 mile of a MAMU stand if helicopter use is necessary.

Within known occupied stands, Pacific Connector sited the route centerline within existing roads that traverse the stand or otherwise sited the right-of-way within existing edge (i.e., within clearcut or regenerating forest adjacent to a stand) to avoid or minimize habitat removal from the stand, where feasible. In other areas, Pacific Connector has rerouted the Original 2007 Route (FERC 2009) to avoid removing habitat and further fragmenting suitable MAMU stands (occupied and presumed occupied). Also, to minimize impacts to MAMU stands and suitable nesting habitat, Pacific Connector has incorporated minor alignment adjustments or TEWA modifications into the Pipeline Project. Other major and minor route alternatives that further minimize effects to

MAMUs and habitat have been considered and included in the Pipeline route, which are discussed in the *Marbled Murrelet and Northern Spotted Owl Avoidance and Minimization Plan* (appendix V.1 to this BA).

When and if Pacific Connector acquires survey access in stands identified to have potential nesting habitat (presumed occupied stands), where survey permission has been denied, Pacific Connector would evaluate the stands for trees with suitable nesting structures. If suitable nesting structures are identified and time permits for two-year protocol surveys prior to beginning the proposed Project, Pacific Connector has indicated they may survey those stands for occupied MAMU behavior. If protocol surveys are not conducted, Pacific Connector would continue to presume occupancy and apply conservation measures to those presumed occupied stands. When and if additional information on the status of these presumed occupied MAMU stands is acquired, Pacific Connector would advise the FWS of their updated status, including whether they are determined to have suitable nesting structures, determined to be occupied or unlikely occupied, or determined to not be suitable habitat for nesting MAMUs.

During construction, Pacific Connector would ensure that the construction contracts include stipulations ensuring that all trash, food waste, debris, and other items attractive to crows, jays, and other corvids would be picked up and removed from the construction areas on a daily basis year round to minimize potential predation of MAMU nestlings. Pacific Connector's EIs would be responsible for overseeing that the construction contractor is adequately following these stipulations.

Pacific Connector has also proposed measures to rectify, repair, rehabilitate, and otherwise reduce impact to forested habitats once construction of the Pipeline is complete. Those measures have been compiled in table 3C in appendix N. Specific conservation measures that would benefit MAMUs include those that:

- replant conifer species outside of the 30-foot-wide maintenance corridor after construction, where allowable, which would contribute to the re-establishment of native vegetation and soften the edge effect created from construction of the Pipeline Project if the area is allowed to revegetate;
- contribute to forest habitat structural diversity (e.g., snags and downed timber); and
- minimize potential for increased human use of the reclaimed construction right-of-way and intrusion into undisturbed habitats.

Following construction, affected forested lands (the construction right-of-way and TEWAs outside of the 30-foot maintenance right-of-way) would be replanted and allowed to return to the pre-construction condition where possible, with tree species in the approximate proportion to those species removed. This replanting would occur on certain federal lands and non-federal lands on a case- by-case basis. Replanted trees may also be harvested from non-federal lands or federal lands slated for timber harvest. Tree establishment would be allowed to occur up to 15 feet on either side of the centerline. Over the short term, replanting a maximum of approximately 1,211 acres on the edge of the 30-foot maintenance corridor within the range of the MAMU would provide a soft edge to adjacent forested habitat and minimize effects of edge, as well as reduce predator presence (see table 3.3.3-11). However, if allowed to regrow, these areas would provide minimal benefit to MAMUs because it would take decades to restore replanted forests to recruitment or suitable habitat conditions. Over the long term (200 to 250 years to become MAMU suitable nesting habitat), revegetated areas outside of the 30-foot maintenance corridor may achieve tree structural characteristics comparable to trees that would be removed, had they not been affected. MAMU habitat affected outside of MAMU SHUs or within a MAMU SHU that were provided a "No Impact Category" in appendix Z1 are considered areas of "Low Impact," as well.

As part of the EIS prepared for the Project, FERC staff recommended that Pacific Connector adhere to FWS-recommended timing restrictions within threshold distances of MAMU stands during construction, operations, and maintenance of the pipeline facilities (as outlined in FWS 2016c). If the Commission authorizes the Project, it is expected that these measures would be incorporated as conditions of the authorization, and therefore the effects described in this BA would be reduced. Specifically, adherence to FWS-timing restrictions would reduce impacts by eliminating the disruption and disturbance effects described above in section 3.3.3.3 (Effects of the Proposed Action, tables 3.3.3-9 and 3.3.3-10, respectively), and summarized below in section 3.3.3.5 (Determination of Effects). We anticipate that the direct removal and modification of habitat described above and below would still occur, and would result in long-term adverse effects to the species (e.g., long-term loss of habitat), but that the noise and visual effects associated with timber clearing, pipeline construction, helicopter use, blasting, and existing road use, as well as direct effects from helicopter rotor wash, would be unlikely to occur. Therefore, the Project would still adversely affect MAMU, but these effects would be reduced by avoiding direct effects to breeding individuals during construction.

Jordan Cove and Pacific Connector have indicated an interest in working with the FWS to discuss possible mitigation for MAMU, but have not proposed such mitigation at this time. Therefore, the effects described in this BA, including the determination of effects summarized below, are in the absence of applicant-proposed mitigation other than industry standard avoidance and minimization measures. If additional mitigation is subsequently proposed by the applicant and deemed appropriate by the FWS, it is assumed that the overall effects to MAMU would be reduced.

3.3.3.5 Determination of Effects

Species

The Project **may affect** MAMUs because:

- suitable habitat is available within the terrestrial nesting analysis area;
- MAMUs have been located within the terrestrial nesting analysis area during survey efforts for the Project; and
- MAMUs are expected to forage offshore in the marine analysis area, and within Coos Bay in the estuarine analysis area.

The Project is **likely to adversely affect** MAMUs because:

- LNG carrier traffic and tractor tugs in the estuarine and marine analysis areas could cause potential behavioral effects on foraging MAMU.
- Disturbance associated with construction of the Project (including clearing of timber and access road use) would occur within the MAMU breeding season and within 0.25 miles of known MAMU stands.

- Proposed actions that generate noise above local ambient levels in approximately 7,145 acres of suitable habitat might disturb or disrupt MAMUs and interfere with essential nesting behaviors.
  - 82 MAMU stands (25 occupied and 57 presumed occupied) are within 0.25 miles of the pipeline construction right-of-way that could be constructed during the breeding season.
  - 168 MAMU stands (50 occupied and 118 presumed occupied) are within 0.25 mile of proposed access roads that could be used during the breeding season.
- Blasting for the pipeline trench may occur within 0.25 mile of 10 MAMU stands between April 1 and September 30.
- Helicopter use within 0.25 miles of eight occupied MAMU stands during the breeding period (between April 1 and September 15) could occur and disturb MAMU adults and nestlings, as well as potentially blow nestlings out of the nest tree within six occupied MAMU Stands from rotor wash.
- The Project would remove approximately 78 acres of suitable nesting habitat within the range of the MAMU, or approximately 0.5 percent of the 14,310 acres of suitable habitat available in the terrestrial nesting analysis area.
- The Project would remove approximately 307 acres of recruitment habitat and 421 acres of capable habitat within the range of the MAMU. This habitat removal does not support the recovery of the species.
- The Project would modify (cause other indirect effects such as increases in edge habitat and loss of interior forest habitat, including increased predation) approximately 656 acres of suitable, 2,058 acres of recruitment, and 2,449 acres of capable habitat.

Critical Habitat

The Project **may affect** MAMU critical habitat because:

- the Project occurs within designated MAMU critical habitat, and
- the Project would result in habitat impacts within designated critical habitat.

The Project is **likely to adversely affect** MAMU critical habitat because:

- the Project could remove or degrade individual trees with potential nesting platforms or the nest platforms themselves, resulting in a decrease in the value of the trees for future nesting use (PCE-1, or suitable or potentially suitable habitat); and
- the Project could remove or degrade trees adjacent to trees with potential nesting platforms that provide habitat elements essential to the suitability of the potential nest tree or platform, such as providing cover from weather or predators (PCE-2, or recruitment/capable habitat).

3.3.4 Northern Spotted Owl

3.3.4.1 Species Account and Critical Habitat

Status

The NSO was listed by the FWS as threatened on June 26, 1990 (FWS 1990), including populations in Oregon. Declining populations due to loss and adverse modification of suitable habitat from timber harvest and natural catastrophes (wild fire, windthrow), as well as inadequate regulatory mechanisms to protect the owl or its habitat (FWS 1990) were the basis for the listing decision.

Threats

As of 1990 when NSO was listed as threatened by the FWS, an estimated 60 percent of suitable NSO habitat present in the Pacific Northwest in 1800 had been eliminated with 90 percent of all remaining suitable habitat occurring on public lands (less than 5 percent of old-growth habitats occurred on private, state, or tribal lands in 1990). At the time of listing, FWS (1990) indicated that given the current trends, remaining unprotected NSO habitat could be eliminated in 10 to 30 years.). At the time of listing, the quality of 50 percent of total remaining NSO habitats across the range of the NSO was judged to be affected by reduction of individual stand size, fragmentation, and edge effects so that successful NSO reproduction was at risk (FWS 1990). Continued logging practices were chiefly responsible for the loss and degradation of habitat, and public forest lands that are intensively managed for timber production generally are not able to achieve old-growth characteristics, which may require 200 years to develop (FWS 1990).

Although timber harvest on federal lands has been greatly reduced since implementation of the NWFP in 1994, documented loss of NSO habitat on federal lands has continued, mostly as a result of wildfires (Davis et al 2016); since 1993, NSO habitat on federal lands has decreased by 1.5 percent range wide (approximately 135,700 acres; Davis et al 2016). Residual habitat loss and continued timber harvest on private lands across the range of NSO continues to threaten this species (FWS 2011c, Davis et al. 2011). Past NSO habitat loss and current NSO habitat loss are still considered pressing threats to the NSO (FWS 2011d).

Natural events and logging create a fragmented landscape that is utilized less by NSO than more intact landscapes (FWS 1990). Further, fragmentation reduces potential metapopulation dynamic interactions between NSO-inhabited patches (extinction, colonization within patches), resulting in potential adverse genetic effects (FWS 1990). High levels of fragmentation, particularly fragmentation found on BLM lands interspersed with private lands forming a "checkerboard," adversely affect adult survivorship and fecundity (FWS 1990), which are the major drivers influencing population growth.

In addition to the relationship of habitat quality and quantity to NSO population declines, in 1990, barred owls were recognized as a potential threat to NSO due to their aggressiveness and potential to displace NSO through competitive interactions (FWS 1990); by 2006, FWS (2007c) recognized that competition from barred owls was a significant "pressing" threat to NSO throughout its range. Threats from barred owls had developed within the context of habitat loss and diminished distribution of habitat by past logging activities and other catastrophic disturbances, as well as ongoing habitat losses from timber harvest, albeit at reduced harvest levels since implementation of the NWFP (FWS 2007c, 2008c; Dugger et al. 2016). Hazards to NSO from barred owl include competition for resources and displacement from suitable habitat (Kelley et al. 2003; Kelley and Forsman 2004) and to a lesser degree than thought in the 1990 listing, hybridization with NSOs (Courtney et al. 2004; Kelley and Forsman 2004). Dugger et al. (2016) report that barred owls have negatively affected spotted owl populations, primarily by decreasing apparent survival and increasing local territory extinction rates.

Another threat to NSO populations is loss of habitat from wildfires, especially within forests that demonstrate succession toward climax communities in the absence of fires (FWS 2011c; Courtney et al. 2004). In drier portions of the NSO range, such as the Eastern Oregon Cascades and Klamath Mountains provinces, wildfire has become more of a threat (FWS 2011c, 2004c). Davis et al. (2016) report 85,900 acres of non-reserved lands in the NSO range had burned since 1993, which represents approximately 48.8 percent of habitat loss reported since 1993. Climate change is expected to increase the risk of large, high-intensity wildfire in the Pacific Northwest (Dugger et al. 2016).

Other potential threats to the NSO and its habitat include West Nile virus and tree diseases, respectively (FWS 2004c; FWS 2006d, 2011c). West Nile Virus has the potential to reduce population numbers beyond what was anticipated from other causes, although to date, no mortality of NSO has been recorded from the West Nile virus (Lint 2005). The revised NSO recovery plan did not consider West Nile virus as a significant threat to spotted owls (FWS 2011c). At this time, no avian diseases, including West Nile Virus, are significantly affecting NSOs (FWS 2011c).

Species Recovery

1992 Draft Recovery Plan (FWS 1992b)

The 1992 Draft Recovery Plan for the NSO considered threats to NSO populations within the proposed project area to include: low and declining populations, loss and fragmentation of habitat, poor population connectivity within each province and with adjacent provinces, and high levels of predators. As a result of these threats, the 1992 Draft Recovery Plan established 196 designated conservation areas (DCAs), of which 56 were considered category 1 DCAs (having the potential to support at least 20 NSO pairs), and the other 140 were considered category 2 DCAs (potential to support 1 to 19 NSO pairs). DCAs were derived from concepts presented by Thomas et al. (1990) in "A Conservation Strategy for the Northern Spotted Owl" that focused on the establishment of large habitat blocks that could support self-sustaining populations of 15 to 20 pairs and protected lands for dispersal of juveniles.

2008 Final Recovery Plan (FWS 2008c)

In April 2007, the FWS released a NSO draft recovery plan for public review, identifying criteria and actions needed to stop NSO decline, reduce threats, and return the species to a stable, well-distributed population in Washington, Oregon, and California over the next 30 years (FWS 2007c). In May 2008, FWS approved the Final Recovery Plan for the Northern Spotted Owl. The recovery plan recommended specific actions that address the threats to the NSO, including threats posed by barred owls, as well as actions to maintain habitat for the recovery and long-term survival of the NSO including dry-forest landscape management strategies. The recovery plan built off strategies set forth in the 1992 Draft Recovery Plan for NSO (FWS 1992b) and the NWFP (Forest Service and BLM 1994), using a network of Managed Owl Conservation Areas (MOCAs) on federal lands and Conservation Support Areas (CSAs) on federal and non-federal lands where recovery actions and criteria would be targeted. MOCAs are larger tracts of lands within non-fire-dominated provinces that are expected to support a stable number of breeding pairs of NSOs over time and allow for movement of NSOs across the network. Within the drier forests of the Eastern Cascades Province, the recovery plan did not identify MOCAs or CSAs since it is expected that the rate of loss of older forests to stand-replacing wildfires would continue or increase in the coming years as the climate changes (Westerling et al. 2006 in FWS 2008c). Rather, the recovery plan recommended treatments to older forests to reduce risks of fires and insect outbreaks even though the strategy could have short-term impacts on NSO habitat, but would achieve the long-term goal of creating more sustainable NSO habitat.

2011 Revised Final Recovery Plan (FWS 2011c)

The 2008 Northern Spotted Owl Recovery Plan was revised in 2011, which continues to address threats of barred owl and habitat loss, and integrates an adaptive management approach to achieve results focusing on the most important actions for recovery, including maintaining and restoring high value habitat for the recovery and long-term survival of the NSO. Recovery criteria have been identified to serve as objective, measurable guidelines to assist in determining if the NSO has recovered and may be delisted, which include: 1) stable population trend, 2) adequate population distribution, and 3) continued maintenance and recruitment of spotted owl habitat. Thirty-three recovery actions were included to guide activities needed to accomplish the four recovery criteria. In some instances, recovery actions are specific to physiographic provinces, which have been identified as recovery units within the 2011 Revised Recovery Plan to assist managers in measuring the objectives of the recovery criteria.

The 2011 Revised Recovery Plan discontinued the recommendation of DCAs, MOCA networks, and CSAs included in previous NSO recovery plans; rather, these areas were considered in revised critical habitat designation in 2012 (FWS 2011c).

Life History, Habitat Requirements, and Distribution

The NSO is a medium-sized owl that occurs in coniferous or mixed coniferous-hardwood forests from southwestern British Columbia through western Washington, Oregon, and northern California south to San Francisco Bay (FWS 1990). Although NSO habitat is variable over its range, to support NSO reproduction, a home range requires appropriate amounts of nesting, roosting, and foraging (NRF) habitat arrayed so that nesting pairs can survive, obtain resources, and breed successfully. NSOs primarily occur in old-growth and mature forests because these habitat types provide the structure and characteristics required for nesting, but they may also inhabit younger forests with the appropriate structural, vegetation, and prey characteristics, including:

- moderate to high canopy cover (60 to 80 percent);
- multi-layered, multi-species canopy dominated by large overstory trees (greater than 30 inches dbh;
- a high incidence of large trees with various deformities,
- numerous large snags;
- large accumulations of fallen trees and other woody debris on the ground; and
- sufficient open space below the canopy to fly (FWS 1990).

High canopy closure is important to help NSOs thermoregulate and reduce potential predation (FWS 1990 and 2007c). Dispersing NSOs, whether adults moving between blocks of suitable NRF habitat (generally 15 miles for females and 9 miles for males; Forsman et al. 2002), or juveniles dispersing from natal areas (a range of 0.3 to 69 miles; Forsman et al. 2002), utilize a wider array of forest types and structures including more open and fragmented habitat. Although forest attributes needed for successful dispersal have not been thoroughly evaluated, they generally consist of conifer and mixed mature conifer-hardwood habitats with canopy cover greater than or equal to 40 percent and conifer trees averaging at least 11 inches dbh (FWS 1992b). Dispersal habitat may occur in NRF habitat, but it lacks the optimal structural characteristics needed for nesting.

Foraging and dispersal habitats may be in younger, more open and fragmented forests than those associated with nesting and roosting (FWS 1992b). Foraging habitat may also be consistent with areas that NSO prey is found. Northern spotted owls are primarily nocturnal, foraging between dusk and dawn, with peak activity occurring two hours after sunset and two hours prior to sunrise (Delaney et al. 1999; Forsman et al. 1984). NSO feed primarily on small mammals, especially northern flying squirrels and woodrats in southwestern Oregon (citations in Anthony et al. 2006).

Northern spotted owls have been reported to occur in the following forest types: Douglas-fir and western hemlock in the coastal forests of Washington and Oregon, Pacific silver fir (*Abies amabilis*) on the west slope of the Cascades in Washington and Oregon, mixed conifer stands including Douglas-fir, grand fir, and ponderosa pine (*Pinus ponderosa*) on the east slope of the Cascades, dry Douglas-fir and mixed conifer in southern interior Oregon, and Douglas-fir, mixed-conifer, and coastal redwood or mixed conifer-hardwood habitat types in California (FWS 1992b; Forsman et al. 1984). The NSO has been reported in a variety of elevations, from 70 feet on the Olympic Peninsula in Washington to more than 6,000 feet in California (FWS 1990).

NSOs are territorial and remain on their home range throughout the year. As a result, NSO have large home ranges that provide all the habitat components and prey necessary for the survival and successful reproduction of a territorial pair. Home ranges vary in size by physiographic province, forest type, and heterogeneity but generally increase in size from south to north where habitat quality decreases and/or becomes more fragmented (Courtney et al. 2004; FWS 1990, 1992b; Forsman et al. 1984). Courtney et al. (2004) determined that the home range size of NSOs appeared to be influenced by a variety of factors including proportion of mature and old-growth forest within the home range, forest fragmentation, and the availability of dominant prey species (larger home ranges where flying squirrels dominated the diet compared to smaller home ranges where wood rats dominated the diet). Within the Pipeline Project area, NSO home ranges typically encompass an area within the following radii around the nest site: 1.5 miles within Coast Range Physiographic Province, 1.3 miles within Klamath Mountains Physiographic Province, and 1.2 miles within East and West Cascades Physiographic Provinces from a nest or roost site (FWS 1992c). Home ranges within the Coast Range physiographic province are much larger where a lot of fragmentation from urban development, timber harvesting, and transmission corridors has occurred (Courtney et al. 2004).

Home ranges contain three distinct use areas: 1) the nest patch, which research has shown to be an important attribute for site selection by NSOs and includes approximately 70 acres of usually contiguous forest (300-meter radius around an activity center; FWS et al. 2008), 2) the core area, which is used most intensively by a nesting pair and varies considerably in size across the geographic range, but on average encompasses approximately 500 acres around the nest site (1/2 mile radius around the activity center), and is generally made up of mostly mature/old-growth forest (FWS 2007c; Courtney et al. 2004), and 3) the remainder of the home range which is used for foraging and roosting and is essential to the year-round survival of the resident pair (FWS 2007c).

NSOs are relatively long-lived. They are sexually mature at the age of 1, but rarely breed until they are 2 to 5 years of age. Females will lay one to four eggs per clutch, with an average of two eggs. However, most NSOs do not nest every year (FWS 2011c). Fecundity in NSOs appears to follow a biennial cycle of high fecundity in even-numbered years and low fecundity in odd-numbered years; however, it is not known what causes the synchronization across the range of the NSO (Dugger et al. 2016). Nesting and fledging varies with latitude and elevation (FWS 1990), although courtship usually occurs in February or March and eggs are laid in late March or April. Although juveniles fledge in late May or June, parental care continues into September when natal dispersal may begin (FWS 2011).

Population Status

Demographic data collected from 11 study areas throughout the range of the northern spotted owl in Washington, California, and Oregon have been used to monitor NSO populations in their geographical range from 1985 through 2013, of which five sites occur in Oregon (Anthony et al. 2006; Dugger et al. 2016). The primary objectives of these studies were to estimate fecundity, apparent survival, and annual population rate of change, and to determine if there were any temporal trends in these population parameters. Recently, studies have also been reporting barred owl activity and its potential effects on the spotted owl population (Dugger et al. 2016). Three of the study sites in Oregon, Tyee, Klamath, and southern Oregon Cascades (South Cascades), are located within and/or adjacent to the Pipeline: Klamath and South Cascades study areas are located in Douglas County (approximately MP 94.13 to MP 98.9) and in Jackson and Klamath counties (approximately MP 153.87 to MP 172.25), and the Tyee study site is located north of the Pipeline. Forests on these study sites were mostly characterized by mixtures of Douglas-fir and western hemlock or by mixed-conifer associations of Douglas-fir, grand fir, western white pine, and ponderosa pine (Anthony et al. 2006; Dugger et al. 2016).

Estimates of fecundity, apparent survival rates, and population change for five study sites within Oregon are included in table 3.3.4-1 (Dugger et al. 2016). Within Oregon, apparent adult survival rates are declining on all but the Oregon Coast Range and Klamath study areas; most annual rates of decline have been increasing. Decreased local extinction rates of NSOs were attributed to barred owl presence in all 11 study areas. In Oregon, increased fecundity was associated with higher annual estimates of the amount of suitable habitat. Overall, demographic declines in study sites were attributed to the increased numbers of barred owls and loss of habitat (Forsman et al. 2011; Davis et al. 2011; Dugger et al. 2016).

TABLE 3.3.4-1

Estimates of Fecundity, Apparent Survival Rates and Population Change for the Five Northern Spotted Owl Demographic Study Sites on Federally-Managed Lands in Oregon from 1985-2013 a/

Study Area	Land-ownership	Fecundity b/		Apparent Survival b/		Population		Overall Trend
		%	Trend	%	Trend	Rate of Change (λ)	Trend	
Coast Range Physiographic Province								
Oregon Coast Range c/	Mixed	22.3	Declining	86.1	No Trend	0.949	Decrease	Declining
Tyee c/	Mixed	26.3	Declining	85.8	Declining	0.976	Decrease	Declining
Klamath Mountains Physiographic Province								
Klamath c/	Mixed	33.5	Declining	84.8	No Trend	0.972	Decrease	Declining
West and East Cascades Physiographic Provinces								
H.J. Andrews d/	Federal	28.8	Declining	87.0	Declining	0.965	Decrease	Declining
South Cascades e/	Federal	32.3	No Trend f/	85.1	Declining	0.963	No Trend f/	Declining

a/ Source: adapted from Dugger et al. 2016.
b/ Provides rates for adults greater than 3 years.
c/ Trends based on data collected between 1990 – 2013
d/ Trends based on data collected between 1988 – 2013
e/ Trends based on data collected between 1991 – 2013
f/ Although study sites appeared stationary throughout the study period (1985-2013), data through 2015 for this study area suggests that fecundity and populations are declining (Dugger 2016).

In 2009, a barred owl removal pilot program was initiated in the Green Diamond Resources (GDR) study area in California where barred owls were removed from a portion of the study area to assess the effectiveness of this program on northern spotted owl survival and population change. Based on the study to-date, removal of barred owls has had a positive effect on northern spotted owl survival and rate of population change, at least at a localized scale (Dugger et al. 2016). Annual rate of decline in all study areas (excluding the GDR treatment area) indicated an average rate of decline of 3.8 percent per year.

Barred owl presence has increased significantly within each NSO demographic study area in Oregon (Dugger 2016; Lesmeister and Reid 2016; Lesmeister 2016; Dugger 2015; Hollen 2015). In 2013, FWS (2013f) released an EIS for the experimental removal of barred owls in four study areas including the Klamath study area in the Pipeline Project area to determine if removal of barred owls can improve localized populations trends of spotted owls (FWS 2013f). Experimental removals following a before-after-control-impact experimental design were initiated in 2015 on three demographic study areas in Oregon and Washington with at least 20 years of pre-treatment demographic data on spotted owls (Wiens et al. 2017). The first 21 months (March 2015 – December 2016) of the planned 5-year experiment has removed 643 individual barred owls outside of the breeding season; treatments are expected to continue through 2020 in the Klamath study area, and through 2019 within the Cle Elum and Coast Ranges study areas. A preliminary analysis of the demographic response of NSOs to experimental removal of barred owls in Oregon and Washington is scheduled to occur after a full 3 years of removal has been completed by March 2018/2019.

Critical Habitat

Critical habitat for the NSO was originally designated on January 15, 1992 and included approximately 6.9 million acres in California, Oregon, and Washington, of which 3.3 million acres occurred in Oregon (FWS 1992c). The 1992 designation was revised in 2008 (FWS 2008e), and more recently in 2012 (FWS 2012e). The 2012 final rule (FWS 2012e) designates approximately

9.6 million acres within 11 CHUs and 60 critical habitat subunits in California, Oregon, and Washington. Eight CHU and 58 subunits are identified in Oregon on a little more than 4.5 million acres. The FWS (2012e) relied on recovery criteria set forth in the 2011 Recovery Plan for the NSO (FWS 2011c) to ensure that designated CHUs met the following criteria: 1) ensures sufficient habitat to support stable, healthy populations across the range and within each CHU, 2) ensures distribution of NSO populations across the range of habitat conditions used by the species, and 3) incorporates uncertainty, including potential effects of barred owls, climate change, and wildfire disturbance risk.

The FWS (1992c) determined that the physical and biological habitat features, the PCEs that are essential for the recovery of the spotted owl, are forested lands used or potentially used for nesting, roosting, foraging, and dispersal; more specificity to PCEs was provided in the revised critical habitat rule in 2012. Based on more current information on the life history, biology, and ecology of the species, the revised PCEs are (FWS 2012e):

- PCE 1: Forest types that may be in early, mid-, or late-seral stages and that support NSOs across its geographical range, primarily: Sitka spruce, western hemlock, grand fir, Pacific silver fir, Douglas-fir, white fir, Shasta red fir (*Abies magnifica*), redwood/Douglas-fir (in coastal California and southwestern Oregon), and the moist end of the ponderosa pine coniferous forest zones. This PCE must occur in concert with at least one of the following PCEs.
- PCE 2: Forested habitat (see PCE 1) that provides for nesting and roosting, and could provide for foraging. Nesting and roosting habitat provides structural features for nesting, protection from adverse weather conditions, and cover to reduce predation risks for adults and young. Across the owl's range, habitat requirements are nearly identical and are associated with a high incidence of large trees with various deformities (large cavities, broken tops, mistletoe infections) or large snags suitable for nest placement. Patches of nesting habitat, in combination with roosting habitat, must be sufficiently large and contiguous to maintain NSO core areas and home ranges, and must be proximate to foraging habitat.
- PCE 3: Habitat that provides for foraging, which varies widely across the NSO range. It can consist of nesting and roosting habitat, and provide for dispersal, but its primary function is to provide a food supply for survival and reproduction. Foraging habitat is closely tied to the prey base and in some cases can include more open and fragmented forests, especially in the southern portion of the owl's range. NSO feed primarily on small mammals, especially northern flying squirrels and wood rats in southwestern Oregon (citations in Anthony et al. 2006).
- PCE 4: Habitat that supports dispersal of spotted owls, which could provide NRF habitat, but could also be composed of other forest types between larger blocks of NRF habitat. Dispersal habitat must, at a minimum, provide stands with adequate tree size and canopy cover to provide protection from avian predators and at least minimal foraging opportunities. It is essential to maintaining genetic and demographic connections among populations across the range of the species.

Because not all NSO life history functions require all the PCEs, not all critical habitat would contain all four PCEs described above. Some CHUs contain all PCEs and support multiple life processes, while other units contain only one or two (FWS 2012e). All CHUs have had or have presence of NSO.

Activities that disturb or remove the PCEs within designated CHUs might adversely modify the owls' critical habitat. These activities could include actions that would reduce the canopy closure of a timber stand, reduce the average dbh of trees in the stand, appreciably modify the multi-layered stand structure, reduce the availability of nesting structures and sites, reduce the suitability of the landscape to provide for safe movement, or reduce the abundance or availability of prey species (FWS 1992c).

Late Successional Reserves

Additional habitat protection for the NSO was established when the Forest Service and BLM adopted the NWFP in 1994. The NWFP (Forest Service and BLM 1994) was designed to protect habitat for NSO and other species associated with late-successional forests while allowing a reduced amount of commercial logging on federal lands. Large amounts of federal land within the range of NSO were allocated for riparian and LSRs; the primary objective for these lands was to maintain or restore habitat for NSO and other fish and wildlife species. Riparian Reserves and other NWFP land use allocations provide connectivity between LSRs and federally designated critical habitat. Additionally the NWFP states that sites currently occupied by MAMUs, and KOAC (100-acre areas identified by BLM and Forest Service) that are within Matrix lands are considered "unmapped LSRs" and managed as LSRs by the NWFP.

In August 2016, the BLM issued two Records of Decision and Approved RMPs for Southwestern Oregon and Northwestern and Coastal Oregon (BLM 2016a and 2016b). These 2016 RMPs supersede the NWFP on BLM-managed lands. The new 2016 RMPs have similar land allocations to those in the NWFP that continue to contribute to the conservation of northern spotted owl habitat within BLM-administered lands, including LSRs and riparian reserves. The NWFP still applies to lands managed by the Forest Service and is still in effect on the three National Forests crossed by the proposed route. A good portion of the federally designated critical habitat overlaps with LSR land allocations; however, some lands do not and therefore LSRs afford additional habitat protection for listed species.

3.3.4.2 Environmental Baseline

Provincial Analysis Area

The proposed action is located within four Physiographic Provinces: Oregon Coast Range, Oregon Klamath Mountains, West Oregon Cascades, and East Oregon Cascades. NSO home ranges vary across provinces as a result of habitat heterogeneity and type, and prey availability (Courtney et al. 2004), and are generally larger on the west coast of Oregon and become smaller in eastern Oregon. Described below are two components of the action area within which Project-related activities could affect NSOs—one for habitat removal or modification that relate to NSO home ranges and a second for disturbance/disruption of NSO during the breeding season. The two components have been combined together to consider all components of the provincial analysis area (see figure 3.3.4-1).

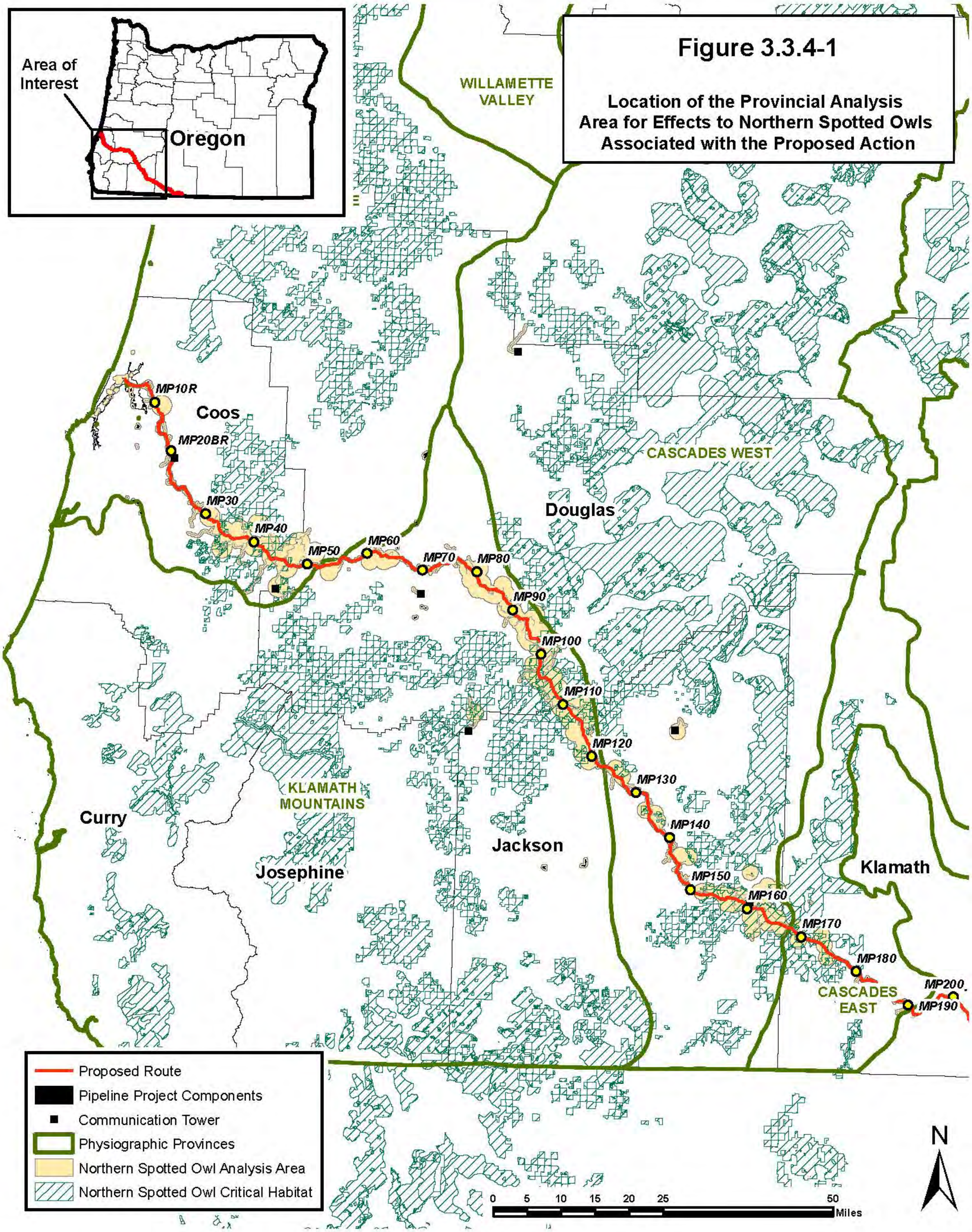


Figure 3.3.4-1
Location of the Provincial Analysis Area for Effects to Northern Spotted Owls Associated with the Proposed Action
Area of Interest
Oregon
WILLAMETTE VALLEY
CASCADES WEST
KLAMATH MOUNTAINS
CASCADES EAST
Coos
Douglas
Curry
Josephine
Jackson
Klamath
MP10R
MP20BR
MP30
MP40
MP50
MP60
MP70
MP80
MP90
MP100
MP110
MP120
MP130
MP140
MP150
MP160
MP170
MP180
MP190
MP200
Proposed Route
Pipeline Project Components
Communication Tower
Physiographic Provinces
Northern Spotted Owl Analysis Area
Northern Spotted Owl Critical Habitat
0 5 10 15 20 25 50 Miles
N

Habitat Removal or Modification

The habitat removal or modification analysis area applies to all proposed action components that have the potential to remove or modify habitat, including construction of the Pipeline and aboveground facilities; no NSO habitat occurs at the LNG Terminal site (LBJ Enterprises 2006; SHN 2013a). The provincial analysis area also includes a 100-meter (328-foot) wide buffer along the edge of the area of habitat impact (e.g., edge of right-of-way or edge of new roadway corridor). In addition to the 100-meter buffer, the provincial analysis area includes any NSO Home Range with an activity center located between the outer edge of the 100-meter (328-foot) wide buffer of the proposed action components out to the distance equal to the applicable NSO physiographic home range radius: 1.5 miles, 1.3 miles, or 1.2 miles of the Project.

Disturbance/Disruption

Harassment that could occur from proposed construction, including blasting (greater than 2 pounds) and/or large transport helicopter use by the proposed action has been analyzed within a 0.25-mile radius of the proposed activity. A 0.25-mile analysis area would be considered for construction and timber removal activities, as well as existing access roads that have been identified for access to the proposed action (excluding paved roads used regularly by the public – County Roads and State Highways) to account for potential disturbance from noise generated from traffic or road improvements.

Species Presence

NSO populations consist of resident owls (adult and subadult) that defend a territory vocally, and non-territorial owls (adult, subadult, and juvenile owls) that generally move through habitats in search of vacant territories or available mates and rarely vocalize. Surveys to determine if potential suitable NSO habitat is occupied are accomplished by imitating NSO calls to elicit a response, generally from the territorial owls. This is usually more effective at night, as NSOs would defend their territory more readily at night (Hobbs et al. 2004; Courtney et al. 2004; Forsman 1983). Generally sites identified at night would be visited the following day to determine status (i.e., pair, nesting, resident single). Reproduction information for territorial owls is obtained by feeding an individual adult owl live mice to determine if it is a member of a nesting pair or not, based on the owl's behavior (Lint 2001; FWS 1992d). FWS (2012f) recommends conducting at least six visits a year for two years prior to a proposed action to determine site occupancy and potential reproductive success, although the survey protocol for NSOs suggests that this information can be gathered during six visits to a site in one year if the only disturbance expected from a project is noise.

NSOs are known to occur within the vicinity of the Pipeline (ORBIC 2017a) and designated critical habitat for the species is present in each county crossed by the Pipeline (FWS 2012e; see CHUs ORC-6, KLE-1, KLE-2, KLE-3, KLE-4, KLE-5, and ECS-1). Additionally, the Pipeline would pass through BLM and Forest Service LSRs in Coos Bay, Roseburg, and Medford BLM Districts, and through LSR units RO 223 on Umpqua NF and RO 227 on Rogue River-Siskiyou National Forest.

To determine species presence and/or absence within the provincial analysis area, GIS data of historical and current NSO locations were obtained from BLM Districts and National Forests crossed by the Pipeline, as well as from the demographic studies occurring within the Pipeline Project area (BLM 2006, 2012, and 2017; Forest Service 2006, 2012, 2017a, 2017b, and 2017c;

FWS 2008d). Additionally, Pacific Connector contracted SBS (Eagle Point, Oregon) to conduct two years of surveys in 2007 and 2008 to determine species presence within the proposed construction right-of-way. Taking a conservative approach for purposes of this BA, all owl sites (known, best location, and PCGP assumed) are analyzed as if occupied and reproductive.

Pacific Connector Spotted Owl Surveys (2007 and 2008)

To determine nesting NSO presence and/or absence, as well as nesting status (if possible) within the analysis area, NSO surveys were conducted by Pacific Connector between March 15 and August 31 in 2007 and 2008 as defined by the *Protocol for Surveying Proposed Management Activities that May Impact Northern Spotted Owls* (FWS 1992d); NSO absence data could be considered accurate for two breeding seasons following complete survey efforts. Surveys were conducted by SBS and were carried out within suitable NRF habitat and outside of ongoing NSO demographic and monitoring survey efforts. In general, surveys were conducted within 0.5 mile of the proposed construction right-of-way where suitable NRF habitat would be removed by the Project. Otherwise, surveys were conducted within 0.25 miles of the proposed construction right-of-way if suitable NRF habitat was present, but would not be removed (as advised by Smith et al. 2007). In areas that were identified as requiring blasting and/or timber removal and construction by helicopter, surveys within suitable NSO habitat were conducted 1 mile from the proposed alignment in 2008 (Smith et al. 2007; Wille et al. 2006).

The 0.25-mile disturbance and the 0.5-mile habitat alteration survey areas followed the 1992 FWS two-year survey protocol (three visits per year) in 2007 and 2008. Surveys conducted out to one mile from potential blasting (greater than two pounds) and/or large transport helicopter disturbance areas in 2008 followed the 1992 one-year survey protocol (six visits per year). Surveys conducted within the Project area took extra precautions to reduce negative effects of barred owls on NSO, following guidance provided by the FWS in March 2007, which dictate that if a barred owl responds to a NSO call, the surveyor should stop calling for the NSO. This guidance is similar to the direction provided in the 2012 revised and updated survey protocol (FWS 2012f). To further reduce NSO harassment from multiple survey efforts, Pacific Connector did not conduct surveys where other survey efforts by agency biologists were ongoing, including demographic and monitoring studies in the Roseburg BLM District (approximately MP 46.8 through MP 100.7), South Cascades demographic study conducted in Jackson and Klamath counties (MP 155.2 through MP 170.7), and a NSO monitoring study area in Lakeview BLM District.

Within the defined survey area for 2007, approximately 28,774 acres were identified as suitable NRF habitat and were organized into 61 separate survey areas. Of that acreage, 8,562 acres identified were located on private lands but permission to survey was granted on only 3,713 acres (access was denied for 4,849 acres). Overall, 83 percent or approximately 23,925 acres were surveyed in 2007 following the 1992 two-year survey protocol. In 2008, an additional 32,221 acres were identified as potential suitable NRF habitat within 1 mile of areas that may require blasting (greater than 2 pounds) and large transport helicopter use. Of the 58,652 acres identified as suitable NRF habitat, permission to survey was granted for 47,679 acres (81 percent), and these were surveyed in 2008. New habitat identified in 2008 followed the 1992 one-year survey protocol.

NSO surveys conducted in 2007 detected NSO 115 times in 29 of the 61 survey areas. Twelve NSO pairs and one resident single (located at least three times on separate survey visits) were detected. No nest sites were located in 2007; however, at one site fledglings were observed with their parents, suggesting a nest location in the vicinity. During 2008 surveys, NSO were detected

190 times and were found in 26 of the 54 survey areas established. NSO pairs were detected at 20 locations and two nests were located. Resident singles were identified at six sites. Approximate activity centers were drawn around the pairs and resident singles documented in 2007 and/or 2008 based on detection date and time, the age and sex of owls observed, the owls' behavior, and occasionally the habitat of a detection location. Seven NSO pairs documented within the survey area were assumed to be NSO activity sites previously documented and/or monitored by other agencies, and seven pairs were incorporated as new activity sites within agency management areas considering activity documented during 2007 and/or 2008 survey results. NSO pairs or resident singles that were not associated with previous known NSO activity centers or were not incorporated by agencies as new activity sites are considered Pipeline Project "best location" activity centers for analysis within this BA.

Although survey design was not intended to locate or census barred owls, this species was documented 36 times in 14 survey areas in 2007, and 115 times in 14 survey areas in 2008, including 8 pairs.

For full description and information on NSO surveys and detections, see the 2007–2008 Northern Spotted Owl Survey Report (SBS 2008).

Pacific Connector Spotted Owl Surveys (2015)

Protocol surveys were initiated along the Blue Ridge portion of the proposed route in 2015 following the revised 2012 survey protocol, which includes two years of surveys, with six visits each year (FWS 2012f). No NSO were documented; however, barred owls were documented 19 times, including three pairs. The presence of barred owls detected during survey efforts decreases the likelihood that NSO are nesting along the Blue Ridge portion of the proposed route. To date, only one year of survey effort has occurred in this portion of the Pipeline Project.

Northern Spotted Owl Activity Sites Considered for Analysis

Initially in 2008, Pacific Connector received a Northern Spotted Owl Occupancy Map (NSOOM) from FWS that included both historical and recent NSO sites provided by BLM Districts and National Forests within the Project area that were combined with survey data collected for the Pipeline by SBS in 2007/2008. Additionally, the NSOOM provided areas of potential NSO nests sites modeled or "predicted" to occur on the landscape based on current NSO occupancy and available NSO habitat (see appendix 1 in appendix A of Trapper Timber Sale Biological Opinion). Agency biologists reviewed the data and revised NSO activity centers considered for the Pipeline based on local knowledge prior to providing the final data to Pacific Connector. The objective of the collaborative process was to generate a clean but complete NSO map that could be used for analyses purposes for the proposed Pipeline. Some areas where owl activity was less certain, such as where resident single or pair activity was identified by SBS that may be associated with other known activity sites but not enough information was available (i.e., no band color collected), were included for analysis (i.e., Pipeline Project best location sites). If an agency-provided alternate nest site was closer to the Pipeline route, the alternate site was considered rather than the site with the most recent activity for a more conservative analysis. By using this conservative approach, the analysis reflects a "worst-case scenario" and likely results in an overestimation of potential impacts to the NSO.

The 2008 NSOOM was revised in 2013 and again in 2014 as part of the previous iteration of the Pipeline Project, and subsequently revised in 2017 to account for new data and new direction by agencies since 2008 for the Pipeline. To revise previous NSOOM and account for new data and new survey efforts since 2008, Pacific Connector requested and obtained new NSO data from each of the BLM Districts and National Forests crossed by the Pipeline, including demographic study data (Forest Service 2017a, 2017b, 2017c; BLM 2017). Using the same methodology that was applied to the 2008 NSOOM, a revised NSOOM was created for this BA. The NSOOM methodology is intended to facilitate a reasonable, but conservative basis for estimating potentially occupied NSO habitat within the proposed analysis area, especially where surveys have not been conducted or not completed as required by the survey protocol, or barred owl presence may have negatively affected the response of NSOs during calling surveys.

In June 2013, the use of the Owl Estimation Model (OEM) that produced "predicted" owls provided in the 2008 NSOOM was challenged in federal district court. As a result of this challenge, FWS, BLM, and Forest Service requested that the use of "predicted owls" utilizing the OEM no longer be used by Pacific Connector. Pacific Connector had used the predicted owl sites and had previously included 18 possible NSO activity centers to produce a more conservative analysis for habitat effects and disturbance disruption effects by the Project. As a result of the 2013 court activity and agency requests, Pacific Connector removed 18 predicted owls created using the OEM that had been previously included in the 2008 NSOOM. In order for Pacific Connector to continue with a conservative analysis approach for spotted owls (similar to Pacific Connector's approach for MAMUs – presumed occupied stands), Pacific Connector identified nine areas (referred to hereafter as "PCGP assumed" sites) within 1.2 to 1.5 miles of Project disturbance (Cascades to Coast Range physiographic province home range radii distances) that could potentially support NSO pairs. "PCGP assumed" sites were established in areas that were either surveyed in 2007/2008 with NSO presence but no pair or resident single determined, or an area that could support a NSO pair based on suitable habitat available in an assumed nest patch/core area that is located farther than the average "nearest neighbor" distance from a known or best location NSO site, as reported by FWS et al. (2008) for each physiographic province crossed (see Table 5 in FWS et al. 2008: more than 2,084 meters [6,837 feet] in Coast Range; more than 2,078 meters [6,817 feet] in Klamath Mountains; more than 2,333 meters [7,654 feet] in West Cascades; and more than 2,446 meters [8,024 feet] in East Cascades).

Pacific Connector took into consideration the general habitat characteristics of known NSO sites in the vicinity of potential "assumed" locations to review the current status of available NRF within known home ranges, because available NRF habitat within a potential PCGP assumed site often did not meet the FWS-recommended NRF threshold of more than 40 percent and more than 50 percent NRF in the home range and core area, respectively. Past predicted owl sites previously analyzed were also reviewed for consideration because Pacific Connector survey efforts had targeted those areas. In five instances, "PCGP assumed" sites were established in the vicinity of previously "mapped" / "predicted" owl sites based on survey efforts or the amount of available high quality NRF habitat that was also contiguous, interior forest. "PCGP assumed" sites have been placed in contiguous high NRF/NRF habitat at least 100 meters (328 feet) from the edge of a forested stand resulting in the site being placed in interior forest. These areas are "PCGP assumed" NSO sites and have been provided a site ID (i.e., PCGP A-8). No "PCGP assumed" sites were established between MPs 0.00 and 32.47 because this area consists of checkerboard BLM/private land ownership where commercial timber harvest is prevalent and surveys conducted within this MP range for the Pipeline in areas of higher quality NRF habitat did not document NSO. Three of the PCGP-assumed sites established in 2014 were replaced by known or historic owl sites provided by BLM or Forest Service in 2017 that were in close proximity to the "PCGP assumed" sites.

Sites considered for analysis within this BA are either 1) known pairs or resident singles provided by BLM and Forest Service (historic or current), 2) best location (pair documented by Pacific Connector survey efforts in 2007/2008 but nest site not located, or 3) "PCGP assumed" (site analyzed where no pair has been documented, but available NRF habitat present could provide habitat for nesting or future nesting NSO). Approximately 105 NSO home ranges – known current/historic (84), best location (15), and "PCGP-assumed" (6) – occur within the vicinity of the proposed Pipeline, including existing access roads (excluding paved, public roads) identified for use for construction and operation of the Pipeline, pipe yards, and rock storage areas, of which 97 home ranges would be affected by construction of the proposed Pipeline, and 78 home ranges would be crossed by proposed access roads. Table 3.3.4-2 provides a summary of NSO home ranges, core areas, and nest patches (known, best location, or "PCGP assumed") that intersect the proposed Pipeline and/or proposed access roads within each physiographic province. Table Q-7 in appendix Q provides additional details for each NSO home range included in the provincial analysis area, including available NSO habitat (high NRF, NRF, dispersal only, and capable) within each home range pre-action.

TABLE 3.3.4-2

Summary of Known, Best Location, or "PCGP-Assumed" NSO Home Ranges, Core Areas, and Nest Patches Crossed by the Pipeline Project, including Access Roads

NSO Status	Number of NSO Activity Centers	Number of Home Ranges Crossed		Number of Core Areas Crossed		Number of Nest Patches Crossed	
		Habitat Affected a/	Access Roads b/	Habitat Affected a/	Access Roads b/	Habitat Affected a/	Access Roads b/
Coast Range Physiographic Province – 1.5 mile home range radius							
Known Sites	14	11	14	5	12	1	11
Best Location Sites d/	0	0	0	0	0	0	0
"PCGP Assumed" Sites e/	3	3	3	2	3	0	3
Total	***17***	***14***	***17***	***7***	***15***	***1***	***14***
Klamath Mountains Physiographic Province – 1.3 mile home range radius							
Known Sites	39	38	27	15	15	1	12
Best Location Sites c/	10	10	9	5	6	3	5
"PCGP Assumed" Sites d/	3	2	2	1	2	1	2
Total	***52***	***50***	***38***	***21***	***23***	***5***	***19***
West Cascades Physiographic Province – 1.2 mile home range radius							
Known Sites	26	24	19	9	13	2	12
Best Location Sites c/	5	5	4	2	3	0	2
"PCGP Assumed" Sites d/	0	0	0	0	0	0	0
Total	***31***	***29***	***23***	***11***	***16***	***2***	***14***
East Cascades Physiographic Province – 1.2 mile home range radius							
Known Sites	5	4	0	1	0	1	0
Best Location Sites c/	0	0	0	0	0	0	0
"PCGP Assumed" Sites d/	0	0	0	0	0	0	0
Total	***5***	***4***	***0***	***1***	***0***	***1***	***0***
All Physiographic Provinces Crossed							
Known Sites	84	77	60	30	40	5	35
Best Location Sites c/	15	15	13	7	9	3	7
"PCGP Assumed" Sites d/	6	5	5	3	5	1	5
Total	**105**	**97**	**78**	**40**	**54**	**9**	**47**

a/ Habitat Affected considers all proposed disturbance, including uncleared storage areas (UCSAs), pipeyards, rock sources, and PARs/TARs.

b/ Access roads considered does not include paved roads that are used regularly by the public (i.e., County Roads, State Highways). Home ranges are included if the activity center is within 0.25 mile of a proposed access road.

c/ Best Location Sites – areas identified with pair activity during Pacific Connector survey efforts in 2007 and/or 2008 but the nest was not located; SBS and local agency biologists determined best potential nest site based on survey data and available habitat.

d/ PCGP Assumed Sites - area identified by Pacific Connector that may provide habitat for NSO pair.

FWS et al. (2008) consider core areas with 50 percent or greater NRF habitat and home ranges with at least 40 percent NRF habitat to be necessary to maintain NSO life history function. Based on FWS et al. (2008) guidelines, 39 of 97 spotted owl sites identified that would have habitat removed by the proposed route are above the threshold of available NRF habitat within both their core area (greater than 50 percent) and home range (greater than 40 percent): 32 known NSO sites and 7 best location sites. The remaining 58 spotted owl activity centers (45 known, 8 best location, and 5 PCGP assumed) are below NRF thresholds for the core area and/or home range (table 3.3.4-3).

Table 3.3.4-3 provides a summary of the current habitat condition by Physiographic Province and owl status (known, best location, or "PCGP assumed") of the 97 NSO sites within the provincial analysis area that would have habitat affected by the Pipeline Project. Note that calculations of habitat conditions for each owl site in table 3.3.4-3 considered suitable habitat located on both federal and non-federal lands. The amount of NRF habitat currently available for each NSO within each habitat type (nest patch, core area, and home range) can be reviewed in table Q-7 in appendix Q. Amount of NRF habitat in table Q-7 in appendix Q is specific to each habitat type in its entirety; acres provided for the home range include acres that also occur within the core area and nest patch, and acres included in the core area also include acres within the nest patch. Table Q-7 in appendix Q provides the amount of suitable habitat for each individual owl in federal and non-federal lands, regardless of overlap with adjacent home ranges and the habitat condition determined pre-action for each NSO home range. A description of how NSO habitat was determined is addressed in the Habitat section below.

TABLE 3.3.4-3

Number of NSO Home Ranges, by Physiographic Province and Habitat Condition that Would Have NSO Habitat Removed by the Pipeline Project a/

Suitable NRF Habitat Condition within Owl Home Ranges [2]	Owl Status [3]	Physiographic Province: Coast Range	Klamath Mountains	West Cascades	East Cascades	Total
Home Range > 40%	Known	1	17	11	3	32
AND	Best Location	0	3	4	0	7
Core Area > 50%	"PCGP-assumed"	0	0	0	0	0
(Above Threshold)	*Total*	*1*	*20*	*15*	*3*	*39*
Home Range > 40%	Known	0	4	5	0	9
AND	Best Location	0	1	0	0	1
Core Area < 50%	"PCGP-assumed"	0	1	0	0	1
(Below Threshold)	*Total*	*0*	*6*	*5*	*0*	*11*
Home Range < 40%	Known	2	6	1	0	9
AND	Best Location	0	1	0	0	1
Core Area > 50%	"PCGP-assumed"	0	0	0	0	0
(Below Threshold)	*Total*	*2*	*7*	*1*	*0*	*10*
Home Range < 40%	Known	8	11	7	1	27
AND	Best Location	0	5	1	0	6
Core Area < 50%	"PCGP-assumed"	3	1	0	0	4
(Below Threshold)	*Total*	*11*	*17*	*8*	*1*	*37*
Overall Total	**Known**	**11**	**38**	**24**	**4**	**77**
	Best Location	**0**	**10**	**5**	**0**	**15**
	"PCGP-assumed"	**3**	**2**	**0**	**0**	**5**
	Total	***14***	***50***	***29***	***4***	***97***

a/ For detailed suitable NRF habitat available for each individual northern spotted owl and its habitat type (nest patch, core area, home range), refer to suitable habitat acres in table Q-7 in appendix Q.

b/ FWS et al. (2008) consider core areas with 50 percent or greater suitable NRF habitat and home ranges with at least 40 percent suitable NRF habitat to be necessary to maintain NSO life history function.

c/ Owl Status: 1) Known sites represent pairs or resident singles - historic or current; 2) Best Location are sites documented during survey efforts for the Pipeline Project but nest site was not located; and 3) PCGP-assumed sites are areas identified by PCGP that may provide habitat for NSO pair.

Pacific Connector requested guidance from FWS in November 2012 to determine what additional surveys for NSO should be conducted for the proposed action, considering the survey protocol was revised in February 2010 (see FWS 2010g) and finalized in January 2012 (see FWS 2012f), and surveys for the Pipeline Project were conducted in 2007 and 2008 following the 1992 survey protocol. FWS (McCorkle 2012; appendix S – ROC) stated that additional full protocol NSO surveys across the entire project were not necessary, but recommended pre-construction "spot check" surveys with at least three site visits occurring prior to construction to confirm occupancy status, and to inform additional opportunities to fine-tune timing or distance buffers around active NSO activity centers. Pacific Connector would conduct "spot check" surveys one year prior to scheduled timber removal in NRF habitat that is within 0.25 mile of the construction right-of-way to detect spotted owls that may have recently established territories in the project area or are utilizing another site for nesting (see "spot check" surveys in the revised NSO survey protocol; FWS 2012f). Surveys would target NRF habitat within home ranges analyzed for the Pipeline Project, as well as additional NRF habitat outside of NSO home ranges that was included in previous survey efforts for the Pipeline (2007, 2008, and 2015 survey efforts) and may be capable of supporting a single or pair of territorial NSO. Surveys would not occur where annual monitoring survey efforts are on-going in the proposed action area to minimize NSO harassment.

Habitat

FWS identified four categories of NSO habitat that should be used to assess impacts to spotted owls and habitat for the proposed action (2014c): highly suitable NRF (high NRF), NRF, dispersal habitat, and capable habitat. High NRF is considered habitat that is characterized by large trees (greater than 32 inches dbh), high canopy cover (>60 percent), and multistoried structure with sufficient down wood and snags to support prey species (FWS 2014c). Other habitat definitions include (FWS 2012e, 2014c; North et al. 1999): 1) NRF consists of conifer-dominated stands older than 80 years, and are multi-storied in structure with large overstory trees (20-30 inches dbh), moderate to high canopy closure greater than 60 percent, high basal area (greater than 240 square feet/acre), high diversity of different diameters of trees, high incidence of large live trees with various deformities (e.g., large cavities, broken tops, mistletoe infections), sufficient snags and down wood, and sufficient open space below the canopy for NSO to fly but does not meet the definition of High NRF; 2) dispersal habitat is composed of conifer and mixed mature conifer-hardwood habitats with a canopy cover greater than or equal to 40 percent in moist forests and greater than 30 percent in dry forests, conifer trees greater than or equal to 11 inches average dbh, and sufficient open space below the canopy to fly; and 3) capable habitat is forested habitat that could provide NSO suitable NRF in the future (including recently harvested stands – i.e., clearcut) but currently does not provide the structures described above for NSO High NRF, NRF, or dispersal habitat. Non-capable habitat has been defined as areas that will never provide habitat for NRF or dispersal habitat, such as agriculture fields, grasslands, rivers, rock outcroppings, roads, etc. (FWS 2006d), as well as forested areas that are non-capable largely because of the natural expression of vegetation patterns resulting from edaphic, topographic, and climatic constraints; such areas may include serpentine dominated soils or dry, south-facing slopes, and could also include oak woodlands.

In the analysis conducted for the previously proposed project (FERC 2009), Pacific Connector used the BioMapper Habitat Model created by the Forest Service Northwest Research Station and used in the 10-year Monitoring Report (see Lint 2005) per recommendations by FWS and Forest Service, as the foundation to determine suitable habitat within the Project area. Davis et al. (2011) determined that the BioMapper model overestimated owl habitat suitability in portions of the range, including pine-dominated forests of the eastern Cascades, and young stands in the Coast Range and western Cascades. Since the previous analysis (FERC 2009), improved NSO habitat models have been developed to monitor status and trends of the NSO populations and habitat within the past 15 and 20 years in the NWFP area and were introduced in the 15-year and 20-year NWFP NSO habitat monitoring documents; the habitat suitability models represent NSO habitat as of 2006 and 2012 in Oregon, respectively (see Davis et al. 2011 and 2016). In 2012, the FWS and Forest Service suggested that Pacific Connector use these models developed for the 15-year NWFP NSO habitat monitoring efforts to assist in categorizing NSO habitat (high NRF, NRF, dispersal, and capable habitat; see FWS 2014c) within the proposed action project area, rather than the BioMapper model. The updated model used in the 20-year NWFP NSO habitat monitoring effort has been used for developing NSO habitat for this BA.

In addition to the updated GIS NSO habitat models developed for the 20-year NWFP monitoring documents (Davis et al. 2016), Pacific Connector received agency-specific NSO habitat GIS data from National Forests crossed by the Pipeline [Umpqua (Forest Service 2017a), Rogue River – Siskiyou (Forest Service 2017b), and Fremont-Winema (Forest Service 2017c)] and BLM Districts crossed by the Pipeline (Coos Bay, Roseburg, Medford, and Lakeview [BLM 2017a]). In order to standardize the available GIS data throughout the provincial analysis area, and create a NSO habitat GIS file with the four recommended NSO habitat categories for this BA (see FWS 2014c), Pacific Connector used the available GIS NSO Habitat files in conjunction with the vegetation GIS coverage that was delineated for the Pipeline. The vegetation GIS coverage for the Pipeline was delineated at a finer scale using 2016 aerial photography, and available agency data (i.e., BLM FOI coverage, late successional Gradient Nearest Neighbor coverage) to classify age of forest, generally within 300 meters (984 feet) of the proposed action and particularly in the affected area, and has been reviewed by local agency biologists; forested habitat was classified by type and age classes (clear-cut – 0 to 5 years, regenerating forest—5 to 40 years, mid-seral—40 to 80 years, late successional—80 to 175 years, and old-growth—greater than 175 years).

NSO habitat was initially delineated using the vegetation GIS file created by Pacific Connector for the proposed action using age classes and forest type: clearcut and regenerating forest was considered "capable;" mid-seral coniferous and mixed forest lands, as well as deciduous forests were considered "dispersal only;" and late successional coniferous and old-growth forest were considered NRF habitat. Next, the seven NSO habitat coverages obtained from the National Forests and BLM Districts crossed by the Pipeline were used to further refine NSO habitat classification, and expand the Pacific Connector NSO habitat coverage beyond the vegetation GIS file delineated for the Pipeline. Where NSO habitat categories differed between the NSO habitat identified from the vegetation GIS file, or from other agency data, Pacific Connector conservatively used the higher habitat category (i.e., an area that was identified as NRF, dispersal, and non-capable was categorized as NRF), especially outside of the finely delineated vegetation GIS file created for the Pipeline Project. Within closer vicinity of the Pipeline, NSO habitat was generally classified using the vegetation GIS file created for the proposed action because forested vegetation on the ground had been updated from 2016 aerial photography to consider recent clearcuts as well as the 2015 Stouts Creek fire; as available agency NSO habitat data often did not reflect changes in forested habitat since 2015 or earlier.

The 2012 nesting/roosting model created for the 20-year NWFP Habitat monitoring provided a pixelated coverage that identified areas of highly suitable, suitable, marginal, and unsuitable habitat throughout the NWFP area. The pixelated areas identified as "highly suitable" were used to classify areas of "high NRF" in the NSO habitat file where the previous steps using the vegetation GIS and agency data determined NSO habitat to be NRF. Further, unclassified NSO habitat within the provincial analysis area was classified using areas identified in the 2012 nesting/roosting model ("suitable" areas were used to classify NSO habitat as NRF and "highly suitable" areas were used to classify high NRF), and previously modeled habitat from the 2015 FERC BA.

Within the resulting modeled areas for the provincial analysis area, 2016 aerial photography was used to delineate obviously young stands (i.e., clearcuts or early regenerating forest) and identify the habitat as capable (in many instances high NRF and NRF modeled from available data and the 2012 NWFP model were located in clearcuts). In 2015, Stouts Creek fire burned through a large quantity of high quality NSO habitat in the provincial analysis area in Klamath Mountain physiographic province; the modeled habitat and agency GIS data often identified this area as providing NRF and high NRF habitat. Pacific Connector consulted with FWS (Stone 2017), Forest Service (Hadwen 2017) and BLM (McGraw 2017) to determine how to proceed with classifying NSO habitat in the affected area. Based on direction received from the agencies, Pacific Connector conservatively classified NSO habitat in the area affected by the fire as follows:

- areas that had been clearcut or burned to the ground were considered capable habitat;
- mid-seral to late successional habitat that that had standing trees but had burned to some degree (trees brown in patches, based on visually reviewing 2016 aerial photography) continued to be considered their modeled NSO habitat type – dispersal, NRF, high NRF; and
- areas that were charred from a high intensity burn, but still had trees standing (contiguous stand of black, standing trees) were considered NRF, but not high NRF if the 2012 NWFP model identified that area as high NRF. Agencies indicated that these areas would be considered areas for NSO foraging and/or roosting, but to include the habitat in the "NRF" category, as defined in the FWS Conservation Framework document (FWS 2014c). In the NSO GIS file, this NSO habitat type is classified as "post-fire NRF" and is incorporated in subsequent tables to identify the NRF habitat that is likely standing dead trees. "Post-fire NRF" is a term used in the Roseburg BLM District NSO habitat GIS file provided to Pacific Connector.

The resulting NSO Habitat file described above provides a good, but conservative approximation of the NSO habitat (high NRF, NRF, dispersal only, and capable) within the proposed action area that would be affected by construction of the Pipeline. The model was used to determine the amount of high NRF, NRF, dispersal, and capable habitat within the provincial analysis area by physiographic province and jurisdiction (see table 3.3.4-4). Figures 2, 3, and 4 in appendix Q provide an overview of NSO habitat within the Project analysis area in relation to spotted owl home ranges, NSO critical habitat, and NWFP LSRs. Table Q-7 in appendix Q identifies the amount of NSO Habitat (high NRF, NRF, dispersal only, and capable habitat) available within each NSO Home Range.

TABLE 3.3.4-4

Summary of NSO Suitable Nesting, Roosting, and Foraging, Dispersal, and Capable Habitat Available within the Provincial Analysis Area by Physiographic Province

Landowner a/	General Location	Total Acres within Analysis Area b/	High NRF Habitat c/ Acres Available	High NRF Habitat c/ Percent	NRF Habitat d/ Acres Available	NRF Habitat d/ Percent	Dispersal Habitat Only e/ Acres Available	Dispersal Habitat Only e/ Percent	Capable Habitat f/ Acres Available	Capable Habitat f/ Percent	Total NSO Habitat Acres Available	Total NSO Habitat Percent
Coast Range Physiographic Province												
Federal	Home Range	27,022	7,761	28.7%	4,433	16.4%	8,314	30.8%	6,372	23.6%	26,880	99.5%
	Outside Home Range	10,422	1,151	11.0%	1,543	14.8%	4,399	42.2%	2,835	27.2%	9,928	95.3%
	Subtotal	**37,443**	8,913	**23.8%**	**5,975**	**16.0%**	**12,713**	**34.0%**	**9,207**	**24.6%**	**36,808**	**98.3%**
Non-Federal	Home Range	34,894	432	1.2%	975	2.8%	3,208	9.2%	27,732	79.5%	32,348	92.7%
	Outside Home Range	19,959	92	0.5%	309	1.5%	1,976	9.9%	9,126	45.7%	11,502	57.6%
	Subtotal	**54,853**	524	**1.0%**	**1,284**	**2.3%**	**5,184**	**9.5%**	**36,858**	**67.2%**	**43,850**	**79.9%**
Coast Range Total	Home Range	61,916	8,194	13.2%	5,408	8.7%	11,522	18.6%	34,103	55.1%	59,228	95.7%
	Outside Home Range	30,381	1,243	4.1%	1,851	6.1%	6,375	21.0%	11,961	39.4%	21,430	70.5%
	Subtotal	**92,297**	**9,437**	**10.2%**	**7,260**	**7.9%**	**17,897**	**19.4%**	**46,064**	**49.9%**	**80,658**	**87.4%**
Klamath Mountains Physiographic Province												
Federal	Home Range	53,344	16,798	31.5%	14,570 (4,110)	27.3%	13,226	24.8%	7,851	14.7%	52,445	98.3%
	Outside Home Range	3,707	899	24.3%	841 (142)	22.7%	1,238	33.4%	553	14.9%	3,531	95.3%
	Subtotal	**57,051**	**17,697**	**31.0%**	**15,411 (4,252)**	**27.0%**	**14,464**	**25.4%**	**8,404**	**14.7%**	**55,976**	**98.1%**
Non-Federal	Home Range	55,276	5,841	10.6%	7,798 (120)	14.1%	7,169	13.0%	27,642	50.0%	48,450	87.7%
	Outside Home Range	16,383	666	4.1%	847 (31)	5.2%	3,263	19.9%	4,603	28.1%	9,380	57.3%
	Subtotal	**71,660**	**6,508**	**9.1%**	**8,645 (151)**	**12.1%**	**10,432**	**14.6%**	**32,244**	**45.0%**	**57,829**	**80.7%**
Klamath Mountains Total	Home Range	108,621	22,639	20.8%	22,368 (4,230)	20.6%	20,395	18.8%	35,492	32.7%	100,895	92.9%
	Outside Home Range	20,091	1,565	7.8%	1,688 (173)	8.4%	4,501	22.4%	5,156	25.7%	12,910	64.3%
	Subtotal	**128,711**	**24,204**	**18.8%**	**24,056 (4,404)**	**18.7%**	**24,896**	**19.3%**	**40,649**	**31.6%**	**113,805**	**88.4%**
West Cascades Physiographic Province												
Federal	Home Range	47,770	9,270	19.4%	14,757	30.9%	15,357	32.1%	5,293	11.1%	44,677	93.5%
	Outside Home Range	4,032	212	5.3%	2,001	49.6%	796	19.7%	331	8.2%	3,341	82.9%
	Subtotal	**51,802**	**9,482**	**18.3%**	**16,758**	**32.4%**	**16,153**	**31.2%**	**5,624**	**10.9%**	**48,018**	**92.7%**
Non-Federal	Home Range	15,111	616	4.1%	1,712	11.3%	3,336	22.1%	7,806	51.7%	13,470	89.1%
	Outside Home Range	9,936	78	0.8%	422	4.2%	1,619	16.3%	4,397	44.3%	6,516	65.6%
	Subtotal	**25,047**	**694**	**2.8%**	**2,134**	**8.5%**	**4,955**	**19.8%**	**12,203**	**48.7%**	**19,986**	**79.8%**
West Cascades Total	Home Range	62,881	9,886	15.7%	16,469	26.2%	18,693	29.7%	13,099	20.8%	58,147	92.5%
	Outside Home Range	13,968	290	2.1%	2,423	17.3%	2,416	17.3%	4,728	33.8%	9,856	70.6%
	Subtotal	**76,850**	**10,176**	**13.2%**	**18,892**	**24.6%**	**21,108**	**27.5%**	**17,827**	**23.2%**	**68,003**	**88.5%**

TABLE 3.3.4-4 (continued)

Summary of NSO Suitable Nesting, Roosting, and Foraging, Dispersal, and Capable Habitat Available within the Provincial Analysis Area by Physiographic Province

Landowner a/	General Location	Total Acres within Analysis Area b/	High NRF Habitat c/		NRF Habitat d/		Dispersal Habitat Only e/		Capable Habitat f/		Total NSO Habitat	
			Acres Available	Percent	Acres Available	Percent	Acres Available	Percent	Acres Available	Percent	Acres Available	Percent
East Cascades Physiographic Province												
Federal	Home Range	10,955	1,402	12.8%	5,503	50.2%	1,678	15.3%	2,247	20.5%	10,830	98.9%
	Outside Home Range	1,094	43	3.9%	480	43.9%	249	22.8%	154	14.1%	927	84.7%
	Subtotal	**12,049**	**1,445**	**12.0%**	**5,984**	**49.7%**	**1,928**	**16.0%**	**2,401**	**19.9%**	**11,757**	**97.6%**
Non-Federal	Home Range	3,530	12	0.3%	297	8.4%	203	5.8%	2,523	71.5%	3,034	85.9%
	Outside Home Range	8,306	0	0.0%	49	0.6%	601	7.2%	6,146	74.0%	6,797	81.8%
	Subtotal	**11,836**	**12**	**0.1%**	**345**	**2.9%**	**804**	**6.8%**	**8,670**	**73.3%**	**9,831**	**83.1%**
East Cascades Total	Home Range	14,486	1,414	9.8%	5,800	40.0%	1,881	13.0%	4,770	32.9%	13,864	95.7%
	Outside Home Range	9,399	43	0.5%	529	5.6%	850	9.0%	6,301	67.0%	7,723	82.2%
	Subtotal	**23,885**	**1,457**	**6.1%**	**6,329**	**26.5%**	**2,731**	**11.4%**	**11,070**	**46.3%**	**21,588**	**90.4%**
All Physiographic Provinces												
Federal	Home Range	139,092	35,231	25.3%	39,263 (4,110)	28.2%	38,576	27.7%	21,762	15.6%	134,832	96.9%
	Outside Home Range	19,255	2,305	12.0%	4,864 (142)	25.3%	6,682	34.7%	3,874	20.1%	17,726	92.1%
	Subtotal	**158,347**	**37,536**	**23.7%**	**44,128 (4,252)**	**27.9%**	**45,258**	**28.6%**	**25,636**	**16.2%**	**152,558**	**96.3%**
Non-Federal	Home Range	108,811	6,902	6.3%	10,782 (120)	9.9%	13,916	12.8%	65,702	60.4%	97,302	89.4%
	Outside Home Range	54,584	836	1.5%	1,627 (31)	3.0%	7,460	13.7%	24,272	44.5%	34,194	62.6%
	Subtotal	**163,396**	**7,738**	**4.7%**	**12,409 (151)**	**7.6%**	**21,375**	**13.1%**	**89,974**	**55.1%**	**131,496**	**80.5%**
Overall Total	Home Range	247,903	42,133	17.0%	50,045 (4,230)	20.2%	52,491	21.2%	87,465	35.3%	232,134	93.6%
	Outside Home Range	73,839	3,141	4.3%	6,491 (173)	8.8%	14,141	19.2%	28,146	38.1%	51,920	70.3%
	Subtotal	**321,742**	**45,274**	**14.1%**	**56,536 (4,404)**	**17.6%**	**66,633**	**20.7%**	**115,611**	**35.9%**	**284,054**	**88.3%**

a/ Landowner is summarized by Federal (BLM Districts and National Forests) and Non-Federal (Private, State, Corps of Engineers, and Bureau of Indian Affairs Land).
b/ Total acres available within the entire analysis area, including non-capable habitat, is not identified in this table.
c/ High NRF (FWS 2014c): forested habitat characterized by large trees (> 32 inches dbh), high canopy cover (>60 percent), and multistoried structure with sufficient down wood and snags to support prey species. Generally includes late successional and old-growth forest (greater than 80 years).
d/ NRF (FWS 2012e, 2014c; North et al. 1999): conifer-dominated forested habitat greater than 80 years that does not meet the definition of High NRF but has multi-storied structure with large overstory trees (20-30 inches dbh), moderate to high canopy closure greater than 60 percent, and sufficient snags and down wood. Acreage in parenthesis identifies the area of NRF (or High NRF) prior to the 2015 Stouts Creek fire that are currently dead standing trees (i.e., “post-fire NRF”).
e/ Dispersal ONLY (FWS 2012e, 2014c): an average tree diameter of 11 inches dbh or greater; conifer overstory trees; canopy closure greater than 40 percent in moist forests and greater than 30 percent in dry forests; open space beneath the canopy to allow for NSO to fly; High NRF and NRF provide dispersal habitat, as well.
f/ Capable Habitat (FWS 2014c: habitat that is forested or could become forested (i.e., including recently harvested timberlands) that do not provide dispersal or NRF characteristics

Both federal and non-federal land occurs within the defined provincial analysis area, and based on acres of high NRF and NRF habitat available within each (see table 3.3.4-4), it is apparent that federally-managed lands provide substantially more suitable NRF habitat than non-federal lands. Therefore, it can be expected that non-federal land within the provincial analysis area plays a minor role in supporting NSOs and aiding in their recovery. Overall, approximately 52 percent of federal lands within the provincial analysis area provide suitable NRF (including High NRF) habitat; this is greater than the 40 percent NRF habitat threshold per home range that FWS et al. (2007) consider necessary to maintain NSO life history function. Also note, the majority of available NRF occurs within NSO home ranges. If physiographic provinces are reviewed individually, less than 40 percent of federal and non-federal lands together provide suitable NRF within each physiographic province; however, federal lands within individual physiographic province (except for the Coast Range) collectively consist of more than 40 percent NRF habitat which is above the recommended threshold. On all lands (federal and nonfederal), the Coast Range provides 18.1 percent NRF; Klamath Mountains, 37.5 percent NRF; West Cascades, 37.8 percent NRF; East Cascades, 32.6 percent NRF.

Discussion at the Task Force - ESA Consultation Subgroup meeting on April 2, 2008, indicated that NSO dispersal habitat could be considered adequate, or sufficient to support dispersing NSO, if at least 50 percent of the analysis area (in the Project's case, the defined provincial analysis area) consists of dispersal habitat. Within the provincial analysis area, dispersal habitat comprises dispersal-only habitat, as well as high NRF and NRF. Calculating the overall high NRF, NRF, and dispersal habitat from table 3.3.4-4, approximately 168,443 acres (52.4 percent) of dispersal habitat are available within the provincial analysis area. Overall, the provincial analysis area provides sufficient levels of dispersal habitat to support dispersing NSO (greater than 50 percent). Using the same method to calculate the available dispersal habitat within each physiographic province, the following acres of dispersal habitat are available within each province: 34,594 acres (37.5 percent) in the Coast Range, 73,156 acres (56.8 percent) in Klamath Mountains, 50,176 acres (65.3 percent) in West Cascades, and 10,517 acres (44.0 percent) in East Cascades. Two of the physiographic provinces within the provincial analysis area – Klamath Mountains and West Cascades physiographic provinces – provide adequate levels of dispersal habitat (greater than 50 percent).

Critical Habitat

Four federally-designated CHUs occur within the provincial analysis area (FWS 2012e): Oregon Coast Ranges – OCR (Unit 2) totaling 859,864 acres and six subunits, East Cascades South – ECS (Unit 8) totaling 368,381 acres and three subunits, Klamath West – KLW (Unit 9) totaling 1,197,389 acres and nine subunits, and Klamath East – KLE (Unit 10) totaling 1,052,731 acres and seven subunits. Eight subunits occur within the provincial analysis area (OCR-6, ECS-1, KLW-1, KLE-1, KLE-2, KLE-3, KLE-4, and KLE-5). All subunits are expected to function primarily for demographic support to the overall population, as well as connectivity between subunits and CHUs. Special management consideration or protection required for each subunit is to address threats from current and past timber harvest and competition from barred owls, as well as losses due to wildfire and the effects on vegetation from fire exclusion (with the exception of OCR-6).

- OCR (Unit 2): forest is dominated by western hemlock, Sitka spruce, and Douglas-fir. NSO nesting habitat tends to be limited to stands providing very large trees with cavities or deformities because Douglas-fir dwarf mistletoe is unusual in this region. Woodrats comprise an increasing proportion of the diet. One subunit occurs in the provincial analysis area: OCR-6.

- OCR-6: consists of approximately 81,900 acres in Coos and Douglas Counties, Oregon and comprises lands managed by the BLM. 97 percent of the area was used by NSO at the time of listing.

- KLW (Unit 9): forest is a highly diverse mix of mesic forest communities such as Pacific Douglas-fir, Douglas-fir tanoak, and mixed evergreen forest interspersed with more xeric forest types; tanoak is a dominant factor. Douglas-fir dwarf mistletoe is uncommon and seldom used for nesting platforms by NSO. Prey is diverse, but dominated by woodrats and flying squirrels. One subunit occurs in the provincial analysis area but would not be affected by the Pipeline Project: KLW-1.
  - KLW-1: consists of approximately 147,326 acres in Douglas, Josephine, Curry, and Coos Counties, Oregon and managed by the State of Oregon and BLM; 96 percent of the area was used by NSO at the time of listing.
- KLE (Unit 10): forest is a mixed-conifer/evergreen hardwood forest type and grades into the western hemlock forest. High summer temperatures and a mosaic of open forest conditions and Oregon white oak woodlands influence NSO distribution in this region. Dwarf mistletoe provides an important component of nesting habitat, enabling NSO to occasionally nest within stands of relatively younger, small trees. Five subunits occur in the provincial analysis area: KLE-1, KLE-2, KLE-3, KLE-4, and KLE-5.
  - KLE-1: consists of 242, 338 acres in Jackson and Douglas Counties, Oregon and managed by Forest Service and BLM; 84 percent of the area was used by NSO at the time of listing.
  - KLE-2: consists of 101,942 acres in Josephine and Douglas Counties, Oregon and is managed by BLM and the Forest Service; 92 percent of the area was used by NSO at the time of listing.
  - KLE-3: consists of 111,410 acres in Jackson, Josephine, and Douglas Counties, Oregon and is managed by Forest Service and BLM; 97 percent of the area was used by NSO at the time of listing.
  - KLE-4: consists of 254,442 acres in Jackson, Klamath, and Douglas Counties, Oregon and is managed by the Forest Service and BLM; 81 percent of the area was used by NSO at the time of listing.
  - KLE-5: consists of 38,283 acres in Jackson County, Oregon and is managed by the BLM and Forest Service; 86 percent of the area was used by NSO at the time of listing.
- ECS (Unit 8): ponderosa pine is dominant at mid-to-lower elevations, with a narrow band of Douglas-fir and white fir at middle elevations providing the majority of NSO habitat. Dwarf mistletoe provides an important component of nesting habitat, enabling NSO to nest within stands of relatively younger smaller trees. One subunit occurs in the provincial analysis area: ECS-1.
  - ECS-1: consists of approximately 127,801 acres in Klamath, Jackson, and Douglas Counties, Oregon and comprises lands managed by the BLM and Forest Service; 78 percent of the area was used by NSO at the time of listing.

The current status of NSO habitat (high NRF, NRF, dispersal only, and capable, as determined through the process for the Pipeline Project identified in the "Habitat" sub-section above) within designated CHUs and subunits located in the Project analysis area is shown in table 3.3.4-5. The baseline information shows that not all designated critical habitat is currently functioning as suitable NRF habitat. However, table 3.3.4-5 also provides the number of NSO that are known to occur in the CHUs located in the analysis area (based on NSO activity centers provided to Pacific Connector by FWS, BLM, and Forest Service). Given that suitable habitat acres within all affected CHUs currently support NRF habitat at levels that are adequate to support pairs of nesting NSOs, these CHUs are considered to be functional with respect to their recovery roles.

Of the 84 known, 15 best location, and 6 "PCGP assumed" NSO activity centers within the analysis area, 59 activity sites occur in CHUs (48 known, 8 best location, 3 "PCGP assumed"). Table 3.3.4-6 summarizes the number of activity sites analyzed within this BA that occur within each critical habitat subunit, and the condition of the home range (see table Q-7 in appendix Q). More than half the activity centers (39 of 59) have suitable NSO habitat above the recommended level of 50 percent suitable NRF habitat in the core area and 40 percent suitable NRF habitat in the home range to support nesting and NSO survival.

TABLE 3.3.4-5

Summary of NSO High NRF, NRF, Dispersal Only, and Capable Habitat in Critical Habitat Subunits Available within the Provincial Analysis Area

					High NRF in CHU b/		NRF in CHU c/		Dispersal Only in CHU d/		Capable in CHU e/		Total NSO Habitat in CHU f/	
CHU and Subunit	**Total Acres in CHU**	**Total Acres in Analysis Area**	**% Subunit within Analysis Area**	**Number of Known Owls a/**	**Acres**	**Percent Total g/**	**Acres**	**Percent Total g/**	**Acres**	**Percent Total h/**	**Acres**	**Percent Total g/**	**Acres**	**Percent Total g/**
Oregon Coast Range CHU (Unit 2 - 859,864 acres)														
OCR-6	81,900	11,906	14.5	52	4,104	5.0	2,453	3.0	2,511	3.1	2,795	3.4	11,863	14.5
Klamath West CHU (Unit 9 - 1,197,389 acres)														
KLW-1	147,326	622	0.4	120	23	0.0	36	0.0	464	0.3	10	0.0	533	0.4
Klamath East CHU (Unit 10 - 1,052,731 acres)														
KLE-1	242,338	25,140	10.4	112	9,492	3.9	6,163 (2,337)	2.5	7,614	3.1	1,590	0.7	24,860	10.3
KLE-2	101,942	7,013	6.9	85	2,401	2.4	2,582 (1,529)	2.5	1,038	1.0	970	1.0	6,991	6.9
KLE-3	111,410	6,293	5.6	75	1,484	1.3	2,478	2.2	1,521	1.4	693	0.6	6,175	5.5
KLE-4	254,442	29,737	11.7	161	6,776	2.7	8,537	3.4	10,430	4.1	3,048	1.2	28,790	11.3
KLE-5	38,283	3,428	9.0	32	334	0.9	1,628	4.3	528	1.4	713	1.9	3,204	8.4
Total Unit 10	**748,415**	**71,611**	**9.6**	**348**	**20,486**	**2.7**	**21,389 (3,866)**	**2.9**	**21,131**	**2.8**	**7,014**	**0.9**	**70,020**	**9.4**
East Cascades South CHU (Unit 8 - 368,381 acres)														
ECS-1	127,801	9,058	7.1	16	1,106	0.9	4,560	3.6	1,354	1.1	1,885	1.5	8,905	7.0
Total CHU (3,478365 acres)														
Overall CHU Total	**1,105,442**	**93,197**	**8.4**	**535**	**25,718**	**2.3**	**28,439 (3,866)**	**2.6**	**25,460**	**2.3**	**11,704**	**1.1**	**91,321**	**8.3**

a/ Number of Known Owls in entire CHU Subunit: known owl sites obtained from known owl locations provided by BLM (2017a), Forest Service (2017), and FWS (2008d) and 2007/2008 surveys conducted by Pacific Connector.

b/ High NRF (FWS 2014c): forested habitat that is characterized by large trees (> 32 inches dbh), high canopy cover (>60 percent), and multistoried structure with sufficient down wood and snags to support prey species.

c/ NRF (FWS 2012e, 2014c; North et al. 1999): conifer-dominated forested habitat greater than 80 years that does not meet the definition of High NRF but has multi-storied structure with large overstory trees (20-30 inches dbh), moderate to high canopy closure greater than 60 percent, and sufficient snags and down wood. Acreage in parenthesis identifies the area of NRF (or High NRF) prior to the 2015 Stouts Creek fire that are currently dead standing trees (i.e., "post-fire NRF").

d/ Dispersal ONLY (FWS 2012e, 2014c): an average tree diameter of 11 inches dbh or greater; conifer overstory trees; canopy closure greater than 40 percent in moist forests and greater than 30 percent in dry forests; open space beneath the canopy to allow for NSO to fly; High NRF and NRF provide dispersal habitat, as well.

e/ Capable Habitat (FWS 2014c): habitat that is forested or could become forested (i.e., recently harvested timberlands) that do not provide dispersal or NRF characteristics.

f/ Total NSO Habitat within CHU Subunits that occur within the provincial analysis area; does not include non-capable habitat.

g/ Percent total: percent of habitat available in entire critical habitat unit, not just the provincial analysis area.

TABLE 3.3.4-6

Summary of Northern Spotted Owl Activity Centers Analyzed that Occur within Northern Spotted Owl Critical Habitat Units, Including Condition of the NSO Activity Center

		Condition of high NRF/NRF in Activity Center				
CHU and Subunit	**Owl Status**	**> 50% NRF in Core Area, > 40% NRF in Home Range**	**< 50% NRF in Core Area, > 40% NRF in Home Range**	**> 50% NRF in Core Area, < 40% NRF in Home Range**	**< 50% NRF in Core Area, < 40% NRF in Home Range**	**Total Activity Centers**
Oregon Coast Range CHU (Unit 2)						
OCR-6	Known	1	0	1	5	7
	Best Location	0	0	0	0	0
	"PCGP Assumed"	0	0	0	1	1
	Total	**1**	**0**	**1**	**6**	**8**
Klamath East CHU (Unit 10)						
KLE-1	Known	11	1	0	0	12
	Best Location	2	0	0	0	2
	"PCGP Assumed"	0	1	1	0	2
	Total	**13**	**2**	**1**	**0**	**16**
KLE-2	Known	3	1	0	0	4
	Best Location	1	0	0	0	1
	Total	**4**	**1**	**0**	**0**	**5**
KLE-3	Known	3	1	0	0	4
KLE-4	Known	9	2	0	1	12
	Best Location	4	0	0	1	5
	Total	**13**	**2**	**0**	**2**	**17**
KLE-5	Known	1	0	1	2	4
East Cascades South CHU (Unit 8)						
ECS-1	Known	4	0	0	1	5
	Total	**4**	**0**	**0**	**1**	**5**
Overall CHU Subunits						
Overall CHU Subunits	Known	32	5	2	9	48
	Best Location	7	0	0	1	8
	"PCGP Assumed"	0	1	1	1	3
	Total	**39**	**6**	**3**	**11**	**59**

Late Successional Reserves

BLM and Forest Service LSRs occur within the provincial analysis area. LSRs on Forest Service lands are provided an LSR unit identified within the NWFP (Forest Service and BLM 1994): RO 223 is a large LSR unit and occurs within Umpqua NF, and RO 227 occurs within Rogue River National Forest and Winema National Forest and is generally contiguous. Additionally, approximately 568 acres of unmapped LSRs on National Forest Service lands associated with known NSO activity centers (KOAC) occur within the provincial analysis area. Table 3.3.4-7 includes a summary of NSO habitat that occurs within LSRs (and respective LSR units on National Forest Service lands) within the provincial analysis area by BLM District and National Forest, as well as NSO habitat within unmapped LSRs.

Much of the LSRs (and unmapped LSRs) within the provincial analysis area overlap the FWS designated CHUs for NSO. The overlap of LSRs with federally designated NSO critical habitat affords a greater degree of protection to the NSO and its critical habitat as the protections for LSRs are automatically imposed on those LSR acres that are found within a CHU. Thus, NSOs located within these land allocations also benefit from increased protection.

TABLE 3.3.4-7

Summary of High NRF, NRF, Dispersal, and Capable Habitat Available within LSRs and Forest Service Unmapped LSRs by Physiographic Province and Landowner within the Provincial Analysis Area

Landowner	Total Acres within Analysis Area	LSR Type a/	High NRF Habitat b/ Acres Available	High NRF Habitat b/ Percent g/	NRF Habitat c/ Acres Available	NRF Habitat c/ Percent g/	Dispersal Habitat Only d/ Acres Available	Dispersal Habitat Only d/ Percent g/	Capable Habitat e/ Acres Available	Capable Habitat e/ Percent g/	Total NSO Habitat f/ Acres Available	Total NSO Habitat f/ Percent g/
Coast Range Physiographic Province												
Coos Bay BLM	15,839	LSR	6,780	42.8	3,637	23.0	3,166	20.0	2,121	13.4	15,705	99.2
Roseburg BLM	37	LSR	25	67.6	12	32.4		0.0		0.0	37	100.0
Coast Range Total	**15,876**	**TOTAL**	**6,806**	42.9	**3,649**	23.0	**3,166**	19.9	**2,121**	13.4	**15,742**	99.2
Klamath Mountains Physiographic Province												
Roseburg BLM	173	LSR	102	59.0	65 (29)	37.6	0	0.0	5	2.9	172	99.4
Medford BLM	8	LSR	3	37.5	5	62.5		0.0		0.0	8	100.0
Umpqua N.F.	12,100	LSR RO223	4,640	38.3	3,599 (2,287)	29.7	3,162	26.1	582	4.8	11,982	99.0
	677	Unmapped LSR	442	65.3	97	14.3	121	17.9	17	2.5	676	99.9
	12,309	LSR Units	4,753	38.6	3,677 (2,317)	29.9	3,168	25.7	592	4.8	12,190	99.0
Klamath Mountains Total	682	Unmapped LSRs	442	64.8	97	14.2	121	17.7	21	3.1	681	99.9
	12,991	**TOTAL**	**5,195**	40.0	**3,774 (2,317)**	29.1	**3,289**	25.3	**613**	4.7	**12,871**	99.1
West Cascades Physiographic Province												
Medford BLM	48	LSR	18	37.5	21	43.8	7	14.6	2	4.2	48	100.0
Rogue River N.F.	30,438	LSR RO227	6,974	22.9	7,904	26.0	10,888	35.8	2,945	9.7	28,712	94.3
(Fish Lake)	112	Unmapped LSR	34	30.4	59	52.7	19	17.0	0	0.0	112	100.0
	31,080	LSR Units	7,086	22.8	8,147	26.2	11,079	35.6	2,994	9.6	29,306	94.3
West Cascades Total	112	Unmapped LSRs	34	30.4	59	52.7	19	17.0	0	0.0	112	100.0
	31,192	**TOTAL**	**7,121**	22.8	**8,205**	26.3	**11,098**	35.6	**2,994**	9.6	**29,418**	94.3
East Cascades Physiographic Province												
Rogue River N.F.	1,187	LSR RO227	188	15.8	492	41.4	385	32.4	89	7.5	1,154	97.2
Winema N.F.	1,820	LSR RO227	193	10.6	896	49.2	364	20.0	270	14.8	1,722	94.6
(Lake of the Woods)	229	Unmapped LSR	91	39.7	138	60.3		0.0	0	0.0	229	100.0
	3,145	LSR Units	386	12.3	1,459	46.4	805	25.6	363	11.5	3,014	95.8
East Cascades Total	229	Unmapped LSRs	91	39.7	138	60.3		0.0	0	0.0	229	100.0
	3,374	**TOTAL**	**478**	14.2	**1,597**	47.3	**805**	23.9	**363**	10.8	**3,243**	96.1

TABLE 3.3.4-7 (continued)

Summary of High NRF, NRF, Dispersal, and Capable Habitat Available within LSRs and Forest Service Unmapped LSRs by Physiographic Province and Landowner within the Provincial Analysis Area

Landowner	Total Acres within Analysis Area	LSR Type a/	High NRF Habitat b/		NRF Habitat c/		Dispersal Habitat Only d/		Capable Habitat e/		Total NSO Habitat f/	
			Acres Available	Percent g/	Acres Available	Percent g/	Acres Available	Percent g/	Acres Available	Percent g/	Acres Available	Percent g/
All Physiographic Provinces												
	62,414	LSR Units	19,031	30.5	16,934 (2,317)	27.1	18,219	29.2	6,072	9.7	60,256	96.5
Overall Total	1,023	Unmapped LSRs	568	55.5	293	28.6	140	13.7	21	2.1	1,022	99.9
	63,437	***TOTAL***	**19,599**	30.9	**17,227 (2,317)**	27.2	**18,359**	28.9	**6,093**	9.6	**61,278**	96.6

a/ Unmapped LSRs consider MAMU occupied stands and Known Owl Activity Centers (KOAC) on NWFP Matrix lands on Forest Service-Managed lands.
b/ High NRF (FWS 2014c): forested habitat that is characterized by large trees (> 32 inches dbh), high canopy cover (>60 percent), and multistoried structure with sufficient down wood and snags to support prey species.
c/ NRF (FWS 2012e, 2014c; North et al. 1999): conifer-dominated forested habitat greater than 80 years that does not meet the definition of High NRF but has multi-storied structure with large overstory trees (20-30 inches dbh), moderate to high canopy closure greater than 60 percent, and sufficient snags and down wood. Acreage in parenthesis identifies the area of NRF (or High NRF) prior to the 2015 Stouts Creek fire that are currently dead standing trees (i.e., “post-fire NRF”).
d/ Dispersal ONLY (FWS 2012e, 2014c): an average tree diameter of 11 inches dbh or greater; conifer overstory trees; canopy closure greater than 40 percent in moist forests and greater than 30 percent in dry forests; open space beneath the canopy to allow for NSO to fly; High NRF and NRF provide dispersal habitat, as well.
e/ Capable Habitat (FWS 2014c): habitat that is forested or could become forested (i.e., recently harvested timberlands) that do not provide dispersal or NRF characteristics.
f/ Total NSO Habitat within NWFP LSRs and unmapped LSRs that occur within the provincial analysis area; does not include non-capable habitat.
g/ Percent total: percent of habitat available in LSR units within the provincial analysis area.

3.3.4.3 Effects of the Proposed Action

Direct Effects

Potential Project-related effects to NSOs that could be caused by the action and occur at the same time and place, including the following within the provincial analysis area: 1) removal of a known nest tree during the breeding season (March 1 through September 30), and 2) human and noise disturbance due to right-of-way clearing, construction, and road use during the breeding period, including noise due to blasting and helicopter support during construction, and smoke from burning slash. These effects would extend over the short term.

Habitat Removal During Breeding Season

Removal of habitat during the breeding season within a nest patch could result in the potential death of nestlings if the nest tree is felled. Removing habitat outside of the entire breeding season (outside of March 1 through September 30) would eliminate any direct impact to individual NSOs or nestlings. Because habitat removal within 0.25 mile of an activity center within the Pipeline route, including subsequent NSO activity centers detected within 0.25 mile of the Pipeline prior to construction, would occur outside of the entire breeding season (outside of March 1 through September 30), no direct effect to NSOs through habitat removal is expected. Maps within appendix V.1 show the timing constraints that would be applied in relation to NSO activity centers for timber felling (and Pipeline construction).

Noise and Visual

In their Revised Conservation Framework, FWS (2014c) provided guidance on determining Project impacts to NSO from noise. This guidance included disturbance and disruption distances based on noise thresholds (as described in FWS 2003a and 2006a; discussed below), and prescribed associated impact levels (No, Low, Moderate, or High) based on Project timing and activity.

Disruption and Disturbance

NSOs could be directly affected by noise and disturbance related to proximate human-related activities associated with timber removal, construction, and operation and maintenance of the Pipeline that could result in diminished reproductive success and survival (if behavior response to construction makes them more vulnerable to injury). Disturbance (both visual and noise) would include use of chainsaws and heavy equipment during vegetation clearing and construction, explosives to trench through rock, helicopters and/or small aircraft to inspect the pipeline once per year during the life of the Pipeline, and brush control (i.e., mowing and cutting) within the 30-foot maintenance right-of-way every three to five years for the life of the Pipeline. The term "disruption" was alluded to in the ESA, under the definition of "harassment" (50 CFR 17.3) as:

> *an intentional or negligent act or omission which creates the likelihood of injury by annoying it (the organism) to such an extent as to significantly disrupt normal behavior patterns which include but are not limited to, breeding, feeding or sheltering.*

The term "disturbance" was not included in the ESA but a reasonable working definition was provided by Leal (2006) and has been incorporated into this BA:

> *any potential auditory or visual stimuli or deviation from ambient/baseline conditions [that] an individual bird, at a given site, is likely to detect and potentially react to.*

Reactions of NSOs from human presence and excessive noise levels in the immediate vicinity of owls could include the following if project activities occur during the breeding season: 1) flushing from the nest site, which would leave eggs or young exposed to predation; 2) causing juveniles to prematurely fledge, which would increase juveniles' risk of predation; 3) interrupting foraging activities, which would result in the reduced fitness or even mortality of an individual; and/or 4) disrupting roosting activities which would cause a NSO to be displaced and possibly relocate. In the Northern Spotted Owl Status Review, none of these types of disturbance were considered a threat to the species (Courtney et al. 2004). However, at the individual level, based on anecdotal information and effects to other bird species (Wesemann and Rowe 1987; Delaney et al. 1999; Delaney and Grubb 2001; Swarthout and Steidl 2001; FWS 2003a, 2005d), disturbance to NSOs could occur.

Disturbance to owls would be expected to be inversely related to stimulus distance and positively related to noise level, similar to results reported for bald eagles (Grubb and King 1991), gyrfalcon (Platt 1977), and other raptors (Awbrey and Bowles 1990). Therefore, for a significant disruption of NSO behavior to occur as a result of disturbance caused by an action, the disturbance and the NSO must be in close proximity to one another (FWS 2003a, 2005d). Human presence on the ground is not expected to cause a significant disruption of behavior because NSOs do not seem to be startled by human presence (FWS 2005d); however, increased human presence in an area that previously had minimal human presence may be an indirect effect of the Pipeline Project.

NSOs disturbed at a roost site are presumably capable of moving away from disturbance without a substantial disruption of behavior. Because NSOs are primarily nocturnal predators, projects that occur during the day are not likely to disrupt foraging behavior and the potential for effects is mainly associated with breeding behavior at an active nest site.

In the late breeding period, potential effects from Pipeline Project activities decline because juvenile NSOs are increasingly more capable of moving as the nesting season progresses. Once capable of sustained flight, young owls are presumably able to distance themselves from disturbance and minimize their risk of predation. To ensure that more than 86 percent of juvenile NSOs in the Oregon Western Cascades Physiographic Province are able to move away from disturbances without increasing their risk of predation or harm, the critical nesting period is considered to be March 1 through July 15. This is based on fledge data (Turner 1999) and includes an additional two weeks to allow for development of flight skills. After July 15, most fledgling NSOs are assumed to be capable of sustained flight and can move away from harmful disturbances. The critical breeding period for the Oregon Western Cascades Physiographic Province is applied to the entire provincial analysis area (March 1 through July 15), even though research has provided data that indicate NSOs fledge earlier in other Physiographic Provinces within the analysis area.

The available research and incidental observations show that the effects of noise from a variety of sources can elicit disturbance as well as disruption responses from spotted owl subspecies (including MSO, NSO, and California spotted owls [CSO]), including responses such as flushing or flight that would be construed as interference with normal behavior patterns including, but not limited to, breeding, feeding, or sheltering. The following are brief summaries of available spotted owl research:

- All NSO foraged adjacent to roads and appeared undisturbed by the occasional passage of vehicles on narrow secondary gravel forest roads (Forsman et al. 1984).

- Male NSOs within 0.25 mile of a major logging road or timber harvest had higher fecal corticosterone levels indicating that the NSO was more stressed than males farther away; no differences found for females related to distance from roads or timber harvest (Wasser et al. 1997).
- Proximity to roads (paved, improved surface, any type) was not correlated with fecal corticosterone in CSO (Tempel and Gutiérrez 2004).
- CSO exposure to chainsaw noise did not result in a detectable increase in fecal corticosterone level; CSO can tolerate low-intensity human sound in their environment without eliciting a physiological stress response (Tempel and Gutiérrez 2003).
- MSO nest occupancy less than 1 mile from firing sites was higher than nest occupancy more than 1 mile away; MSO not affected by explosives but were affected by hikers (Hathcock et al. 2010).
- MSO response to military aircraft overflights (noise levels 78, 92 and 95 dB during sequential exposures) ranged from none to sudden head turning; behaviors during flights were no different than pre- and post-flight periods (Johnson and Reynolds 2002).
- Relationships of NSO baseline physiology, nutritional stress, and reproductive success to exposures to high and low levels of routine OHV traffic (Hayward et al. 2011).
  - Male NSO showed high fecal glucocorticoid (GC) response to OHV trials during incubation period, indicating a higher level of stress.
  - Male NSO 164 to 2,625 feet (50 to 800 meters) from loud roads showed lower fecal GC response to motorcycle trials than males 164 to 2,625 feet (50 to 800 meters) from quiet roads in July (fledging period).
  - Female NSO with good nutrition but no young showed high fecal GC response to OHV trials.
  - Female NSO with 2 young and poor nutrition showed low fecal GS response to OHV trials.
  - NSO close to roads had better nutrition but levels of fecal GC were not related to proximity to roads or noise.
  - NSO within 328 feet (100 meters) of quiet roads fledged more young than NSO farther from roads; NSO within 328 feet (100 meters) of noisy roads fledged fewer young.

These studies to date show a mixed spotted owl response to noise. The majority of these studies focus on short-term measures of fecal steroids and do not necessarily account for potential longer term effects of noise over a breeding season. However, Hayward et al. (2011) did measure the effects on reproductive success of OHV traffic and found that that proximity to busy roads resulted in lower reproduction, which by definition is a measure of disruption. The literature summarized above indicates that while in the short term responses to noise may not be measurable, over a breeding season noise from roads has the potential to result in disruption.

Auditory and Visual Disturbance – FWS Guidance

FWS (2003a, 2006a) indicated that the disturbance behaviors noted above may occur when 1) the project-generated sound level substantially exceeds existing ambient noise levels by 20 to 25 dB; 2) when the total sound level (project and ambient noise levels combined) exceeds 90 dB; or 3) when the visual proximity of human disturbance occurs within 130 feet of an active nest site. FWS concluded that noise and human presence can result in a significant disruption of breeding, feeding, and/or sheltering behavior of NSOs such that it creates the potential for injury to the individuals (i.e., incidental take in the form of harassment).

FWS (2006a) established distances within which sound levels and visual disturbance for various activities may result in injury or harassment of NSOs by significantly disrupting the normal behavior pattern of individuals or breeding pairs. Table 3.3.4-8 (Disruption Threshold Distance) provides the distances at which FWS (2003a, 2006a, and 2014c) indicate that NSOs could be disrupted or "harassed" by certain activities during the critical breeding period and late breeding period. Within the Revised Conservation Framework, FWS (2014c) provided distances from a project boundary within which NSOs could potentially be distracted, or "disturbed" from their normal activity. Those distances are often applied as seasonal buffers to minimize impacts of projects on nesting NSOs (Disturbance Threshold Distance; table 3.3.4-8).

TABLE 3.3.4-8

Threshold Distances where Noise and Visual Disturbances are Unlikely to Occur to Nesting Northern Spotted Owls during the Breeding Season a/

	Disruption Threshold Distances From NSO Activity Centers		Disturbance Threshold Distance From NSO Activity Centers	
Activity	**NSO Critical Breeding Season b/**	**NSO Late Breeding Season b/**	**NSO Critical Breeding Season b/**	**NSO Late Breeding Season b/**
Use of Existing Low Use Roads c/	35 yards (105 feet)	No Disruption Anticipated	0.25 mile	No Disturbance Anticipated
Use of Existing High Use Roads d/	No Disruption Anticipated	No Disruption Anticipated	0.25 mile	No Disturbance Anticipated
Chainsaws	45 yards (135 feet)	No Disruption Anticipated	0.25 mile	No Disturbance Anticipated
Heavy equipment e/	35 yards (105 feet)	No Disruption Anticipated	0.25 mile	No Disturbance Anticipated
Rock ditching equipment f/	120 yards (360 feet)	No Disruption Anticipated	0.25 mile	No Disturbance Anticipated
Blasting – more than 2 pounds with mitigation measures	120 yards (360 feet)	120 yards (360 feet)	0.25 mile	0.25 mile
Small Helicopter/Airplanes	120 yards (360 feet)	No Disruption Anticipated	0.25 mile	No Disturbance Anticipated
Large/Transport Helicopters with mitigation measures g/	240 yards (720 feet)	240 yards (720 feet)	0.25 mile	0.25 mile

a/ Sources: FWS 2003a, 2006a, 2014c; Michael Minor & Associates 2008 (see appendix P).
b/ Northern Spotted Owl breeding period is from March 1-September 30; critical breeding period is considered from March 1-July 15; late breeding season is considered from July 16-September 30.
c/ Existing Low Use Roads include federal roads designated as local/resource and private roads that appear to receive light traffic and periodic maintenance.
d/ Existing High Use Roads include federal roads that are designated as arterial and collector roads. Includes some federal roads local/resources roads that are paved or receive regular traffic/maintenance and are the primary access routes within checkerboard (federal/private) ownership. Also includes other private residential roads driveways or other roads that provide access to multiple rural residences.
e/ Heavy equipment includes: back trackhoes, side-booms, bulldozers, semi-trucks, pneumatic hammers.
f/ Rock ditching equipment includes: auger drill rig, mounted impact hammer (hoe ram), rock drill, and blasting (mitigated or less than 2 pounds.
g/ Transport helicopters proposed for this Project include Boeing Chinook (CH-47) and Boeing Vertol 107-II (CH-46).

FWS (2003a, 2006a) reviewed available scientific literature on behavioral and physiological responses of different bird species to various noise sources. They determined that birds would likely detect noises that were ≥4 decibels or more above ambient noise levels. FWS (2006a) defined an "injury threshold" of 92 dBA, and a "tolerance threshold" of 82 dB for NSOs and MAMUs. The tolerance threshold assumes that respective nest sites become "intolerable" to the species and harassment occurs due to the total sound level the species must endure. FWS (2006a) did recognize that a tolerance threshold of 92 dB for aircraft (e.g., helicopters) would be applicable due to the usually slow onset of aircraft noise approaching, but otherwise FWS (2006a) applied the threshold of 82 dB as a sound-related injury threshold level. Based on Delaney et al. (1999) and Brown (1990), FWS (2006a) subtracted the noise level that elicited a harassment-indicating behavior (flight or flushing) from the minimum ambient noise at the respective sites and deduced that action-generated noise levels that are 25 dB above ambient levels would constitute the sound level threshold above which harassment is likely to occur (FWS 2006a). From that exercise, FWS (2006a) deduced that a noise level of 70 dB would be a disturbance threshold and noise ≥70 dB would be disruptive.

The FWS typically considers the disturbance threshold for general noise-generating activities within a 0.25-mile radius (125-acre area) of the activity during the critical breeding season (March 1 to July 15). For louder disturbance activities such as open air blasting using more than a 2 pound charge or large aircraft, FWS generally applies a 1.0-mile radius (2,176-acre area) around NSO sites during the entire breeding season (March 1 to September 30) to minimize disturbance to nesting NSO (FWS 2003a; Smith et al. 2007; Wille et al. 2006). However, FWS suggested that if additional studies could demonstrate that use of larger blasts (greater than 2 pounds) and large helicopters with mitigation measures proposed for the Project attenuated to less than 92 dB, and preferably below 70 dB (disturbance threshold versus 92 dB disruption threshold) within a mile, to provide a report and additional data would be considered to reduce the threshold distances for those activities (Smith et al. 2007; Wille et al. 2006).

Blasting and Helicopter Noise Levels

Pacific Connector prepared a report (see appendix P) that analyzes the distances at which conventional blasting required for trenching within rock substrate for construction and transport helicopters attenuate to 92 dB. Appendix P shows empirical noise data evaluations for trench blasting and heavy transport helicopters and was used to determine the distances for which noise levels remain below 92 dB during construction activities with appropriate mitigation measures applied. Under the worst-case conditions with common and appropriate mitigation measures applied to trench blasting operations, it is expected that blasting noise would attenuate to 92 dB within 200 feet of the source, and to 70 dB within 1,025 feet of the blast source in soft rock. Likewise, large transport helicopters would attenuate to 92 dB within 700 feet. The greater distance for helicopter use is due to the directional aspects of blade slap noise that is directed toward the ground.

Mitigation for helicopter noise includes operational restrictions, such as maintaining a high altitude and flight paths away from noise sensitive areas whenever possible. Analyses for NSOs in this BA consider the distances for larger blasts and large helicopters to be more conservative than what the noise report suggests. A disruption threshold distance for blasting greater than 92 dB has been used but with mitigation measures applied to be the same disruption distance expected for smaller blasts (less than 92 dB)—120 yards or 360 feet—more conservative than the noise report describes, and the disturbance threshold distance associated with large blasts to be expected within 0.25 mile of blasting activity (see table 3.3.4-8). It is expected that these distances be considered throughout the entire breeding season (March 1–September 30) because of the sudden onset of noise associated with blasting activities. A disruption threshold distance for large/transport helicopter use has been used with proposed mitigation to be slightly farther than the report suggests, considering disruption distance of 240 yards (720 feet) and a disturbance threshold distance of 0.25 mile (1,320 feet) (see table 3.3.4-8).

Even though FWS (2003a) provided some evidence suggesting that noise that builds gradually, such as a helicopter approaching from a distance, may result in less risk, and even though FWS does not anticipate effects from smaller aircraft use after the critical breeding period, it is anticipated that use of large/transport helicopters may disrupt or disturb NSOs throughout the entire breeding season (March 1–September 30) and therefore the analysis within this assessment makes the same assumption. The FWS indicated that if noise levels above 92 dB are recorded at 0.25 mile of the blasting activities, that blasting operations should cease until more effective mitigation measures can be employed (memorandum dated September 16, 2008).

Disruption and Disturbance – Timber Clearing, Pipeline Construction, Existing Road Use

Approximately 7.7 miles of timber clearing and construction would occur within 0.25 mile of 12 NSO activity centers (nine known sites, two best location sites, and one “PCGP assumed” site; Pacific Connector proposes to clear timber within 0.25 mile of NSO activity centers between October 1 and February 28, outside of the NSO breeding season (March 1 through September 30); therefore, noise, visual disturbance, and in some instances large helicopter use would not be expected to disturb or disrupt NSO breeding activities at these 12 activity centers (see *Habitat Removal during Breeding Season*, above). However, due to construction constraints and safety of construction crew, Pacific Connector has indicated they would need to construct and install the pipe within 0.25 mile of activity centers during the breeding season. To minimize disturbance, though, Pacific Connector would construct within 0.25 mile of activity centers after the critical breeding season (after July 15).

With the exception of large transport helicopter activities to deliver pipe to inaccessible areas that could occur within 0.25 mile of three NSO activity centers (2317B, PCGP 095.3, and assumed PCGP A-3) and/or potential blasting activities (greater than 2 pounds of explosives) that could occur within 0.25 mile of five additional NSO activity centers (four known sites and one best location sites), acoustic and visual disturbances from the Project are not expected to disrupt NSO nesting and rearing activities because they would occur after the critical breeding season (see table 3.3.4-8). Therefore, activities from Pipeline construction during the late breeding period (July 16 through September 30) could disrupt or disturb NSO at 10 NSO activity centers within 0.25 mile of the Pipeline right-of-way, and construction activities off the right-of-way would occur during the entire breeding season and could disturb NSO at two known activity centers (0071 and 4052A) located within 0.25 of Pipeline Project components, if NSO are present (see table 3.3.4-9). Table Q-8 in appendix Q provides distances from proposed project activities (timber clearing, construction activities, road use, operations/maintenance) and timing of those actions, including large transport helicopter use and blasting more than 2 pounds of explosives that are expected to occur within 0.25 mile of known, best location, and “PCGP assumed” NSO sites. Additionally, table Q-8 in appendix Q provides the expected direct effect (disruption, disturbance, no effect) and rationale for each known, best location, and PCGP assumed NSO site based on timing and distance from the Project activities for each proposed activity (based on disturbance distances from table 3.3.4-8).

TABLE 3.3.4-9

Number of Northern Spotted Owl Sites within each Physiographic Province with Expected Disturbances from Noise and/or Visuals Associated with Activities Proposed within 0.25 mile of Activity Centers a/

Status of Northern Spotted Owl Site	Total Number of Owl Sites	Construction Activities and Road Use b/		Construction Activities Only c/		Road Use Only d/		
		Disruption	Disturbance	Disruption	Disturbance	Disruption	Disturbance	None e/
Coast Range Physiographic Province								
Known Site	14	0	0	1	0	0	6	7
Best Location	0	0	0	0	0	0	0	0
PCGP Assumed	3	0	0	0	0	0	1	2
Coast Range Total	17	0	0	1	0	0	7	9
Klamath Mountains Physiographic Province								
Known Site	39	0	3	0	0	1	7	28
Best Location	10	0	1	1	0	1 f/	2	5
PCGP Assumed	3	0	1	0	0	0	1	1
Klamath Mountains Total	52	0	5	1	0	2	10	34
West Cascades Physiographic Province								
Known Site	26	0	2	0	2	0	10	12
Best Location	5	0	0	0	0	0	2	3
PCGP Assumed	0	0	0	0	0	0	0	0
West Cascades Total	31	0	2	0	2	0	12	15
East Cascades Physiographic Province								
Known Site	5	0	0	0	1	0	0	4
Best Location	0	0	0	0	0	0	0	0
PCGP Assumed	0	0	0	0	0	0	0	0
East Cascades Total	5	0	0	0	1	0	0	4
Total Physiographic Provinces								
Known Site	84	0	5	1	3	1	23	51
Best Location	15	0	1	1	0	1 f/	4	8
PCGP Assumed	6	0	1	0	0	0	2	3
Overall Total	**105**	**0**	**7**	**2**	**3**	**2**	**29**	**62**

a/ Summarized from table Q-8 in appendix Q; see appendix Z2 for D/D Impact Categories for each NSO activity center applying guidance provided by FWS (2014c) in the Revised Conservation Framework.
b/ Construction Activities and Road use: both proposed activities occur within 0.25 mile of NSO activity center
c/ Construction Activities Only: includes general construction activities, blasting (> 2 lbs explosives), and/or large transport helicopter use; no proposed road use within 0.25 mile of NSO activity centers
d/ Road use only: includes non-public roads that would be used by for the Pipeline Project; no construction activities proposed within 0.25 mile of NSO activity centers.
e/ None: construction and proposed road use > 0.25 mile of NSO activity center
f/ Best location site PCGP 090.2 is also located within 0.25 mile of Pipeline construction but no large transport or mitigated blasting (> 2 pounds explosives) would occur; no disturbance or disruption would be expected because construction could occur during the late breeding season.

Informal consultations with FWS (June 5, 2008, meeting; see NSO and MAMU Avoidance Plan, appendix V.1) identified disturbance from travel on existing roads to be less of an impact than other actions associated with the proposed Project, especially if farther than 35 yards (105 feet) from an NSO activity center. Based on the Revised Conservation Framework (FWS 2014c) that includes guidance provided by FWS, as well as available scientific literature, use of existing high use roads may be detectable by NSO within 0.25 mile but it is not expected that use of every existing high-use road would disturb nesting NSOs and use of existing high-use roads would not substantially disrupt normal behavior patterns and lead to harassment under the ESA. However, use of existing low-use roads has the potential to disrupt normal behavior patterns during the breeding season (March 1 through September 30) and lead to harassment under the ESA within 35 yards of an activity center. Use of public, high-volume access roads (i.e., State highways and County roads) are not expected to disturb NSO.

For the purposes of this analysis, existing low-use roads include federal roads designated as local/resource and private roads that appear to receive light traffic and periodic maintenance. Existing high-use roads include federal roads that are designated as arterial and collector roads as well as some local/resources roads that are paved or receive regular traffic/maintenance and are the primary access routes within checkerboard (federal/private) ownership. Existing high-use roads also include other private residential roads driveways or other roads that provide access to multiple rural residences. Use of existing low-volume access roads would potentially disrupt NSO at two activity centers within 35 yards of the access roads and would potentially disturb NSO at 36 activity centers located within 0.25 mile, including seven activity centers that would experience disturbance from Pipeline construction during the late breeding season, if present.

Expected Disturbance Effects

Impact assessments were prepared following guidance from FWS's Revised Conservation Framework (FWS 2014c) for each NSO activity center analyzed within this BA (see appendix Z.2) that identify how far a NSO activity center is in relation to proposed construction activities, including large transport helicopter use and blasting (greater than 2 pounds of explosives). The impact assessments in appendix Z2 also identify existing access roads by high or low traffic use within 0.25 mile of known, "PCGP assumed," or best location NSO sites, including distance from the access road(s) and expected road improvements within the nest patch or 0.25-mile buffer of the activity site. Each NSO activity center has a series of maps with the analysis that show the NSO home range in relation to the proposed actions and include a 0.25-mile spatial buffer around each activity center (see appendix Z.2); maps in appendix V1 identify the seasonal constraints that would be applied to minimize impact to NSO during timber felling and Pipeline construction. Additionally, maps 1 through 39 in appendix Q show the locations of NSO activity centers in relation to different Project components and identify spatial buffers (360 feet, 720 feet, and 0.25-mile buffers) associated with a NSO activity site.

Table 3.3.4-9 summarizes the effects (disruption, disturbance, no effect) to known, best location, or "PCGP assumed" NSO sites located within 0.25 mile of proposed project activities, including use of access roads within the provincial analysis area affected by the proposed Project based on the timing of activities and distance from proposed activity to NSO activity center (summarized from table Q-8 in appendix Q and described in appendix Z.2).

The FWS (2014c) provided a method in the Revised Conservation Framework to categorize direct effects to NSO pairs within a disruption and/or disturbance distance (0.25 mile) of project activities, including use of access roads, into the following D/D Impact Categories: High Impact, Moderate Impact, Low Impact, Low Impact – no mitigation, and No Impact. The assessment considers the timing, types, and location of Project-related activities in relation to NSO activity centers that could result in disturbance or disruption of NSO to assist in determining a D/D Impact Category for each Project activity for each NSO activity center.

Using the Revised Conservation Framework (FWS 2014c) as guidance, the D/D Impact Category for each NSO activity center within 0.25 mile of proposed Project activities was determined as shown in appendix Z.2, including a list of factors considered when determining if an activity would be considered a disruption, a disturbance, or have no effect on each NSO activity center. In many instances, an NSO activity center could experience disturbance from more than one proposed activity (e.g., construction effects and proposed use of existing access roads; see D/D Impact Categorization in appendix Z.2). In May 2018, FWS reviewed the D/D impact categories provided for each NSO activity center and agreed with the categories provided by Pacific Connector. The resulting D/D Impact Category is included for each NSO activity center in table Q-8 in appendix Q, and within appendix Z.2.

Table NSO-1 in the introduction to appendix Z.2 summarizes the number of NSO activity centers by D/D Impact Category and status of NSO activity center. No NSO activity center was assigned a "High" category because within 0.25 mile of an NSO activity center, Pacific Connector would remove timber outside of the entire breeding period and construct outside the critical breeding period (March 1 to July 15).

Temporary Habitat Loss Due to Disturbance

There is a potential for NSO present within 0.25 mile of Pipeline activities to be disturbed or disrupted from normal activities due to associated noise from Pipeline Project activities, which could cause NSO to temporarily avoid or move away from habitat within 0.25 mile of Pipeline Project activities (i.e., temporary habitat loss). Approximately 16,051 acres of suitable NRF habitat (high NRF and NRF) within the provincial analysis area occur within 0.25 mile of the proposed action, of which 12,687 acres occur within NSO home ranges analyzed within this BA that could result in temporary loss of habitat due to associated noise disturbance from construction and pipelay activities within the NSO breeding season (March 1 through September 30; table 3.3.4-10).

TABLE 3.3.4-10

Amount (acres) of Nesting, Roosting, and Foraging Habitat (acres) within 0.25 mile of Pipeline Project Activities that Could Directly Impact NSO during the Breeding Season (March 1 through September 30)

Physiographic Province	Miles of Proposed Pipeline	Suitable NRF within 0.25 mile of Proposed Activities a/	Suitable NRF within 0.25 mile of Proposed Activities within NSO Home Ranges a/	Percent of NRF Habitat within NSO Home Ranges
Coast Range	53.0	2,522	1,664	66.0
Klamath Mountains	71.0 (1.8)	7,022 (805)	6,405 (805)	91.2
West Cascades	45.0	5,309	3,977	74.9
East Cascades	23.1	1,199	641	53.5
Total	**192.1 (1.8)**	**16,051 (805)**	**12,687 (805)**	**79.0**

a/ Suitable NRF Habitat includes both high NRF and NRF habitat within 0.25 mile of proposed habitat removal. Acreage in parenthesis identifies the area of NRF (or High NRF) prior to the 2015 Stouts Creek fire that are currently dead standing trees (i.e., "post-fire NRF").

Within 0.25 mile of NSO activity centers, timber removal would occur outside of the entire breeding season beginning in October and continuing through February and continue the following year outside of the NSO breeding season, if necessary (see table Q-9 in appendix Q for specific timing within individual owl home ranges), so direct effects to NSO would not occur. Timber removal and construction activities could occur during the entire NSO breeding season when beyond 0.25 mile of NSO activity centers. Activity would not occur simultaneously within the 192.1 miles of the proposed Pipeline Project within the range of the NSO, and therefore, any temporary habitat loss would be less than estimated in table 3.3.4-10, and potential effects to NSO utilizing habitat would be short in duration. Pacific Connector would conduct additional "spot-check" surveys within the NSO provincial analysis area one year prior to scheduled timber removal/construction in NRF habitat that is within 0.25 mile of the construction right-of-way to detect, if possible, spotted owls that may have recently established territories in the Pipeline Project area and adjust the schedule, if necessary, further minimizing direct effects to NSO during the breeding season.

Helicopter Rotor Wash

Strong winds can cause direct mortality of NSOs by blowing chicks out of nests (FWS 1992b). Helicopter drive rotors produce high velocity vortices (winds) that extend from the center of the helicopter outward in all directions. Vertical downwash of air (rotor wash) close enough to the ground produces surface winds that dissipate as they move away from the helicopter (sidewash). Induced winds caused by helicopter rotor wash may exceed hurricane force velocities and would be expected to adversely affect nesting NSOs in the area. Induced rotor downwash and surface sidewash are functions of helicopter size, rotor surface area, helicopter weight, flight speed and height above ground (Teske et al. 1997; Gordon et al. 2005). Effects to nesting birds can be minimized or avoided by routing helicopter flight paths and staging locations far enough away from nests so that locally induced winds would not adversely affect nests or nestlings.

Maximum induced surface velocities produced by downwash and sidewash from various helicopters were measured in the field to determine the decay function of rotor-produced vortices near ground level (Teske et al. 1997). Field studies included measurements on three helicopter models that might be utilized during construction of the Pipeline: 1) the twin-rotor CH-47 (civilian variant is the Boeing HH-47 Chinook) with rotor diameter 59.1 feet, 2) the single rotor CH-54 with a rotor diameter of 72 feet (civilian variant is the Sikorsky S-64 Skycrane), and 3) the twin-rotor CH-46 (civilian variant Boeing Vertol 107) with rotor diameter of 49.9 feet (Teske et al. 1997). Using parameters derived from the field trials, estimates of maximum induced surface velocities were made for each of the three helicopter models at varying heights above ground while flying at different ground speeds. In general, maximum induced surface velocities increase with rotor diameters, decrease with distance above ground, and decrease with faster ground speeds.

Results of modeling maximum induced surface velocities (model described in Teske et al. 1997) produced by a Chinook helicopter are shown in figure 3.3.4-2 for drop heights (heights above ground level at which the helicopter would discharge a payload of foam, water, or retardant during wild fire control) ranging from 10 to 320 feet while flying at ground speeds ranging from 5 to 25 mph. Included in figure 3.3.4-2 are four wind speed categories on the Beaufort Scale (NOAA 2015b) which was developed to describe damage associated with wind forces ranging from calm to hurricane forces. On the Beaufort Scale, induced surface winds of 9 to 11 mph produced by rotor wash would be equivalent to a "gentle breeze" during which leaves and small twigs would be constantly moving and light flags would be extended. Wind velocities of 19 to 24 mph are classified as a “fresh breeze” (small trees in leaf would sway). Winds 39 to 46 mph are “gale” force strength—difficult to walk against, while twigs and small branches would be blown off trees—and winds greater than 74 mph are classified as a “hurricane.”

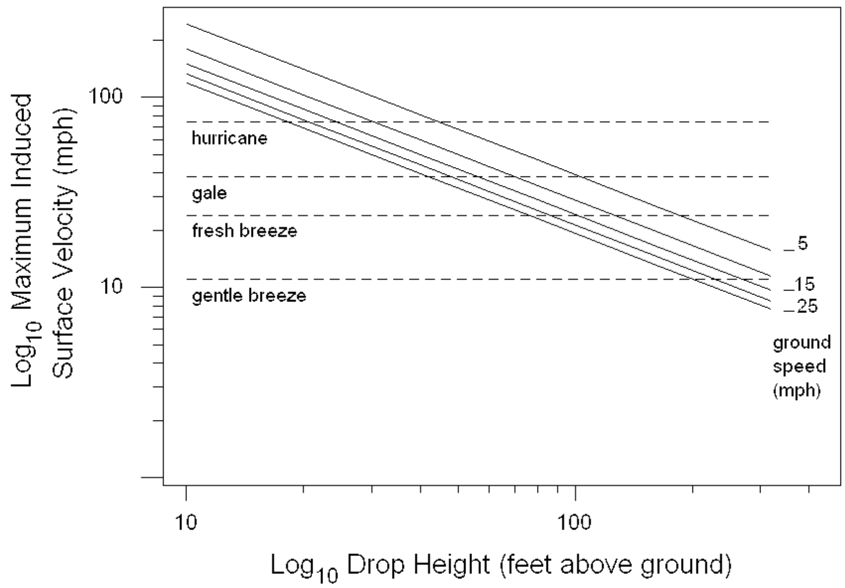


Figure 3.3.4-2 Modeled Maximum Surface Velocities Induced by Chinook C-47 Helicopters while Flying at Ground Speeds From 5 to 25 mph at Heights from 10 to 320 feet Above Ground (Modeled from data in Teske et al. 1997) .

Figure 3.3.4-2 shows the heights above ground that Chinook helicopters would produce maximum induced surface winds with velocities equivalent to a “fresh breeze” while traveling at ground speeds of 5, 10, 15, 20 or 25 mph. For example, if traveling at a ground speed of 5 mph, the Chinook would have to be approximately 185 feet above ground to produce a maximum induced surface velocity of 24 mph, equivalent to a “fresh breeze.” If traveling at ground speed of 25 mph, the Chinook could be 75 feet above ground and still induce a maximum surface velocity of 24 mph.

In the project area, wind speeds reported by the Western Regional Climate Center (2015) at the North Bend airport averaged 10.2 mph in June, 11.2 mph in July and 9.9 mph in August, the three months with highest average wind velocities during the period from 1996 to 2006. During the same period, winds in Roseburg averaged 5.0 mph in June, 5.2 mph in July, and 4.4 mph in August. These data indicate that winds as strong as a fresh breeze (19 to 24 mph) would be expected along the Oregon Coast and most likely inland during the period when NSOs are nesting. It is assumed that induced winds the strength of a fresh breeze would not adversely affect young or nests. Incoming or outgoing Chinook helicopters flying at 5 mph while 185 feet above a tree with a nest would most likely produce winds with velocities less than a fresh breeze at the tree top because there would be no resistance by the ground to induce maximum sidewash vortices.

Similar results were produced by the Boeing Vertol 107 (see figure 3.3.4-3) even though it is smaller than the Chinook (rotor diameter 49.9 feet compared to 59.1 feet). The Vertol 107, flying at a ground speed of 5 mph, would have to be approximately 200 feet above ground to produce a maximum induced surface velocity of 24 mph, equivalent to a fresh breeze. If traveling at a ground speed of 25 mph, the Vertol 107 could be 82 feet above ground and still induce a maximum surface velocity of 24 mph. Overall, the Vertol 107 produces slightly greater maximum induced surface velocities than the Chinook CH-47 even though its maximum equipment weight is less than the Chinook.

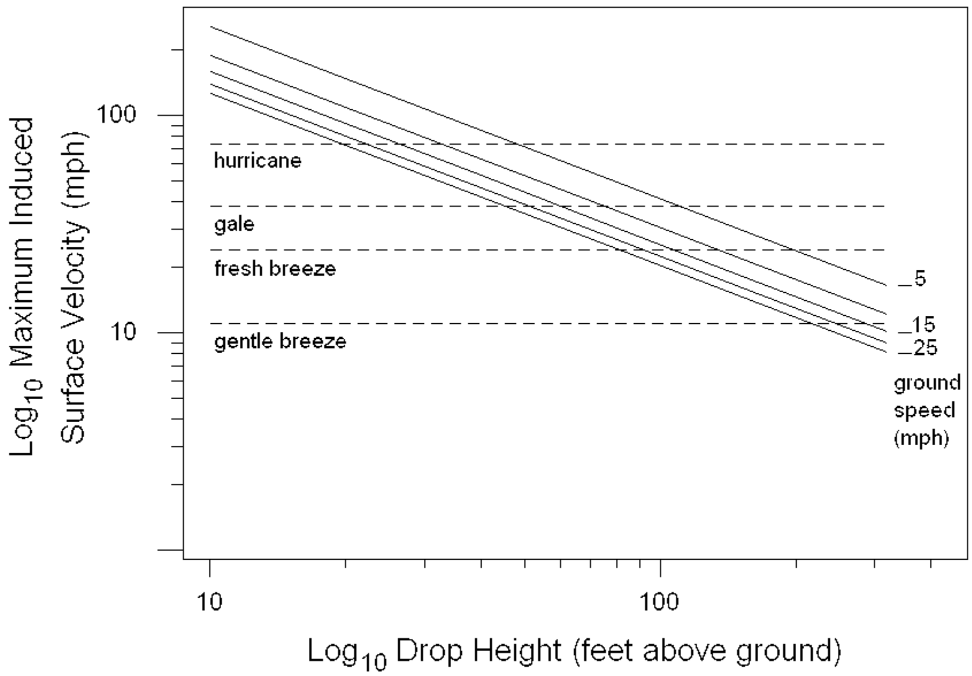


Figure 3.3.4-3 Modeled Maximum Surface Velocities Induced by Boeing Vertol 107 Helicopters while Flying at Ground Speeds From 5 to 25 mph at Heights From 10 to 320 feet Above Ground (Modeled from data in Teske et al. 1997).

The single rotor S-64 Skycrane has the largest rotor diameter (72 feet diameter) of the three models. As modeled in figure 3.3.4-4, the Skycrane would produce greater maximum induced surface velocities while flying at the same ground speeds and same drop heights as the other two helicopter models.

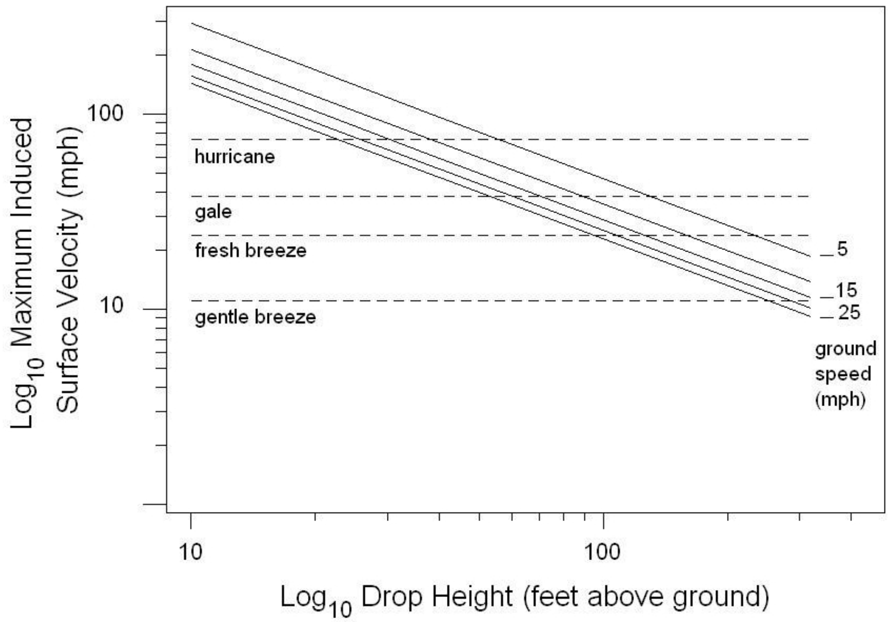


Figure 3.3.4-4 Modeled Maximum Surface Velocities Induced by Skycrane S-64 Helicopters while Flying at Ground Speeds From 5 to 25 mph at Heights From 10 to 320 feet Above Ground (Modeled from data in Teske et al. 1997).

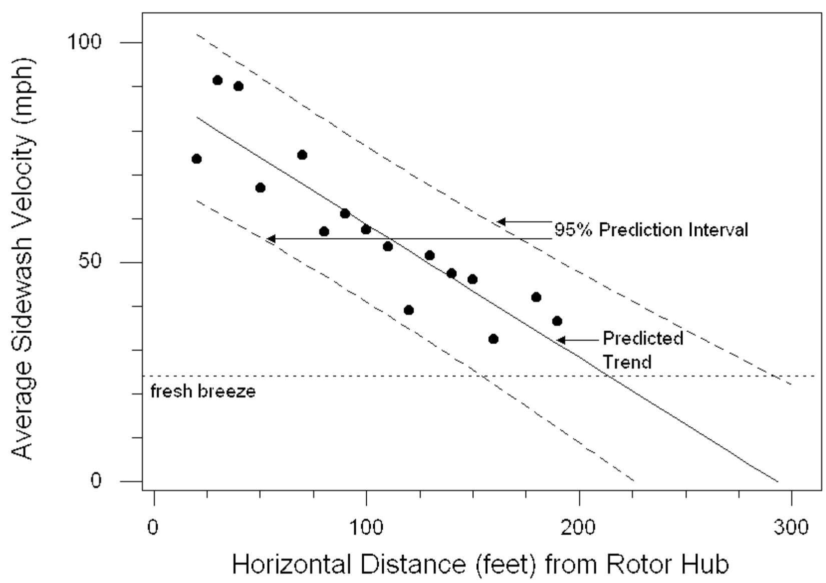
Flying at a ground speed of 5 mph, the Skycrane would have to be approximately 233 feet above ground to produce a maximum induced surface velocity of 24 mph, equivalent to a fresh breeze. The Chinook and Vertol 107 helicopters would induce similar maximum surface velocities flying at heights of 185 feet and 200 feet above ground, respectively. If traveling at ground speed of 25 mph, the Skycrane could be 95 feet above ground to induce a maximum surface velocity of 24 mph.

Actual downwash and sidewash vortices produced by Chinook CH-47 and Skycrane (CH-54) helicopters were measured during field tests (Leese and Knight 1974) while aircraft were hovering at 40–50 feet and 80–90 feet agl while under maximum loads of 36,000 pounds (CH-47) and 45,000 to 47,000 pounds (CH-54). The Vertol 107 (CH-46) was not included in the field tests.

With a 47,000-pound load, the single rotor CH-54 hovering at 40 feet agl produced a maximum sidewash velocity of 87 mph 50 feet away from the rotor hub. At 80 feet agl, the maximum sidewash was 74 mph, also measured at 50 feet from the hub though the gross weight was 45,000 pounds during that particular trial. Both maximum sidewash measurements were at heights of 0.3 feet above ground (Leese and Knight 1974). Under the specified load conditions, the CH-54 produced a sidewash of 11 mph 170 feet away from the rotor hub while hovering at 40 feet agl and a sidewash of 9 mph 150 feet away from the hub while hovering at 80 feet agl. Maximum sidewash velocities of 74–87 mph that were associated with the CH-54 helicopter while it was hovering, are within the range of hurricane force winds on the Beaufort Scale while winds of 9–11 mph produced by rotor sidewash would be described as a “gentle breeze.” Sidewash velocities between 9 and 11 mph at distances 150 to 170 feet away from a CH-54 helicopter (Skycrane) would not create a risk of young NSOs being blown out of nests.

Downwash and sidewash velocities measured for the CH-47 helicopter (Chinook) were greater than 100 mph up to 70 feet horizontally from the rotor hub when it was hovering at 90 feet agl with maximum load of 36,000 pounds (Leese and Knight 1974). The twin rotor CH-47 produced sidewash velocities as high as 56 mph 190 feet away from the rotor hub when it was hovering 90 feet agl. The Beaufort Scale classifies winds between 55 and 63 mph as a “storm”, with trees uprooted and structural damage likely. The strength of winds produced by the CH-47 is likely due to the interaction of descending air produced by the two rotors (Fabey 2008); sidewash winds are generally strongest at 120 and 240 degrees (4 o’clock and 8 o’clock, respectively) relative to the helicopter’s heading (data in Leese and Knight 1974).

Sidewash wind velocities produced by the CH-47 at various distances away from the rotor hub (Leese and Knight 1974) were used to predict the distance at which the helicopter would be far enough away from adversely affecting NSO nests and young. The prediction is based on the sidewash wind velocities produced by the CH-47 averaged for wind measurements made 0.3 feet above ground at angles of 120 and 240 degrees while the helicopter was hovering 90 feet agl under a load of 36,000 pounds. The prediction is shown below in figure 3.3.4-5 in which a sidewash velocity of 0 mph would occur 293 feet away from the rotor hub. Due to the observed variation in sidewash winds at different distances away from the rotor hub (solid circles in figure 3.3.4-5), the upper 95 percent prediction interval on that predictive estimate of 0 mph at 293 feet from the hub would be 23.8 mph. A wind velocity of 23.8 mph is classified as a fresh breeze on the Beaufort Scale. One can be 95 percent certain that a stronger wind, which could potentially adversely affect nesting NSOs, would not occur.



Source: Leese and Knight 1974

Figure 3.3.4-5 Average Sidewash Wind Velocities Produced by the CH-47 at Varying Horizontal Distances from the Rotor Hub While Hovering 90 feet agl Under a Load of 36,000 pounds. The Observed Averages (solid circles) were used to Predict Sidewash Winds at Distances Out to 300 feet.

These estimates clearly suggest that greater distances would be required to avoid adverse effects to NSOs if Chinook helicopters, rather than Skycranes, are employed for heavy lifting along remote sections of the Pipeline construction right-of-way. Based on the similarities of maximum induced surface velocities between Chinook and Vertol 107 helicopters, sidewash velocities induced while hovering are likely to be similar as well. However, if known NSO activity centers can be avoided by at least 200 feet above tree tops by heavy-lifting helicopters in transit and avoided horizontally by at least 300 feet while helicopters hover above staging sites, no adverse effects to the species would be expected due to rotor downwash and induced sidewash.

Three activity centers occur within 0.25 mile of proposed helicopter use (known 2317B, best location site PCGP 095.3, and assumed PCGP A-3), of which two sites (2317B and PCGP 095.3) could have helicopter activity within their nest patch (see table Q-8 in appendix Q, and individual NSO impact assessments, appendix Z.2). Helicopter use for timber extraction within 0.25 mile of an NSO activity center would occur outside of the entire breeding season (between October 1 and February 28); no adverse effects from rotor wash of large helicopters are expected during timber extraction. Helicopter activity could occur within two nest patches (2317B and PCGP 095.3) and adverse effects could occur from rotor wash of large helicopters during pipe delivery for construction of the proposed action if the activities occur within 200 feet above nest trees and horizontally within 300 feet of nest trees; however, the activity centers analyzed for both NSO sites are located further than 300 feet, but the nest site is unknown for PCGP 095.3 (best location site). Helicopter use would only occur after the critical breeding season (after July 15), minimizing risk to NSO.

Burning and Smoke

Effects on NSOs from smoke, whether by prescribed burning as a habitat enhancement procedure or by burning slash have not been studied. However, FWS et al. (2007) have declared (see Table 15 in FWS et al. 2007) that "smoke can cause [spotted owl] adults to move off nest sites, therefore leaving eggs or young exposed to predation or resulting in lost feedings reducing the young's fitness."

According to BLM and Forest Service (2008: 34), NSOs "are potentially affected by fire control activities and drifting smoke during burning. The threshold distance for disturbance from smoke is 0.25 mile for spotted owls," which would be subject to smoke-related disturbance during the critical breeding period (March 1 to July 15). Pacific Connector would not conduct slash burning during the critical breeding season within 0.25 mile of an occupied NSO activity center. Therefore, no direct effect to NSOs due to slash burning is expected.

Maintenance and Operations

No activities associated with general maintenance and operations of the proposed action are expected to affect NSO sites. Vegetation maintenance activities within the operational right-of-way would occur only between August 1 and April 15 of any year (see appendix C). To further reduce impacts to nesting NSOs, Pacific Connector would conduct vegetation maintenance activities within the operational right-of-way after the entire breeding season within known, best location, and "PCGP assumed" nest patches and after the critical breeding season within 0.25 mile of NSO activity centers. Routine clearing of vegetation within the 30-foot operational right-of-way would not occur more frequently than every 3 years. A 10-foot corridor centered over the pipeline may be maintained annually in an herbaceous state to facilitate periodic corrosion and leak surveys. Pacific Connector would also require pilots conducting annual aerial inspection (small plane/helicopter) of the pipeline to adhere to the spatial restrictions recommended in the vicinity of known, best location, or "PCGP assumed" sites (no overflight within 1,300 feet of ground level during the critical breeding season [March 1 through July 15]); therefore, no effects from aerial pipeline inspection would be expected.

Indirect Effects

Habitat loss and modification, whether to nesting, roosting or foraging habitats, due to forest clear-cutting has been the primary factor causing declines of the NSO (FWS 1992b). Habitat losses and habitat fragmentation have indirect impacts that can affect survival and reproduction of NSOs. Short-term impact is expected with UCSAs and is likely to last from the initiation of use until 1 to 5 years afterward. Long-term impact to NSOs and NSO habitat is expected to last at least 5 years or more.

Other indirect effects to NSOs that are often related to habitat loss or modification are increased predation, increased competition, and effects to prey utilized by NSOs. Other indirect effects to NSOs also include increased edge and decreased interior forest habitats, as well as reduction of those habitats that are capable of achieving higher quality habitat status but for the Project's impacts within LSR, Riparian Reserves, or within NSO home ranges. In addition, secondary effects (Comer 1982) due to an increased human population base are expected as a consequence of the action (i.e., the need for ancillary goods, services, recreational opportunities resulting from the Project). Potential indirect or secondary effects by the proposed Pipeline Project include increased recreation demand (including off-road vehicle use), increased habitat conversion, and habitat degradation by human intrusion and encroachment (Comer 1982).

To determine potential indirect effects to known, best location, and "PCGP assumed" owl home ranges within the provincial analysis area, 14 NSO groups (note that WC-L and EC-M are in the same group) were created that included all known, best location, and "PCGP assumed" owls whose home ranges overlapped. Table 3.3.4-11 summarizes the number of owls by status (known, best location, and "PCGP assumed") and physiographic province that occur within each owl group. The number of owls included in each group varied from one to 45 NSO activity centers (see table Q-7 in appendix Q for specific information on each NSO site included in each owl group). Owl groups have been used to identify the area of habitat being affected within and outside of NSO home ranges in the project area.

TABLE 3.3.4-11

Summary of the Number of Northern Spotted Owls Included in each Owl Group by Owl Status (known, best location, PCGP assumed) and Physiographic Province a/

		Number of Northern Spotted Owl Sites within each Group			
NSO Group	**Project Location**	**Known b/**	**Best Location b/**	**"PCGP Assumed" b/**	**Total**
Coast Range Physiographic Province					
CR-A	MP 9.35R-12.52R	1	0	0	1
CR-B	MP 29.15-48.60	12	0	3	15
CR-C	EAR 46.51; Kenyon Mountain (Signal Tree) CT	1	0	0	1
	Total Coast Range	*14*	*0*	*3*	*17*
Klamath Mountains Physiographic Province					
KM-D	MP 52.55 – 55.30	2	0	0	2
KM-E	MP 58.95 – 65.66	2	2	0	4
KM-F	MP 76.99 – 121.39	34	8	3	45
KM-G	Starveout Creek Road; Starveout Creek CT	1	0	0	1
	Total Klamath Mountains	*39*	*10*	*3*	*52*
West Cascades Physiographic Province					
WC-H	MP 123.17 – 127.27	2	0	0	2
WC-I	Flounce Rock CT	1	0	0	1
WC-J	MP 132.83 – 137.43	3	0	0	3
WC-K	MP 143.02-144.63	2	0	0	2

TABLE 3.3.4-11 (continued)

Summary of the Number of Northern Spotted Owls Included in each Owl Group by Owl Status (known, best location, PCGP assumed) and Physiographic Province a/

NSO Group	Project Location	Number of Northern Spotted Owl Sites within each Group: Known b/	Best Location b/	"PCGP Assumed" b/	Total
WC-L	Rock Source/Disposal (log storage)	1	0	0	1
WC-M	MP 150.51-167.71	17	5	0	22
	Total West Cascades	*26*	*5*	*0*	*31*
East Cascades Physiographic Province					
EC-M (part of group WC-L)	MP 167.71 – 170.70	2	0	0	2
EC-N	MP 172.35 – 175.99	3	0	0	3
	Total East Cascades	*5*	*0*	*0*	*5*
	Overall Total within Provincial Analysis Area	**84**	**15**	**6**	**105**

a/ Summarized from table Q-7 in appendix Q.
b/ Owl status: known (provided by BLM Districts, Forest Service, or FWS within the project area), PCGP assumed (area identified by Pacific Connector that may provide habitat for NSO activity center), best location (no nest located during PCGP survey efforts but survey results determined best potential site for nest).

Analysis of indirect effects to NSO habitat by Pipeline construction and operation within the physiographic analysis area followed guidance provided by FWS included in the Revised Conservation Framework developed for the Project (see FWS 2014c).

Habitat Removal and Modification

The decline of NSOs has been linked to the removal and degradation of available suitable NRF habitat. Appropriate vegetation and structural components are necessary to maintain suitable habitat, and the removal of these components can potentially have adverse effects on NSO populations. These effects could include displacement from traditional nesting areas, increased concentration of NSOs into smaller, fragmented areas of suitable habitat, and diminished reproductive success (FWS 2011c).

In the provincial analysis area, NSO habitat needs and home ranges vary based on physiographic provinces and forest type. In the Coast Range Physiographic Province (MP 0.00 to MP 51.74), the home range is assumed to be circular with a radius of 1.5 miles. Within the Klamath Mountains Physiographic Province (MP 51.74 to MP 122.67), the home range radius is 1.3 miles, and in the West Cascades (MP 122.67 to MP 167.76) and East Cascade Physiographic Provinces (MP 167.76 to MP 190.64) the home range radius is 1.2 miles (FWS 1992d). Although differences exist in natural stand characteristics that influence provincial home range size, habitat loss and forest fragmentation caused by timber harvest effectively reduce habitat quality in the home range. A reduction in the amount of suitable habitat reduces NSO abundance and nesting success (Bart and Forsman 1992; Bart 1995), and recent studies have indicated that NSOs' home ranges are substantially larger in more heavily fragmented stands (Courtney et al. 2004).

The Pipeline would affect NSOs over the long term by habitat removal and modifications. Table 3.3.4-12 summarizes effects to NSO habitat from construction and operation (30-foot maintenance corridor) of the proposed Pipeline by physiographic province, land owner, and Project component (see table Q-9 in appendix Q for detailed information on habitat impact including amount removed/modified from CHUs, LSRs, and interior forest, by landowner within and outside of NSO groups). Habitat cleared outside of the 30-foot-wide operational right-of-way would be revegetated after construction where possible, although non-federal and Matrix or Harvest Land

Base lands may be harvested before they reach dispersal or NRF characteristics and thus would provide minimal benefit to NSO.

In total, construction of the Pipeline would remove approximately 517 acres of suitable NRF habitat (high NRF and NRF which include 26 acres of "post-fire NRF" removed; see table 3.3.4-12 and table Q-9 in appendix Q), of which approximately 134 acres (includes 7 acres of "post-fire NRF") would be within the 30-foot operational easement and maintained free of forested vegetation for the life of the Pipeline (table 3.3.4-12; table Q-9 in appendix Q). A maximum of approximately 383 acres of suitable NRF habitat cleared outside the 30-foot operational right-of-way (including 19 acres of "post-fire NRF") would be revegetated, at least on federal land, and considered capable of becoming NRF habitat in approximately 80 years, although some of it may become functional foraging or roosting habitat prior to 80 years. However, replanted or naturally seeded trees may be harvested from non-federal lands or federal lands slated for timber harvest (i.e., Matrix or Harvest Land Base lands) before becoming NRF habitat.

Removal of 517 acres of NRF habitat across the four physiographic provinces crossed represents approximately 0.5 percent of the 101,810 acres of suitable NRF/high NRF habitat in the provincial analysis area (see table 3.3.4-4, above) or less than 0.01 percent of the 5,091,800 acres available within Oregon (Davis et al 2016). Additionally, 214 acres of suitable NRF habitat (including 37 acres of "post-fire NRF") have been identified for use by the proposed project as UCSAs, which would not have vegetation removed but may be used to store forest slash, stumps, and dead and downed log materials between existing trees during construction and before they are scattered across the right-of-way after construction during restoration (see table 3.3.4-12; table Q-9 in appendix Q). Use of the UCSAs would be a short-term modification of suitable NRF habitat, and habitat function should be maintained following construction.

Discussion at the Task Force–ESA Consultation Subgroup meeting on April 2, 2008, indicated that NSO dispersal habitat could be considered adequate, or sufficient to support dispersing NSO, if at least 50 percent of the analysis area (in the Project's case, the defined provincial analysis area) consisted of dispersal habitat. Table 3.3.4-4 shows the amount of dispersal habitat available (High NRF, NRF, and Dispersal Only habitat) and its percentage for each physiographic province, and overall, within the defined provincial analysis area. Approximately 1,158 acres of dispersal habitat (high NRF, NRF, and dispersal only habitat) would be removed by the Proposed Action, which represents approximately 0.7 percent of all total available dispersal habitat (168,443 acres) within the provincial analysis area (see high NRF, NRF, and dispersal only habitat in table 3.3.4-4). After construction of the Pipeline Project, approximately 167,285 acres (52.0 percent) of dispersal habitat would be available within the provincial analysis area and would continue to provide sufficient habitat to support NSO dispersal.

Two physiographic provinces currently provide more than 50 percent available dispersal habitat – Klamath Mountains (56.8 percent) and West Cascades (65.3 percent). Removal of 515.95 acres of dispersal habitat from the Klamath Mountains Physiographic Province and 287.09 acres of dispersal habitat from the West Cascades Physiographic Province would still provide more than 50 percent dispersal habitat for both physiographic provinces within the defined provincial analysis area (approximately 72,604 acres or 56 percent in the Klamath Mountains Physiographic Province and 49,889 acres or 65 percent available in the West Cascades Physiographic Province). Removal of dispersal habitat in two physiographic provinces currently with less than 50 percent available dispersal habitat – Coast Range (37.5 percent) and East Cascades (44.0 percent) – would further reduce the amount of dispersal habitat available within those provinces: approximately 34,363 acres (37.2 percent) of dispersal habitat would remain in the Coast Range province after removal of 231.42 acres, and approximately 10,394 acres (43.5 percent) of dispersal habitat would remain in the East Cascades province after removal of 123.13 acres. Removal of dispersal habitat would not be in one locale, but would be removed along 192.1 miles of the Pipeline in the range of the NSO. After the Pipeline Project is completed, neither the temporary 95-foot-wide construction right-of-way and associated temporary extra work areas or the permanent 30-foot-wide operational right-of-way would impede the movement of juveniles and adults.

Construction and permanent effects to habitat that is not currently NRF habitat, but is capable of becoming suitable NRF habitat (capable habitat), are also included in table 3.3.4-12. Approximately 919 acres of NSO capable habitat would be removed by construction of the proposed Project, of which 216 acres would remain in a permanent herbaceous/shrub state within the 30-foot operational right-of-way for the life of the Pipeline. Approximately 632 acres of capable habitat removed on private lands is not expected to mature to provide suitable NRF or high NRF habitat for NSO based on review of research on timber harvest practices in Oregon (Zhou et al. 2005; Rasmussen et al. 2012). These studies noted that forest harvest practices on non-federal lands typically occur between 45 and 65 years of age.

The majority of NRF habitat (high NRF and NRF) removed by the Pipeline Project (approximately 386 acres) occurs within known, best location, or “PCGP assumed” home ranges of NSOs within the analysis area (see NSO Groups in table 3.3.4-11) and could affect NSO over the long term; this is approximately 75 percent of all suitable NRF habitat removed or modified by the proposed Project (517 acres total) within the range of the NSO. Table Q-10 in appendix Q provides a summary of suitable, dispersal, and capable habitat affected by the Project within NSO groups by nest patch, core area, and home range. Suitable but unoccupied habitat removed outside of known, best location, or “PCGP assumed” home ranges may reduce the physical, geographical, and/or demographic connectivity between habitat and population reserves.

Davis et al. (2011) observed increased extinction rates of spotted owls in response to decreased amounts of old forest within the core area and higher colonization rates when old-forest habitat was less fragmented in the Southern Cascades Study Area, which is situated within the project area on federal lands (see Population Status section, above). The proposed action would affect NSO high NRF and NRF habitat within approximately 40 core areas (30 known sites, seven best location sites, and three “PCGP assumed” sites, see tallies in table 3.3.4-14) mostly within the Klamath Mountains Physiographic Province (21 core areas affected, see table 3.3.4-13), potentially increasing habitat abandonment and/or barred owl competition and encroachment (see Davis et al. 2011). Table Q-7 in appendix Q identifies the location and distance of each spotted owl site center from construction of the Pipeline, as well as identifies the current condition of each spotted owl nest site and the amount of habitat removed from the nest patch, core area, and home range for each NSO activity center, where applicable. It would be expected that spotted owl sites with less habitat available within their core area (i.e., Habitat Condition 2 or 4 in table Q-7 in appendix Q) would be affected more by habitat removal within their core area including: three “PCGP assumed” sites, four best location sites, and 13 known spotted owl sites (table 3.3.4-14).

TABLE 3.3.4-12

Indirect Effects (acres) to NSO Habitat by Land Ownership from Construction and Operation of the Project within the Range of the NSO

		High NRF b/			NRF c/			Dispersal Only d/			Capable e/			Non-Capable f/			Total Acres		
		Construction		Operation	Construction		Operation	Construction		Operation	Construction		Operation	Construction		Operation	Construction		Operation
Land Owner	**General Location a/**	**Removed g/**	**UCSA h/**	**30-foot Corridor i/**	**Removed g/**	**UCSA h/**	**30-foot Corridor i/**	**Removed g/**	**UCSA h/**	**30-foot Corridor i/**	**Removed g/**	**UCSA h/**	**30-foot Corridor i/**	**Removed g/**	**UCSA h/**	**30-foot Corridor i/**	**Removed g/**	**UCSA h/**	**30-foot Corridor i/**
Coast Range Physiographic Province																			
BLM - Coos Bay	NSO Groups	15.44	4.26	4.88	7.82	1.08	2.41	34.90	6.85	8.41	32.36	2.63	5.71	14.86	0.13	4.57	105.38	14.96	25.98
	Outside NSO Groups	4.29	1.04	1.22	21.35	7.14	5.44	60.20	6.60	15.79	37.72	11.65	10.18	13.29	1.01	3.48	136.85	27.44	36.10
	Total	19.73	5.29	6.10	29.18	8.22	7.85	95.11	13.46	24.20	70.08	14.28	15.89	28.15	1.15	8.05	242.24	42.40	62.09
BLM - Roseburg	NSO Groups	1.23		0.38	1.81		0.56	5.40		1.08	1.64		0.09	1.17		0.06	11.27	0.00	2.18
	Outside NSO Groups				2.93		0.93	9.33		2.39				0.64		0.25	12.90	0.00	3.57
	Total	1.23		0.38	4.75		1.48	14.73		3.48	1.64		0.09	1.81		0.31	24.17	0.00	5.75
State	NSO Groups													0.04		0.02	0.04	0.00	0.02
	Outside NSO Groups							0.18						105.94		3.90	106.12	0.00	3.90
	Total							0.18						105.98		3.92	106.16	0.00	3.92
Private / Other	NSO Groups	0.17	0.00	0.08	1.85	0.00	0.44	20.93	3.15	3.07	169.85	22.96	38.14	59.28	0.44	13.46	252.08	26.55	55.18
	Outside NSO Groups	0.56	0.07	0.15	5.81	1.20	1.54	37.19	4.74	9.04	133.71	18.56	29.71	236.78	0.65	16.76	414.04	25.21	57.20
	Total	0.73	0.07	0.23	7.66	1.20	1.98	58.12	7.89	12.11	303.56	41.52	67.85	296.06	1.08	30.22	666.12	51.76	112.38
Coast Range Subtotal	*NSO Groups*	16.85	4.26	5.34	11.49	1.08	3.41	61.24	10.01	12.56	203.85	25.59	43.94	75.36	0.57	18.11	368.78	41.51	83.35
	Outside NSO Groups	4.85	1.10	1.37	30.10	8.33	7.90	106.90	11.34	27.22	171.43	30.21	39.89	356.64	1.66	24.39	669.91	52.65	100.78
	Total	21.70	5.36	6.71	41.58	9.41	11.31	168.14	21.35	39.79	375.28	55.80	83.83	432.00	2.23	42.49	1,038.69	94.15	184.13
Klamath Mountains Physiographic Province																			
BLM - Roseburg	NSO Groups	33.12	28.00	8.67	48.08 (12.96)	41.05 (15.10)	11.05 (3.20)	20.31	10.68	4.07	45.36	22.62	9.27	18.11	2.67	4.50	164.98	105.01	37.56
	Outside NSO Groups	4.41	0.10	1.18	5.52	0.84	1.39	6.47	0.01	1.56		0.00		3.91	1.08	1.04	20.30	2.04	5.16
	Total	37.53	28.10	9.84	53.60 (12.96)	41.90 (15.10)	12.45 (3.20)	26.78	10.69	5.62	45.36	22.62	9.27	22.02	3.75	5.54	185.28	107.05	42.72
BLM - Medford	NSO Groups	9.30	5.29	2.78	15.43	3.76	3.38	17.95	5.46	3.84	2.45	0.63	0.88	6.22	1.09	1.37	51.36	16.23	12.26
	Outside NSO Groups	0.01		0.00	1.74	0.29	0.36	5.33	1.64	1.84	0.00			0.30		0.10	7.38	1.93	2.30
	Total	9.31	5.29	2.78	17.18	4.05	3.75	23.28	7.10	5.68	2.46	0.63	0.88	6.51	1.09	1.47	58.74	18.16	14.56
Umpqua N.F.	NSO Groups	41.36	9.82	11.37	36.88 (12.63)	24.21 (22.15)	9.06 (3.40)	30.37	7.59	6.04	35.22	0.07	10.19	25.45	0.41	2.64	169.28	42.10	39.30
	Outside NSO Groups																0.00	0.00	
	Total	41.36	9.82	11.37	36.88 (12.63)	24.21 (22.15)	9.06 (3.40)	30.37	7.59	6.04	35.22	0.07	10.19	25.45	0.41	2.64	169.28	42.10	39.30
State	NSO Groups																0.00	0.00	
	Outside NSO Groups													3.60			3.60	0.00	
	Total													3.60			3.60	0.00	
Private / Other	NSO Groups	6.60	9.03	0.99	23.67 (0.12)	17.48 (0.11)	4.94	110.76	87.40	28.43	160.10	126.16	37.01	158.80	14.27	29.97	459.93	254.35	101.34
	Outside NSO Groups	0.94	0.42	0.05	7.30	1.04	0.99	90.39	17.65	22.91	17.42	12.43	4.37	365.44	5.71	29.72	481.50	37.24	58.04
	Total	7.54	9.45	1.04	30.97 (0.12)	18.52 (0.11)	5.93	201.16	105.05	51.34	177.53	138.59	41.38	524.24	19.98	59.69	941.43	291.59	159.38
Klamath Mountains Subtotal	*NSO Groups*	90.38	52.14	23.81	124.07 (25.72)	86.51 (37.36)	28.44 (6.61)	179.39	111.12	42.39	243.13	149.48	57.35	208.57	18.43	38.48	845.55	417.69	190.46
	Outside NSO Groups	5.35	0.52	1.23	14.56	2.17	2.75	102.19	19.30	26.31	17.43	12.43	4.37	373.24	6.79	30.85	512.78	41.21	65.50
	Total	95.74	52.67	25.04	138.63 (25.72)	88.68 (37.36)	31.18 (6.61)	281.58	130.42	68.69	260.56	161.91	61.72	581.82	25.22	69.33	1,358.33	458.90	255.97
West Cascades Physiographic Province																			
BLM - Medford	NSO Groups	1.20	0.44	0.35	27.61	4.68	6.34	18.85	0.92	4.08	24.98	0.44	5.29	28.87	0.14	5.65	101.51	6.61	21.71
	Outside NSO Groups				35.76	5.51	8.62	4.55	1.19	1.17	1.00	0.68	0.36	37.68	2.14	8.68	78.99	9.52	18.84
	Total	1.20	0.44	0.35	63.37	10.19	14.96	23.40	2.11	5.25	25.98	1.12	5.65	66.54	2.28	14.34	180.50	16.14	40.55
Rogue River N.F.	NSO Groups	29.46	12.54	9.08	46.61	22.32	13.33	17.17	7.33	5.46	77.85	23.56	17.78	37.97	2.95	3.18	209.07	68.71	48.84
	Outside NSO Groups																0.00	0.00	
	Total	29.46	12.54	9.08	46.61	22.32	13.33	17.17	7.33	5.46	77.85	23.56	17.78	37.97	2.95	3.18	209.07	68.71	48.84
State	NSO Groups							2.06		0.36				0.62		0.19	2.68	0.00	0.55
	Outside NSO Groups							0.15		0.05				0.15		0.05	0.30	0.00	0.10
	Total							2.21		0.41				0.77		0.23	2.98	0.00	0.64
Private / Other	NSO Groups	0.91	0.45	0.38	6.68	2.59	1.60	33.11	3.29	7.80	48.77	8.51	11.12	31.20	1.34	7.59	120.67	16.18	28.49
	Outside NSO Groups		0.02		13.18	2.41	3.56	49.78	2.04	12.29	10.89	1.61	3.15	118.94	1.17	25.87	192.79	7.26	44.88
	Total	0.91	0.47	0.38	19.86	5.00	5.16	82.89	5.33	20.09	59.66	10.13	14.27	150.14	2.51	33.47	313.46	23.44	73.37
West Cascades Subtotal	*NSO Groups*	31.57	13.43	9.81	80.90	29.59	21.27	71.19	11.54	17.71	151.60	32.52	34.19	98.66	4.43	16.62	433.93	91.50	99.59
	Outside NSO Groups	0.00	0.02	0.00	48.94	7.92	12.18	54.48	3.23	13.51	11.89	2.29	3.52	156.76	3.32	34.61	272.08	16.78	63.81
	Total	31.57	13.46	9.81	129.84	37.51	33.45	125.68	14.77	31.22	163.49	34.81	37.71	255.42	7.74	51.22	706.00	108.29	163.40

TABLE 3.3.4-12 (continued)

Indirect Effects (acres) to NSO Habitat by Land Ownership from Construction and Operation of the Pipeline Project within the Range of the NSO

		High NRF b/			**NRF c/**			**Dispersal Only d/**			**Capable e/**			**Non-Capable f/**			**Total Acres**		
		Construction		**Operation**	**Construction**		**Operation**	**Construction**		**Operation**	**Construction**		**Operation**	**Construction**		**Operation**	**Construction**		**Operation**
Land Owner	**General Location a/**	**Removed g/**	**UCSA h/**	**30-foot Corridor i/**	**Removed g/**	**UCSA h/**	**30-foot Corridor i/**	**Removed g/**	**UCSA h/**	**30-foot Corridor i/**	**Removed g/**	**UCSA h/**	**30-foot Corridor i/**	**Removed g/**	**UCSA h/**	**30-foot Corridor i/**	**Removed g/**	**UCSA h/**	**30-foot Corridor i/**
East Cascades Physiographic Province																			
BLM - Lakeview	NSO Groups																0.00	0.00	
	Outside NSO Groups				13.01		3.50	0.00						1.81		0.27	14.82	0.00	3.77
	Total				*13.01*		*3.50*	*0.00*						*1.81*		*0.27*	*14.82*	*0.00*	*3.77*
Rogue River N.F.	NSO Groups	1.12	0.54	0.40	0.99	0.11	0.35				0.90	0.15	0.30				3.00	0.80	1.05
	Outside NSO Groups																0.00	0.00	
	Total	*1.12*	*0.54*	*0.40*	*0.99*	*0.11*	*0.35*				*0.90*	*0.15*	*0.30*				*3.00*	*0.80*	*1.05*
Fremont - Winema N.F.	NSO Groups	3.72	0.25	1.14	24.54	3.63	6.95	2.78	0.92	0.84	27.22	4.32	7.42	2.59	0.05	0.37	60.86	9.18	16.71
	Outside NSO Groups	1.71	0.26	0.49	11.13	1.93	3.17	5.04	0.17	1.24	0.32	0.01	0.12	1.60	0.01	0.28	19.80	2.39	5.30
	Total	*5.43*	*0.52*	*1.63*	*35.67*	*5.57*	*10.11*	*7.82*	*1.09*	*2.08*	*27.54*	*4.33*	*7.54*	*4.19*	*0.07*	*0.65*	*80.66*	*11.57*	*22.01*
Private / Other	NSO Groups				0.35	0.02	0.09	2.09		0.49	20.43	2.28	5.13	3.74	0.00	1.01	26.61	2.31	6.73
	Outside NSO Groups				1.15	0.01	0.35	55.49		15.83	70.58	0.38	20.05	68.44	0.05	14.38	195.66	0.44	50.61
	Total				*1.49*	*0.03*	*0.45*	*57.59*		*16.32*	*91.01*	*2.66*	*25.17*	*72.17*	*0.05*	*15.39*	*222.27*	*2.74*	*57.34*
East Cascades Subtotal	*NSO Groups*	4.84	0.79	1.54	25.88	3.77	7.39	4.88	0.92	1.33	48.55	6.75	12.84	6.33	0.05	1.39	90.47	12.28	24.49
	Outside NSO Groups	1.71	0.26	0.49	25.29	1.94	7.02	60.54	0.17	17.07	70.90	0.39	20.17	71.85	0.06	14.93	230.29	2.82	59.68
	Total	6.55	1.05	2.03	51.16	5.71	14.41	65.42	1.09	18.40	119.45	7.14	33.01	78.18	0.12	16.32	320.75	15.11	84.17
Total Northern Spotted Owl Range																			
BLM	NSO Groups	60.30	37.99	17.06	100.77 (12.96)	50.57 (15.10)	23.75 (3.20)	97.42	23.90	21.49	106.79	26.32	21.24	69.23	4.03	16.16	434.51	142.81	99.69
	Outside NSO Groups	8.70	1.14	2.39	80.32	13.79	20.25	85.88	9.44	22.74	38.72	12.33	10.54	57.62	4.24	13.81	271.25	40.93	69.75
	Total	*69.00*	*39.13*	*19.45*	*181.09* *(12.96)*	*64.35* *(15.10)*	*44.00* *(3.20)*	*183.31*	*33.34*	*44.24*	*145.51*	*38.65*	*31.78*	*126.85*	*8.27*	*29.97*	*705.75*	*183.75*	*169.44*
Forest Service	NSO Groups	75.66	23.15	21.99	109.03 (12.63)	50.28 (22.15)	29.69 (3.40)	50.32	15.84	12.34	141.19	28.10	35.69	66.01	3.41	6.19	442.21	120.78	105.90
	Outside NSO Groups	1.71	0.26	0.49	11.13	1.93	3.17	5.04	0.17	1.24	0.32	0.01	0.12	1.60	0.01	0.28	19.80	2.39	5.30
	Total	*77.37*	*23.42*	*22.48*	*120.16* *(12.63)*	*52.21* *(22.15)*	*32.85* *(3.40)*	*55.36*	*16.01*	*13.58*	*141.51*	*28.11*	*35.81*	*67.61*	*3.42*	*6.47*	*462.01*	*123.17*	*111.20*
State	NSO Groups	0.00	0.00	0.00	0.00	0.00	0.00	2.06	0.00	0.36	0.00	0.00	0.00	0.67	0.00	0.20	2.72	0.00	0.56
	Outside NSO Groups	0.00	0.00	0.00	0.00	0.00	0.00	0.33	0.00	0.05	0.00	0.00	0.00	109.69	0.00	3.95	110.02	0.00	4.00
	Total	0.00	0.00	0.00	0.00	0.00	0.00	2.39	0.00	0.41	0.00	0.00	0.00	110.35	0.00	4.15	112.74	0.00	4.56
Private / Other	NSO Groups	7.68	9.48	1.45	32.54 (0.12)	20.10 (0.11)	7.08	166.90	93.84	39.79	399.15	159.92	91.39	253.01	16.05	52.04	859.28	299.38	191.74
	Outside NSO Groups	1.50	0.51	0.20	27.43	4.65	6.44	232.86	24.43	60.07	232.61	32.98	57.28	789.59	7.58	86.73	1,283.99	70.14	210.73
	Total	*9.18*	*9.99*	*1.65*	*59.98* *(0.12)*	*24.74* *(0.11)*	*13.52*	*399.76*	*118.27*	*99.86*	*631.76*	*192.89*	*148.67*	*1,042.61*	*23.63*	*138.77*	*2,143.28*	*369.53*	*402.46*
Total Northern Spotted Owl Range	**NSO Groups**	**143.64**	**70.62**	**40.49**	**242.34** **(25.72)**	**120.94** **(37.36)**	**60.51** **(6.61)**	**316.70**	**133.59**	**73.99**	**647.13**	**214.34**	**148.32**	**388.91**	**23.48**	**74.59**	**1,738.72**	**562.98**	**397.90**
	Outside NSO Groups	**11.91**	**1.91**	**3.09**	**118.88**	**20.37**	**29.86**	**324.11**	**34.04**	**84.11**	**271.65**	**45.32**	**67.94**	**958.50**	**11.83**	**104.77**	**1,685.06**	**113.46**	**289.77**
	Total	***155.55***	***72.54***	***43.59***	***361.22*** ***(25.72)***	***141.31*** ***(37.36)***	***90.36*** ***(6.61)***	***640.81***	***167.63***	***158.10***	***918.78***	***259.66***	***216.26***	***1,347.42***	***35.31***	***179.36***	***3,423.78***	***676.44***	***687.67***

a/ General Location identifies areas within Northern Spotted Owl Groups (areas within NSO home ranges; see table Q-10 in appendix Q) and areas outside of NSO groups (outside of NSO home ranges).
b/ High NRF (FWS 2014c: forested habitat that is characterized by large trees (> 32 inches dbh), high canopy cover (>60 percent), and multistoried structure with sufficient down wood and snags to support prey species.
c/ NRF (FWS 2012e, 2014c; North et al. 1999): conifer-dominated forested habitat greater than 80 years that does not meet the definition of High NRF but has multi-storied structure with large overstory trees (20-30 inches dbh), moderate to high canopy closure greater than 60 percent, and sufficient snags and down wood. Acreage in parenthesis identifies the area of NRF (or High NRF) prior to the 2015 Stouts Creek fire that are currently dead standing trees (i.e., "post-fire NRF").
d/ Dispersal ONLY (FWS 2012e, 2014c): an average tree diameter of 11 inches dbh or greater; conifer overstory trees; canopy closure greater than 40 percent in moist forests and greater than 30 percent in dry forests; open space beneath the canopy to allow for NSO to fly; High NRF and NRF provide dispersal habitat, as well.
e/ Capable Habitat (FWS 2014c): habitat that is forested or could become forested (i.e., recently harvested timberlands) that do not provide dispersal or NRF characteristics.
f/ Noncapable Habitat: not forested and not capable of becoming forested.
g/ Project components considered in calculation of habitat "Removed": construction right-of-way, temporary extra work areas, aboveground facilities, permanent and temporary access roads (PAR, TAR), pipe storage yards, rock source/disposal sites, and hydrostatic test locations.
h UCSAs would not be cleared of trees during construction and would not affect nesting structures or characteristics. These areas would be used to store forest slash, stumps and dead and downed log materials that would be removed and scattered across the right-of-way after construction during restoration and are considered as temporary insignificant understory habitat effects.
i/ 30-foot Maintenance Corridor would be kept in a shrub/sapling state for the life of the project; all other habitat outside of the 30-foot maintenance corridor would be revegetated, except for those habitats on non-federal or matrix lands where there is less certainty that replanting would occur or be maintained on the landscape.

Note: More detailed information on BLM Districts and National Forests impacted, as well as critical habitat, NWFP late successional reserves, is located in table Q-9 in appendix Q.

TABLE 3.3.4-13

Effects (acres) to Northern Spotted Owl (NSO) Habitat in each NSO Habitat Type by Owl Groups Impacted by Construction of the Pipeline Project within the Range of the NSO

NSO Habitat Type	Number of Habitat Types Crossed by the Project within each Province	High NRF Habitat b/			NRF Habitat c/			Dispersal Only Habitat d/			Capable Habitat e/			Non-Capable Habitat f/			Total		
		Construction		Operation	Construction		Operation	Construction		Operation	Construction		Operation	Construction		Operation	Construction		Operation
		Removed g/	UCSA h/	30-foot Corridor i/	Removed g/	UCSA h/	30-foot Corridor i/	Removed g/	UCSA h/	30-foot Corridor i/	Removed g/	UCSA h/	30-foot Corridor i/	Removed g/	UCSA h/	30-foot Corridor i/	Removed g/	UCSA h/	30-foot Corridor i/
Coast Range Physiographic Province																			
Home Range b/	14	7.11	0.42	2.44	3.66	1.08	1.18	46.33	6.08	9.41	161.40	15.44	35.75	66.64	0.25	14.78	285.15	23.27	63.56
Core Area	7	4.97	1.32	1.48	7.82	0.00	2.23	14.90	3.92	3.15	42.45	10.15	8.19	8.71	0.32	3.32	78.85	15.71	18.38
Nest Patch	1	4.77	2.52	1.42													4.77	2.52	1.42
Overall Coast Range Total	*N/A*	*16.85*	*4.26*	*5.34*	*11.49*	*1.08*	*3.41*	*61.24*	*10.01*	*12.56*	*203.85*	*25.59*	*43.94*	*75.36*	*0.57*	*18.11*	*368.78*	*41.51*	*83.35*
Klamath Mountains Physiographic Province																			
Home Range	50	55.34	38.82	14.70	80.25 (18.03)	56.35 (22.94)	17.88 (4.42)	153.81	95.23	37.76	175.82	100.92	42.56	155.21	13.41	28.25	620.43	304.73	141.15
Core Area	21	31.75	12.00	8.26	42.43 (7.11)	27.20 (12.77)	10.05 (1.97)	23.85	15.53	4.08	61.09	45.29	13.22	51.92	4.92	10.07	211.03	104.95	45.68
Nest Patch	5	3.29	1.31	0.85	1.39 (0.58)	2.96 (1.64)	0.50 (0.22)	1.73	0.37	0.55	6.23	3.26	1.57	1.44	0.11	0.16	14.09	8.02	3.63
Overall Klamath Mountains Total	*N/A*	*90.38*	*52.14*	*23.81*	*124.07* *(25.72)*	*86.51* *(37.36)*	*28.44* *(6.61)*	*179.39*	*111.12*	*42.39*	*243.13*	*149.48*	*57.35*	*208.57*	*18.43*	*38.48*	*845.55*	*417.69*	*190.46*
West Cascades Physiographic Province																			
Home Range	29	18.14	8.40	5.63	64.46	22.81	16.69	55.43	8.66	13.62	116.26	23.00	26.09	79.02	3.05	13.08	333.30	65.92	75.11
Core Area	11	11.00	4.56	3.45	16.32	6.78	4.58	13.51	2.27	3.40	32.47	9.51	7.59	19.33	1.35	3.39	92.63	24.47	22.41
Nest Patch	2	2.43	0.47	0.72	0.13		0.00	2.25	0.61	0.68	2.87	0.01	0.51	0.31	0.02	0.14	7.99	1.12	2.07
Overall West Cascades Total	*N/A*	*31.57*	*13.43*	*9.81*	*80.90*	*29.59*	*21.27*	*71.19*	*11.54*	*17.71*	*151.60*	*32.52*	*34.19*	*98.66*	*4.43*	*16.62*	*433.93*	*91.50*	*99.59*
East Cascades Physiographic Province																			
Home Range	4	2.64	0.79	0.78	22.41	3.77	6.42	4.88	0.92	1.33	42.92	6.24	11.20	5.77	0.05	1.29	78.61	11.77	21.01
Core Area	1	2.04		0.68	3.45		0.97				5.63	0.51	1.65	0.55	0.00	0.09	11.68	0.51	3.39
Nest Patch	1	0.16		0.09	0.02		0.00										0.18	0.00	0.09
Overall East Cascades Total	*N/A*	*4.84*	*0.79*	*1.54*	*25.88*	*3.77*	*7.39*	*4.88*	*0.92*	*1.33*	*48.55*	*6.75*	*12.84*	*6.33*	*0.05*	*1.39*	*90.47*	*12.28*	*24.49*
Overall NSO Range																			
Home Range	97	83.23	48.43	23.54	170.77 (18.03)	84.01 (22.94)	42.17 (4.42)	260.45	110.89	62.12	496.39	145.60	115.58	306.65	16.76	57.41	1,317.50	405.68	300.83
Core Area	40	49.76	17.88	13.87	70.02 (7.11)	33.98 (12.77)	17.83 (1.97)	52.26	21.72	10.63	141.64	65.46	30.65	80.52	6.60	16.87	394.20	145.64	89.86
Nest Patch	9	10.65	4.31	3.08	1.54 (0.58)	2.96 (1.64)	0.51 (0.22)	3.99	0.98	1.23	9.10	3.27	2.08	1.74	0.13	0.30	27.02	11.66	7.21
Overall Physiographic Province Total	**N/A**	**143.64**	**70.62**	**40.49**	**242.34** **(25.72)**	**120.94** **(37.36)**	**60.51** **(6.61)**	**316.70**	**133.59**	**73.99**	**647.13**	**214.34**	**148.32**	**388.91**	**23.48**	**74.59**	**1,738.72**	**562.98**	**397.90**

a/ Nest patch: includes an area that is 300 meters (984 feet) from the site center (70 acres occur within a nest patch).
Core area: generally 502 acres occur within a core area.
Home range: generally 4,525 acres, 3,398 acres, and 2,895 acres occur within the Oregon Coast Range, Klamath Mountains, and Cascades NSO home ranges, respectively.

b/ High NRF (FWS 2014c): forested habitat that is characterized by large trees (> 32 inches dbh), high canopy cover (>60 percent), and multistoried structure with sufficient down wood and snags to support prey species.

c/ NRF (FWS 2012e, 2014c; North et al. 1999): conifer-dominated forested habitat greater than 80 years that does not meet the definition of High NRF but has multi-storied structure with large overstory trees (20-30 inches dbh), moderate to high canopy closure greater than 60 percent, and sufficient snags and down wood. Acreage in parenthesis identifies the area of NRF (or High NRF) prior to the 2015 Stouts Creek fire that are currently dead standing trees (i.e., "post-fire NRF").

d/ Dispersal ONLY (FWS 2012e, 2014c): an average tree diameter of 11 inches dbh or greater; conifer overstory trees; canopy closure greater than 40 percent in moist forests and greater than 30 percent in dry forests; open space beneath the canopy to allow for NSO to fly; High NRF and NRF provide dispersal habitat, as well.

e/ Capable Habitat (FWS 2014c): habitat that is forested or could become forested (i.e., recently harvested timberlands) that do not provide dispersal or NRF characteristics.

f/ Noncapable Habitat: not forested and not capable of becoming forested.

g/ Project components considered in calculation of habitat "Removed": construction right-of-way, temporary extra work areas, aboveground facilities, permanent and temporary access roads (PAR, TAR), pipe storage yards, rock source/disposal, and hydrostatic test locations.

h/ UCSAs would not be cleared of trees during construction and would not affect nesting structures or characteristics. These areas would be used to store forest slash, stumps and dead and downed log materials that would be removed and scattered across the right-of-way after construction during restoration and are considered as temporary insignificant understory habitat effects.

i/ 30-foot Maintenance Corridor would be kept in a shrub/sapling state for the life of the project; all other habitat outside of the 30-foot maintenance corridor would be revegetated, except for those habitats on non-federal or matrix lands where there is less certainty that replanting would occur or be maintained on the landscape.

NOTE: Summarized from table Q-10 in appendix Q.

TABLE 3.3.4-14

Number of NSO Home Ranges, by Physiographic Province and Habitat Condition that Would Have NSO Habitat Removed by the Pipeline Project a/

Suitable NRF Habitat Condition within Owl Home Ranges b/	Owl Status c/	Coast Range			Klamath Mountains			West Cascades			East Cascades			Overall Total		
		Home Range	Core Area	Nest Patch	Home Range	Core Area	Nest Patch	Home Range	Core Area	Nest Patch	Home Range	Core Area	Nest Patch	Home Range	Core Area	Nest Patch
Home Range > 40%	Known	1	1	0	17	5	1	11	6	2	3	0	0	32	12	3
AND	Best Location	0	0	0	3	0	0	4	2	0	0	0	0	7	2	0
Core Area > 50%	PCGP Assumed	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
(Above Threshold)	*Total*	*1*	*1*	*0*	*20*	*5*	*1*	*15*	*8*	*2*	*3*	*0*	*0*	39	14	3
Home Range > 40%	Known	0	0	0	4	1	0	5	2	0	0	0	0	9	3	0
AND	Best Location	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Core Area < 50%	PCGP Assumed	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0
(Below Threshold)	*Total*	*0*	*0*	*0*	*5*	*1*	*0*	*5*	*2*	*0*	*0*	*0*	*0*	10	3	0
Home Range < 40%	Known	2	2	1	6	3	0	1	0	0	0	0	0	9	5	1
AND	Best Location	0	0	0	1	1	1	0	0	0	0	0	0	1	1	1
Core Area > 50%	PCGP Assumed	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
(Below Threshold)	*Total*	*2*	*2*	*1*	*7*	*4*	*1*	*1*	*0*	*0*	*0*	*0*	*0*	10	6	2
Home Range < 40%	Known	8	2	0	11	6	0	7	1	0	1	1	1	27	10	1
AND	Best Location	0	0	0	6	4	2	1	0	0	0	0	0	7	4	2
Core Area < 50%	PCGP Assumed	3	2	0	1	1	0	0	0	0	0	0	0	4	3	0
(Below Threshold)	*Total*	*11*	*4*	*0*	*18*	*11*	*2*	*8*	*1*	*0*	*1*	*1*	*1*	38	17	3
Overall Total	**Known**	**11**	**5**	**1**	**38**	**15**	**1**	**24**	**9**	**2**	**4**	**1**	**1**	**77**	**30**	**5**
	Best Location	**0**	**0**	**0**	**10**	**5**	**3**	**5**	**2**	**0**	**0**	**0**	**0**	**15**	**7**	**3**
	PCGP Assumed	**3**	**2**	**0**	**2**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**5**	**3**	**0**
	Total	***14***	***7***	***1***	***50***	***21***	***4***	***29***	***11***	***2***	***4***	***1***	***1***	***97***	***40***	***8***

a/ For detailed NRF/High NRF habitat available for each NSO and its habitat type (nest patch, core area, home range), refer to "pre-action" suitable habitat acres in table Q-7 in appendix Q.

b/ FWS et al. (2008) consider core areas with 50 percent or greater suitable NRF habitat and home ranges with at least 40 percent suitable NRF habitat to be necessary to maintain NSO life history function. Habitat condition for each NSO affected is summarized from table Q-7 in appendix Q.

c/ Owl Status: 1) Known sites represent NSO activity sites provided by BLM and Forest Service biologists within the provincial analysis area; 2) Best Location sites represent pairs or resident singles documented by PCGP during surveys in 2007 and 2008 with no nest site/activity center located, and; 3) PCGP assumed sites represents an area identified by Pacific Connector that may provide habitat for NSO pair.

The Revised Conservation Framework (FWS 2014c) was used to guide categorizing effects to NSO habitat within home ranges into Habitat Impact Categories (Severe, High, Moderate, and Low categories), considering the amount and type of NSO Habitat removed, as well as where the NSO habitat is affected within an NSO home range, core area, and/or nest patch (see NSO habitat impact categorization for each NSO home range in appendix Z2). No NSO home range was provided a "Severe Impact" category because the Project would not remove a known nest site or activity center or cause a NSO home range to become nonfunctional (loss of the territory).

The Habitat Impact Category assigned to each NSO home range (appendix Z2, table Q-7 in appendix Q) was then applied to acres of NSO habitat affected by the Pipeline Project (summarized in table 3.3.4-12 from table Q-9 in appendix Q). Where home ranges overlapped, the higher impact category was considered. NSO habitat affected outside of NSO home ranges or within NSO home ranges that were provided a "No Impact Category" in appendix Z.2 are considered areas of "Low Impact". Table NSO-3 in the introduction to appendix Z.2 provides a summary of NSO habitat affected by Habitat Impact Category within and outside of interior forest.

<u>Known, Best Location, or "PCGP Assumed" Owl Sites</u>

There are 105 known, best location, or "PCGP assumed" owl home ranges that overlap the Project. Of these, 8 NSO home ranges would not have habitat removed or modified because they are only intersected by existing roads to be used to access the right-of-way or are within 100 meters (328 feet) of habitat removal. The effects of habitat changes to the other 97 known, best location, or PCGP assumed NSO activity centers within the provincial analysis area as a result of the proposed action were evaluated at three scales: the nest patch, the core area, and the home range. The pre-action and post-action habitat conditions are provided in table Q-7 in appendix Q for each NSO home range; the amount of NSO habitat is specific to each habitat type in its entirety; acres provided for the home range include acres that also occur within the core area and nest patch, and acres included in the core area also include acres within the nest patch. Also, the amount of suitable NRF habitat removed within each owl habitat type does not consider overlap with neighboring owl sites.

Table 3.3.4-14 summarizes the number of NSO activity centers and acres of NSO habitat by physiographic province that would have NSO habitat removed from their nest patch, core area, and/or home range (summarized from table Q-7 in appendix Q). NSOs that are below the FWS recommended suitable habitat thresholds or are near those thresholds, either in the core area or home range, and would have suitable habitat removed could be impacted more by the Project than those above the recommended FWS suitable habitat thresholds (greater than 50 percent and/or greater than 40 percent available high NRF/NRF in their core area or home range, respectively). Table 3.3.4-14 tabulates the number of NSO home ranges/core areas below threshold, by physiographic province, that would have habitat removed and identifies the habitat use area (nest patch, core area, home range) for each owl group affected. Generally, removal of habitat from home ranges already below threshold represents less than 0.2 percent of available suitable habitat within the owls' home range (see table Q-7 in appendix Q). Because removal of habitat represents such a small percentage of available suitable NRF habitat (high NRF and NRF) within the core area and/or home range, removal of habitat within owl site core areas and home ranges should not adversely impact those NSO pairs or resident singles. However, habitat removed in closer proximity to the nest site or nest patch may have a greater impact to the NSO pair or resident single.

NSOs with suitable habitat availability within their core area and/or home range below the FWS recommended threshold of suitable habitat (less than 40 percent suitable habitat in home range/less than 50 percent suitable habitat in core area) could be considered adversely affected, especially if habitat is removed during the breeding season within 0.25 mile of an activity center. Habitat would be removed from 97 home ranges (including 40 core areas) within the four physiographic provinces crossed, of which 58 home NSO activity centers are below the recommended habitat thresholds in the core area and/or home range (table 3.3.4-3). Habitat removal within 0.25 mile of 13 NSO activity centers (9 known, 3 best location, and one "PCGP assumed"), of which nine are below recommended NRF threshold (core area and/or home range), would occur outside of the entire breeding period (between October 1 and February 28); disturbance associated with timber removal should not adversely affect spotted owls. If survey efforts prior to construction identify additional NSO reproductive activity within 0.25 mile, habitat removal would occur outside of the breeding season within 0.25 mile of those sites.

Eight nest patches would be crossed by the proposed action; suitable NRF habitat (high NRF, NRF, post-fire NRF [4008B]) would be removed from seven nest patches, of which five NSO home ranges have suitable habitat below the recommended NRF threshold in the core area and/or home range (see table 3.3.4-15). Timber would be removed outside the entire breeding season (after September 30 but before March 1) within each nest patch and 0.25 mile of that activity center; therefore, no direct impact to those NSOs is expected. Removal of habitat from the nest patches, however, could have an indirect, negative impact on those NSOs, especially in the four sites below recommended FWS NRF threshold for core area and/or home range. Three NSO sites represent pairs documented during 2008 survey efforts (best location sites); however, none of the sites had a nest tree identified. As a result, these nest patches represent a 300-meter radius around the "best location" as determined by the surveyors and local agency biologists based on detection date and time, individual owls (age and sex) present at particular detections, behavior of owls at a particular detection, and occasionally the habitat of a detection location. In discussions with various agency biologists (table S-1 in appendix S), it was thought that these sites were associated with other monitored pairs and that nesting at the "best location" sites was not occurring, but not enough information was available to be sure of this. Therefore, Pacific Connector continues to include these best location NSO pair sites for analyzing worst-case scenarios. If additional surveys conducted prior to construction and timber clearing indicate that these are not active, Pacific Connector would revise the schedule accordingly. Table 3.3.4-15 provides details specific for each NSO nest patch crossed by the Pipeline. These details include the length of Pipeline within each nest patch, how much suitable habitat would be removed, and the pre-action NRF habitat status of each NSO home range. Within the "additional description" column, information is provided about the effects to habitat in the nest patch and its location relative to existing disturbance and/or the creation of new edge in the nest patch.

TABLE 3.3.4-15

Summary of NSO Nest Patches Crossed by the Pipeline Project

MSNO or Site ID	Site Name	Nest Patch Location (MP)	Landowner	Land Allocation	Available High NRF/NRF a/ (acres)	Length Crossed b/ (feet)	High NRF/NRF Affected c/		Pre-Action Habitat Condition d/	Additional Description
							Area (acres)	Percent of Available NRF		
Coast Range Physiographic Province										
2317B	Brewster Valley	35.90-39.41	Coos Bay BLM	LSR	69.63	2,068	4.77	6.9	<40% Home Range, >50% Core	Coos Bay BLM provided a newly documented alternate NSO activity center to Pacific Connector in January 2014; this area had been surveyed in previous years by Coos Bay BLM and Pacific Connector and spotted owl activity was identified in area, but no nest location or pair was documented (see Raymond et al. 2012; SBS 2008); no detections in 2015 and 2016 (BLM 2017). Project would bisect late successional forest through the nest patch (generally High NRF) and western portion of the core area (generally NRF) of this site. This NSO nest patch is also located within MAMU Stand C3090 (see table 3.3.3-13).
Klamath Mountains Physiographic Province										
PCGP 064.2 (Best Location)	Kent Creek	62.70-65.66	Private	None	6.67	1,011	0	0	<40% Home Range, <50% Core Area	Project located in regenerating forest approximately 220 meters (720 feet) from best location site located within strip of mid-seral forest adjacent to regenerating forest; one road travels through the nest patch; within the home range, the right-of-way would create additional fragmentation and create edge within older regenerating interior forest as well as create new edge in forest already affected by existing edge.
PCGP 090.2 (Best Location)	Bland Mountain	88.86-91.61	Roseburg BLM	Matrix	25.20	2,035	2.66	10.6	<40% Home Range, <50% Core Area	Project located through middle of best location nest patch; best location site identified adjacent to an existing access road that also bisects the nest patch; consultations within agencies (see table S-1 in appendix S) presume the nest site is not at this best location site; northern portion of the right-of-way traverses through old-growth, including interior forest and bisects the stand.
PCGP 095.3 (Best Location)	Milo South	93.82-97.04	Roseburg BLM	LSR	39.74	1,795	1.44	3.6	<40% Home Range, > 50% Core	Project bisects nest patch and traverses through late successional forest within the nest patch, some of which has been burned and left standing from the 2015 Stouts Creek fire; the remainder of project is in early regenerating forest or in recent clearcut affected by the 2015 Stouts Creek Fire.

TABLE 3.3.4-15 (continued)

Summary of NSO Nest Patches Crossed by the Pipeline Project

MSNO or Site ID	Site Name	Nest Patch Location (MP)	Landowner	Land Allocation	Available High NRF/NRF a/ (acres)	Length Crossed b/ (feet)	High NRF/NRF Affected c/		Pre-Action Habitat Condition d/	Additional Description
4008B	Hatchet Creek South	99.23-101.98	Roseburg BLM	LSR CHU KLE1	40.49 (25.73)	432	0.58 (0.58)	1.4	> 40% Home Range, >50% Core Area	Project follows existing road on edge of nest patch (approximately 275 meters or 911 feet from activity center); removes regenerating forest on edge of road. Stouts Creek Fire burned most of this nest patch, core area, and home range; activity center provided by BLM occurs in post-fire NRF (previously NRF, standing dead trees) adjacent to fire-related clearcut.
West Cascades Physiographic Province										
1620 (PCGP 160.7)	Big Elk	160.13-162.77	Rogue River N.F.	LSR CHU KLE4	50.62	1,873	2.14	4.2	>40% Home Range, >50% Core Area	Project occurs approximately 133 meters (437 feet) from Forest-Service provided activity center generally along regenerating strip; one road traverses eastern portion of nest patch; the project would create new edge extending from regenerating strip to access road in old-growth forest.
0994	Cox Creek	161.81-164.49	Rogue River N.F.	LSR CHU KLE4	61.36	1,126	0.43	0.7	>40% Home Range, >50% Core Area	Project located approximately 200 meters (650 feet) from activity center; project traverses through regenerating forest patch adjacent to late successional forest; would bisect regenerating interior forest in the nest patch.
East Cascades Physiographic Province										
0023	Buck Lake	172.35-174.72	Winema N.F.	CHU ECS 1	19.71	129	0.18	0.9	<40% Home Range, <50% Core Area	Project located approximately 285 meters (930 feet) from activity center; project parallels or is adjacent to Clover Creek Road in old-growth forest adjacent to regenerating forest.

a/ Available high NRF and NRF in the nest patch; see table Q-7 in appendix Q.
b/ Length is provided for Pipeline across the nest patch.
c/ Acres of NRF (high NRF and NRF) affected within the nest patch, if NRF affected; see table Q-7 in appendix Q. Acreage in parenthesis identifies the area of NRF (or High NRF) prior to the 2015 Stouts Creek fire that are currently dead standing trees (i.e., “post-fire NRF”).
d/ FWS et al. (2008) considers NSO home ranges and core areas to provide suitable NRF if the available NRF is greater than 50 percent (Core Area) or is greater than 40 percent (Home Range).

Habitat Fragmentation

In addition to impact by surface disturbances, fragmentation of connected, contiguous habitat would occur. Fragmentation of NSO habitat is considered a cause for poor demographic performance, although the threat posed by fragmentation is still not fully understood (Courtney et al. 2004) and, as described below, NSO fecundity has also been positively correlated with forest edge, which is associated with fragmentation (Franklin et al. 2000; Olson et al. 2004; Hayward et al. 2011). FWS (2004c) indicated that habitat fragmentation was the “aggregate of effects of historical habitat loss, continuing habitat loss due to uncharacteristic wildfire, and continuing timber harvest, albeit at reduced levels,” and that habitat fragmentation remained a threat in the northern part of the NSO’s range but was reduced in the southern part. Courtney et al. (2004) indicated that typically a larger area is required for NSO home ranges in more fragmented habitats. Based on this assumption, the Provincial Home Range Radii provided in the 2012 Northern Spotted Owl Survey Protocol would be indicative of more fragmented habitats in the northern part of the NSO’s range than in the southern portion (1.8-mile radius in the Washington Cascades, 2.2 miles on the Olympic Peninsula, 1.2 miles in the Oregon Cascades, 1.5 miles in the Oregon Coast Ranges, and 1.3 miles in Klamath Province).

Effects of fragmentation on NSO demographic parameters are complex. Fragmentation includes increasing levels of edge between older forests and younger forest types and NSO fecundity has been positively related to forest edge (Franklin et al. 2000; Olson et al. 2004; Hayward et al. 2011). FWS (2011c) has suggested that spotted owls evolved with natural disturbance processes (e.g., fire) that caused mosaics of forest age classes, edges included. While the size of old-growth patches was strongly related to nest site selection by NSO, extent of clearcut forest and indices of forest fragmentation were not (Meyer et al. 1998). Prey abundance and higher nutritional status have been related to forest edges (Franklin et al. 2000; Franklin and Gutiérrez 2002; Hayward et al. 2011), particularly the abundance of woodrats (Ward et al. 1998), and possibly flying squirrels (Rosenberg and Anthony 1992). On one hand, reproductive output was found to be greater at sites with more edge between older forest (mature and old growth) and other adjacent vegetation, while reproductive output declined in areas with greater amounts of interior forest (Franklin et al. 2000). Alternatively, NSO survival increased with more interior forest and increased edge (Franklin et al. 2000). As reviewed by Franklin and Gutiérrez (2002), locations in which NSO have high reproduction and high survivorship (collectively, high fitness) represent a balance between the amounts of interior forest and edges with older forest.

Increased fragmentation can lead to decreased survivorship of NSOs by facilitating predation by great horned owls, northern goshawks, and other avian predators (Franklin et al. 2000; FWS 2011c). Competition with barred owls may also be facilitated by forest fragmentation, although the levels of competition are not straight forward (Dugger et al. 2011). With increased fragmentation, NSO have been found to expand their home range size (Schilling et al. 2013) which could lead to increased predation (larger areas equating to more time spent away from nests) and possibly increased competition (Dugger et al. 2011).

The provincial analysis area has already been subjected to extensive fragmentation by past land uses including transportation corridors, timber harvest and associated activities (i.e., road construction), and urban development. The Project would cross approximately 192.1 miles of four physiographic provinces (MP 0.00 to MP 190.58), of which 109.5 miles occur within NSO home ranges (table Q-9 in appendix Q). Within the four physiographic provinces crossed by the proposed action, the Pipeline would be located within or adjacent to existing utility or road corridors for approximately 77.8 miles (40.5 percent of proposed pipeline miles in the NSO range; see table Q-4 in appendix Q), thus minimizing fragmentation within approximately 78 home ranges and NSO habitat. Table Q-4 in appendix Q identifies the location of NSO home ranges (including nest patches and core areas) in relation to existing rights-of-ways and corridors. However, additional fragmentation would occur within high NRF and NRF habitat, as well as dispersal and capable habitat, due to the Pipeline Project. Depending on local conditions, fragmentation may not be an adverse impact to NSO home ranges if prey abundance ultimately increases, but on the other hand, fragmentation could contribute to increased predation of NSO nests which would be detrimental.

Other indirect effects from construction of the Pipeline are also expected within habitat adjacent to the construction right-of-way, including within interior forest within NSO high NRF, NRF, dispersal, and capable habitat. The conversion of large tracts of old-growth forest to small, isolated forest patches with large edge areas can create changes in microclimate, vegetation species, and predator-prey dynamics. In general, microclimates along edges differ from those in forest interiors. Two main physical factors affecting and creating an edge microclimate are sun and wind (Forman 1995; Chen et al. 1995; Harper et al. 2005). Compared to the forest interior, areas near edges receive more direct solar radiation during the day, lose more long-wave radiation at night, have lower humidity, and receive less short-wave radiation. Such a change in humidity could affect migration and dispersal of flying insects, including tree parasites such as the Douglas-fir beetle (Chen et al. 1995) and promote expansions of infestations which can affect interior forest stand structure and formations of gaps in formerly closed stands (Furniss 1979). Humidity, coupled with soil moisture and temperature, also affects decomposition of litter and coarse woody debris; rates of litter decomposition were higher near edges with a shallower organic layer (Chen et al. 1995). Decreased humidity may also affect distribution of fungi that are dependent on old-growth forest environments. Because the diets of northern flying squirrels mostly consist of fungi (Verts and Carraway 1998), changes in interior forest microclimates could affect local abundance of prey utilized by NSOs.

Another physical factor affecting edge is edge orientation (Chen et al. 1995). For example, the general orientation of the Pipeline is from northwest to southeast. Therefore, edge effects would be most pronounced on the southwest-facing edges and weakest along the northeast-facing edges (see discussion in Chen et al. 1995).

Harper et al. (2005) reported that the mean distance of edge influence could occur to approximately 328 feet (100 meters) and influence 1) tree mortality, damage, recruitment, growth rate, canopy foliage, understory foliage, and seedling mortality, 2) amounts of canopy trees, canopy cover, snags and logs, understory tree density, herbaceous cover, and shrub cover, and 3) stand composition metrics such as species, exotics, individual species, and species diversity. In other younger coniferous forests or mixed forests with deciduous species, edge effects compared to interior forests have been much less pronounced (Heithecker and Halpern 2007; Harper and MacDonald 2002).

Old-growth and late seral forests are important to NSOs as NRF habitat, but edges associated with those NRF habitats have been shown to increase NSO fitness in terms of fecundity and survivorship (see Franklin et al. 2000, Olson et al. 2004; Hayward et al. 2011). Annual survival of NSO was positively associated both with amounts of interior old-growth forest and with length of edge between those forests and other vegetation types. Conversely, reproduction was negatively associated with interior forest, but positively associated with edge between mature and old-growth conifer forest and other vegetation types (Franklin et al. 2000). Similarly, Olson et al. (2004) found that a mixture of mid- and late successional with young forest and nonforested habitats appear best for NSO reproduction and survival. Roads create edges that affect interior forest biotic and microclimatological conditions, even narrow forest roads 40 feet wide (Baker and Dillon 2000). Edges created by roads with low levels of traffic disturbance have been shown to have a positive effect on NSO nutrition and fecundity (Hayward et al. 2011), perhaps due to abundance of prey (wood rats) along edges, including those associated with roads. Edges may affect interior old growth forests, but not necessarily adversely affect NSO fitness.

To determine other indirect effects to NSO habitat (high NRF, NRF, dispersal only, capable) from construction of the Pipeline outside of habitat removal within the right-of-way, Pacific Connector assessed effects to NSO habitat within 100 meters (328 feet) of proposed habitat removal, including effects to interior forest. To determine which tracts of forested land (late regenerating, mid-seral, late successional, and old-growth) should be considered interior forest, existing edges, such as wide-surface roads, large rivers, early seral forest, and nonforested habitat were buffered by 100 meters (328 feet), and forested habitat included in the buffered area was identified as forested habitat currently affected by existing edge (FWS 2014c). Smaller roads with existing canopy cover were buffered by 50 feet per direction of FWS (2014c). Forested habitat (late regenerating to old-growth forest) that was not included in buffered "currently affected" area was classified as "interior forest" and incorporated into the interior forest model. This BA considers the indirect effects of the newly constructed right-of-way on NSO habitat within 100 meters (328 feet) of habitat removal, including interior forest.

Table 3.3.4-16 identifies the length of proposed Pipeline crossing through NSO habitat within and outside of interior forest habitat, and summarizes the acreage of NSO habitat directly removed and indirectly affected within 100 meters (328 feet) of the Pipeline Project (habitat removal) by physiographic province, landowner, and NSO Groups (summarized from table Q-9 in appendix Q).

Approximately 13,294 acres of NSO habitat (1,307 acres of high NRF/NRF habitat, 4,147 acres of dispersal only habitat, and 5,690 acres of capable habitat) occur within 100 meters (328 feet) of habitat removal, of which 4,326 acres (or 32.5 percent of NSO habitat within 100 meters of habitat removal) of interior NSO habitat would be indirectly affected (1,586 acres of high NRF/NRF habitat, 1,388 acres of dispersal only habitat, and 1,352 acres of capable habitat; tabulated in table 3.3.4-16). The majority of NSO habitat indirectly affected occurs within NSO groups crossed by the Pipeline Project: 8,393 acres (63.1 percent) of all NSO habitat within 100 meters (328 feet) of habitat removal, which includes 2,996 acres of interior NSO habitat and 5,397 acres of NSO habitat currently affected by existing edge. Table Q-9 in appendix Q identifies the acres of NSO habitat affected within 100 meters (328 feet) from habitat removal by physiographic province and general landowner, including effects within critical habitat and LSR. Effects to NSO habitat adjacent to the construction right-of-way would decrease as the forested area (a maximum of approximately 1,568 acres; see table 3.3.4-12) outside of the 30-foot maintenance corridor is replanted with trees and returned to early regenerating stands; however, this replanting would occur on certain federal lands and non-federal lands on a case-by-case basis and replanted trees may also be harvested from non-federal lands or federal lands slated for timber harvest (i.e., Matrix and Harvest Land Base lands).

Based on analyses summarized in table 3.3.4-16, at least 38.5 miles of interior forest would experience fragmentation as a result of the Pipeline Project, creating at least 77.0 miles (38.5 miles x 2) of additional edge in NSO habitat; this considers interior forest crossed by the Pipeline Project within older regenerating forest to old-growth forest. Additional fragmentation of approximately 23.5 miles within forest currently affected by existing disturbance ("other" forest in table 3.3.4-16) could be affected since approximately 40.5 percent (77.8 miles) of the project within the range of NSO occurs within or is adjacent/parallels existing disturbance (see co-locate table Q-4 in appendix Q; 101.3 miles minus 77.8 miles = 23.5 miles), creating approximately 47.0 miles of additional edge in forest already affected by existing disturbance. In addition to NSO habitat crossed and affected within the NSO range, approximately 52.3 miles of non-capable habitat would be crossed with approximately 1,347 acres removed (see table Q-9 in appendix Q). Figure 3.3.4-6 provides an example of the area considered for acreage of other indirect effects to NSO habitat (100 meters from habitat removal), both within and outside of interior forest as presented in table 3.3.4-16.

TABLE 3.3.4-16

Other Indirect Effects from Construction of the Pipeline Project to Northern Spotted Owl Habitat (High NRF, NRF, Dispersal Only, Capable), Including Interior Forest within and outside Northern Spotted Owl Groups by Landowner

Landowner a/	General Location b/	Interior Forest c/	High NRF Habitat d/ Miles Crossed	High NRF Habitat d/ Construction Removed i/ (acres)	High NRF Habitat d/ Construction Indirect j/ (acres)	High NRF Habitat d/ UCSA k/ (acres)	NRF Habitat e/ Miles Crossed	NRF Habitat e/ Construction Removed i/ (acres)	NRF Habitat e/ Construction Indirect j/ (acres)	NRF Habitat e/ UCSA k/ (acres)	Dispersal Only Habitat f/ Miles Crossed	Dispersal Only Habitat f/ Construction Removed i/ (acres)	Dispersal Only Habitat f/ Construction Indirect j/ (acres)	Dispersal Only Habitat f/ UCSA k/ (acres)	Capable Habitat g/ Miles Crossed	Capable Habitat g/ Construction Removed i/ (acres)	Capable Habitat g/ Construction Indirect j/ (acres)	Capable Habitat g/ UCSA k/ (acres)	Total Acres h/ Miles Crossed	Total Acres h/ Construction Removed i/ (acres)	Total Acres h/ Construction Indirect j/ (acres)	Total Acres h/ UCSA k/ (acres)
Coast Range Physiographic Province																						
Federal	NSO Groups	Interior	1.0	12.47	115.25	3.28	0.2	2.70	35.18	0.60	0.8	11.66	96.89	1.66	0.7	13.05	76.90	0.84	2.7	39.88	324.21	6.38
		Other	0.4	4.21	65.18	0.98	0.6	6.94	54.44	0.48	1.8	28.64	148.94	5.20	0.9	20.95	72.42	1.79	3.7	60.74	340.99	8.44
		Subtotal	1.4	16.68	180.43	4.26	0.8	9.64	89.62	1.08	2.6	40.31	245.83	6.85	1.6	34.00	149.32	2.63	6.4	100.62	665.20	14.82
	Outside NSO Groups	Interior	0.1	1.59	22.23	0.43	1.0	11.84	94.70	4.21	2.4	34.94	287.18	4.80	0.9	13.49	148.92	6.33	4.4	61.85	553.02	15.78
		Other	0.2	2.69	13.38	0.61	0.8	12.45	60.18	2.92	2.6	34.60	134.00	1.80	1.9	24.23	82.67	5.32	5.5	73.97	290.23	10.65
		Subtotal	0.3	4.29	35.61	1.04	1.8	24.29	154.88	7.14	5.0	69.53	421.17	6.60	2.8	37.72	231.59	11.65	9.9	135.83	843.26	26.43
	Federal Subtotal	*Interior*	*1.1*	*14.06*	*137.48*	*3.71*	*1.2*	*14.53*	*129.88*	*4.82*	*3.2*	*46.60*	*384.06*	*6.46*	*1.6*	*26.54*	*225.82*	*7.17*	*7.0*	*101.73*	*877.24*	*22.16*
		Other	*0.6*	*6.90*	*78.56*	*1.59*	*1.4*	*19.40*	*114.62*	*3.40*	*4.4*	*63.24*	*282.94*	*7.00*	*2.8*	*45.17*	*155.09*	*7.11*	*9.2*	*134.71*	*631.22*	*19.09*
		Total	*1.7*	*20.96*	*216.04*	*5.29*	*2.6*	*33.93*	*244.50*	*8.22*	*7.6*	*109.84*	*667.01*	*13.46*	*4.4*	*71.72*	*380.92*	*14.28*	*16.3*	*236.45*	*1,508.46*	*41.25*
Non-Federal	NSO Groups	Interior	0.0	0.12	1.30		0.0	0.62	1.04		0.1	2.34	50.85	0.42	1.4	22.20	169.05	1.77	1.5	25.28	222.25	2.19
		Other	0.0	0.05	1.49	0.00	0.1	1.23	4.90	0.00	0.7	18.59	130.04	2.73	9.1	147.65	751.64	21.19	9.9	167.52	888.07	23.92
		Subtotal	0.0	0.17	2.79	0.00	0.1	1.85	5.94	0.00	0.8	20.93	180.89	3.15	10.5	169.85	920.69	22.96	11.4	192.80	1,110.31	26.11
	Outside NSO Groups	Interior		0.14	2.42	0.00	0.1	1.09	22.64	0.57	0.9	14.39	95.52	2.86	1.5	22.65	191.10	6.46	2.5	38.26	311.68	9.89
		Other	0.0	0.42	0.07	0.06	0.4	4.72	18.96	0.63	1.6	22.98	158.04	1.88	6.5	111.06	640.61	12.10	8.5	139.18	817.68	14.67
		Subtotal	0.0	0.56	2.49	0.07	0.4	5.81	41.60	1.20	2.5	37.36	253.56	4.74	8.1	133.71	831.71	18.56	11.0	177.45	1,129.36	24.56
	Non-Federal Subtotal	*Interior*	*0.0*	*0.26*	*3.72*	*0.00*	*0.1*	*1.71*	*23.68*	*0.57*	*1.0*	*16.73*	*146.37*	*3.28*	*2.9*	*44.85*	*360.15*	*8.23*	*4.1*	*63.54*	*533.93*	*12.08*
		Other	*0.0*	*0.47*	*1.56*	*0.06*	*0.5*	*5.95*	*23.86*	*0.63*	*2.2*	*41.56*	*288.08*	*4.61*	*15.7*	*258.71*	*1,392.25*	*33.28*	*18.4*	*306.70*	*1,705.75*	*38.59*
		Total	*0.1*	*0.73*	*5.28*	*0.07*	*0.5*	*7.66*	*47.54*	*1.20*	*3.3*	*58.29*	*434.45*	*7.89*	*18.6*	*303.56*	*1,752.40*	*41.52*	*22.5*	*370.24*	*2,239.68*	*50.67*
Coast Range Total	NSO Groups	Interior	1.0	12.59	116.55	3.28	0.3	3.31	36.22	0.60	0.8	14.01	147.74	2.08	2.1	35.25	245.95	2.61	4.2	65.16	546.46	8.58
		Other	0.4	4.26	66.67	0.98	0.7	8.17	59.34	0.48	2.5	47.23	278.99	7.93	10.0	168.60	824.06	22.98	13.6	228.26	1,229.06	32.36
		Subtotal	1.4	16.85	183.22	4.26	0.9	11.49	95.56	1.08	3.3	61.24	426.73	10.01	12.1	203.85	1,070.01	25.59	17.8	293.42	1,775.52	40.94
	Outside NSO Groups	Interior	0.1	1.73	24.65	0.43	1.0	12.93	117.34	4.78	3.3	49.32	382.70	7.66	2.5	36.14	340.03	12.79	6.9	100.11	864.71	25.67
		Other	0.3	3.12	13.45	0.67	1.2	17.17	79.14	3.55	4.1	57.58	292.04	3.68	8.4	135.29	723.28	17.42	14.0	213.16	1,107.91	25.32
		Subtotal	0.4	4.85	38.10	1.10	2.2	30.10	196.48	8.33	7.5	106.90	674.73	11.34	10.9	171.43	1,063.31	30.21	20.9	313.27	1,972.62	50.99
	Coast Range Total	*Interior*	*1.1*	*14.32*	*141.20*	*3.71*	*1.3*	*16.24*	*153.56*	*5.39*	*4.2*	*63.33*	*530.43*	*9.74*	*4.5*	*71.39*	*585.98*	*15.41*	*11.1*	*165.27*	*1,411.17*	*34.24*
		Other	*0.7*	*7.38*	*80.12*	*1.65*	*1.9*	*25.34*	*138.48*	*4.02*	*6.6*	*104.81*	*571.03*	*11.61*	*18.5*	*303.89*	*1,547.34*	*40.40*	*27.6*	*441.41*	*2,336.97*	*57.68*
		Total	*1.8*	*21.70*	*221.32*	*5.36*	*3.1*	*41.58*	*292.04*	*9.41*	*10.8*	*168.14*	*1,101.46*	*21.35*	*23.0*	*375.28*	*2,133.32*	*55.80*	*38.7*	*606.69*	*3,748.14*	*91.92*
Klamath Mountains Physiographic Province																						
Federal	NSO Groups	Interior	3.8	49.81	397.25	26.18	3.1 (0.9)	44.28 (12.84)	293.60 (111.28)	45.18 (26.82)	1.9	29.78	220.64	15.91	1.2	17.16	122.40	5.56	9.9	141.03	1,033.89	92.83
		Other	2.5	33.97	275.15	16.93	3.3 (0.9)	56.12 (12.75)	241.71 (42.68)	23.85 (10.43)	2.0	38.85	268.78	7.82	4.4	65.87	283.43	17.76	12.2	194.81	1,069.06	66.35
		Subtotal	6.3	83.78	672.40	43.12	6.4 (1.8)	100.40 (25.59)	535.31 (153.95)	69.02 (37.25)	3.9	68.63	489.42	23.72	5.6	83.03	405.83	23.32	22.1	335.84	2,102.95	159.18
	Outside NSO Groups	Interior	0.2	3.08	19.39		0.2	3.42	20.73	0.11	0.7	8.62	45.81	1.64		0.00	0.01		1.2	15.13	85.93	1.75
		Other	0.1	1.33	10.94	0.10	0.2	3.84	18.17	1.02	0.3	3.18	19.80	0.01		0.00	2.56	0.00	0.6	8.35	51.47	1.13
		Subtotal	0.3	4.41	30.33	0.10	0.5	7.26	38.90	1.14	0.9	11.80	65.60	1.65		0.00	2.57	0.00	1.7	23.48	137.40	2.89
	Federal Subtotal	*Interior*	*4.0*	*52.90*	*416.64*	*26.18*	*3.3 (0.9)*	*47.70 (12.84)*	*314.33 (111.28)*	*45.29 (26.82)*	*2.6*	*38.40*	*266.45*	*17.55*	*1.2*	*17.16*	*122.41*	*5.56*	*11.1*	*156.16*	*1,119.82*	*94.58*
		Other	*2.6*	*35.30*	*286.09*	*17.03*	*3.6 (0.9)*	*59.97 (12.75)*	*259.87 (42.68)*	*24.87 (10.43)*	*2.2*	*42.03*	*288.57*	*7.83*	*4.4*	*65.87*	*285.99*	*17.76*	*12.8*	*203.16*	*1,120.53*	*67.49*
		Total	*6.6*	*88.20*	*702.73*	*43.22*	*6.9 (1.8)*	*107.66 (25.59)*	*574.20 (153.95(*	*70.16 (37.25)*	*4.8*	*80.43*	*555.02*	*25.37*	*5.6*	*83.03*	*408.39*	*23.32*	*23.9*	*359.32*	*2,240.35*	*162.07*
Non-Federal	NSO Groups	Interior	0.0	0.43	18.96	1.25	0.2	3.67	30.32	1.33	2.4	33.73	284.08	44.86	1.4	19.15	130.04	16.02	4.0	56.99	463.41	63.45
		Other	0.2	6.17	56.36	7.78	1.1	20.00 (0.12)	130.52 (0.92)	16.15 (0.11)	5.4	77.03	459.51	42.54	8.6	140.95	857.42	110.14	15.4	244.15	1,503.81	176.62
		Subtotal	0.2	6.60	75.32	9.03	1.3	23.67 (0.12)	160.85 (0.92)	17.48 (0.11)	7.8	110.76	743.60	87.40	10.0	160.10	987.45	126.16	19.4	301.13	1,967.22	240.07
	Outside NSO Groups	Interior	0.0	0.18	2.06		0.0	0.73	6.77	0.18	1.6	20.88	141.89	8.12	0.0	0.04	16.25	0.30	1.7	21.83	166.97	8.60
		Other	0.0	0.76	7.54	0.42	0.2	6.57	19.33	0.86	4.8	69.51	502.89	9.53	1.4	17.38	175.75	12.13	6.4	94.22	705.51	22.94
		Subtotal	0.0	0.94	9.60	0.42	0.3	7.30	26.10	1.04	6.5	90.39	644.77	17.65	1.4	17.42	192.00	12.43	8.1	116.06	872.48	31.54

TABLE 3.3.4-16 (continued)

Other Indirect Effects from Construction of the Pipeline Project to Northern Spotted Owl Habitat (High NRF, NRF, Dispersal Only, Capable), Including Interior Forest within and outside Northern Spotted Owl Groups by Landowner

Landowner a/	General Location b/	Interior Forest c/	High NRF Habitat d/				NRF Habitat e/				Dispersal Only Habitat f/				Capable Habitat g/				Total Acres h/			
				Construction				Construction				Construction				Construction				Construction		
			Miles Crossed	Removed i/ (acres)	Indirect j/ (acres)	UCSA k/ (acres)	Miles Crossed	Removed i/ (acres)	Indirect j/ (acres)	UCSA k/ (acres)	Miles Crossed	Removed i/ (acres)	Indirect j/ (acres)	UCSA k/ (acres)	Miles Crossed	Removed i/ (acres)	Indirect j/ (acres)	UCSA k/ (acres)	Miles Crossed	Removed i/ (acres)	Indirect j/ (acres)	UCSA k/ (acres)
	Non-Federal Subtotal	Interior	0.0	0.61	21.02	1.25	0.3	4.40	37.10	1.51	4.0	54.62	425.97	52.98	1.4	19.19	146.29	16.32	5.7	78.82	630.37	72.05
		Other	0.2	6.93	63.90	8.20	1.3	26.57 (0.12)	149.85 (0.92)	17.01 (0.11)	10.2	146.54	962.40	52.07	10.0	158.33	1,033.17	122.27	21.8	338.37	2,209.32	199.56
		Total	0.3	7.54	84.92	9.45	1.6	30.97 (0.12)	186.95 (0.92)	18.52 (0.11)	14.3	201.16	1,388.37	105.05	11.4	177.53	1,179.46	138.59	27.5	417.19	2,839.70	271.61
Klamath Mountains Total	NSO Groups	Interior	3.8	50.24	416.22	27.43	3.3 (0.9)	47.95 (12.84)	323.92 (111.28)	46.51 (26.82)	4.3	63.51	504.72	60.77	2.6	36.32	252.44	21.58	13.9	198.02	1,497.30	156.28
		Other	2.7	40.14	331.51	24.71	4.4 (0.9)	76.13 (12.88)	372.23 (43.60)	40.00 (10.53)	7.4	115.88	728.29	50.36	13.1	206.81	1,140.84	127.90	27.6	438.96	2,572.87	242.97
		Subtotal	6.5	90.38	747.72	52.14	7.7 (1.8)	124.07 (25.72)	696.15 (154.87)	86.51 (37.36)	11.7	179.39	1,233.02	111.12	15.7	243.13	1,393.28	149.48	41.6	636.98	4,070.17	399.25
	Outside NSO Groups	Interior	0.2	3.26	21.45	0.00	0.3	4.15	27.50	0.29	2.3	29.51	187.69	9.76	0.0	0.04	16.26	0.30	2.8	36.96	252.90	10.35
		Other	0.1	2.09	18.48	0.52	0.5	10.41	37.49	1.88	5.1	72.68	522.68	9.54	1.4	17.39	178.31	12.13	7.0	102.57	756.98	24.07
		Subtotal	0.3	5.35	39.93	0.52	0.8	14.56	65.00	2.17	7.4	102.19	710.38	19.30	1.4	17.43	194.57	12.43	9.8	139.53	1,009.87	34.42
	Klamath Mountains Total	Interior	4.0	53.50	437.66	27.43	3.6 (0.9)	52.10 (12.84)	351.42 (111.28)	46.80 (26.82)	6.6	93.02	692.42	70.53	2.6	36.36	268.69	21.88	16.8	234.98	1,750.20	166.64
		Other	2.8	42.23	349.99	25.24	4.9 (0.9)	86.53 (12.88)	409.73 (43.60)	41.88 (10.53)	12.5	188.56	1,250.97	59.90	14.4	224.20	1,319.16	140.03	34.6	541.53	3,329.85	267.04
		Total	6.8	95.74	787.66	52.67	8.5 (1.8)	138.63 (25.72)	761.15 (154.87)	88.68 (37.36)	19.1	281.58	1,943.39	130.42	17.0	260.56	1,587.85	161.91	51.4	776.51	5,080.05	433.68
West Cascades Physiographic Province																						
Federal	NSO Groups	Interior	1.2	14.93	125.29	7.59	2.4	35.03	229.69	14.11	0.9	12.24	76.36	3.67	2.1	26.82	221.26	12.54	6.6	89.01	652.60	37.91
		Other	1.4	15.74	126.25	5.39	3.1	39.20	265.36	12.89	1.7	23.79	148.26	4.58	4.2	76.01	327.89	11.46	10.5	154.74	867.76	34.32
		Subtotal	2.6	30.67	251.54	12.98	5.5	74.23	495.06	27.00	2.6	36.02	224.62	8.25	6.3	102.83	549.15	24.00	17.1	243.75	1,520.37	72.23
	Outside NSO Groups	Interior			1.61		0.3	4.45	25.94				0.96				0.43		0.3	4.45	28.94	0.00
		Other			0.62		2.1	31.31	208.57	5.51	0.3	4.55	38.52	1.19	0.1	1.00	10.63	0.68	2.5	36.86	258.33	7.38
		Subtotal			2.23		2.4	35.76	234.50	5.51	0.3	4.55	39.48	1.19	0.1	1.00	11.05	0.68	2.8	41.31	287.27	7.38
	Federal Sub total	Interior	1.2	14.93	126.90	7.59	2.7	39.47	255.63	14.11	0.9	12.24	77.32	3.67	2.1	26.82	221.68	12.54	6.9	93.46	681.54	37.91
		Other	1.4	15.74	126.87	5.39	5.2	70.51	473.93	18.40	2.1	28.33	186.78	5.77	4.3	77.01	338.52	12.14	13.0	191.60	1,126.10	41.71
		Total	2.6	30.67	253.77	12.98	7.9	109.99	729.56	32.51	3.0	40.57	264.10	9.44	6.5	103.83	560.20	24.68	19.9	285.06	1,807.63	79.61
Non-Federal	NSO Groups	Interior	0.1	0.90	2.88	0.45	0.2	3.30	23.22	1.80	0.2	5.05	38.26	0.08	0.6	11.39	66.21	0.56	1.2	20.64	130.57	2.89
		Other		0.01	3.15		0.2	3.38	33.46	0.79	2.0	30.12	183.58	3.21	2.4	37.38	184.78	7.95	4.7	70.88	404.97	11.96
		Subtotal	0.1	0.91	6.03	0.45	0.4	6.68	56.68	2.59	2.2	35.17	221.84	3.29	3.1	48.77	250.98	8.51	5.9	91.52	535.53	14.84
	Outside NSO Groups	Interior			1.62	0.02	0.1	0.99	6.29	0.51	0.0	0.14	5.74	0.03	0.2	3.21	21.66	0.54	0.3	4.34	35.32	1.10
		Other			0.88		0.9	12.19	52.30	1.90	3.4	49.79	335.10	2.01	0.7	7.68	145.52	1.07	5.0	69.66	533.79	4.98
		Subtotal			2.49	0.02	1.0	13.18	58.59	2.41	3.4	49.94	340.85	2.04	0.9	10.89	167.18	1.61	5.3	74.00	569.11	6.08
	Non-Federal Subtotal	Interior	0.1	0.90	4.50	0.47	0.3	4.29	29.51	2.30	0.2	5.19	44.00	0.12	0.8	14.60	87.87	1.10	1.5	24.98	165.88	3.99
		Other	0.0	0.01	4.02	0.00	1.1	15.56	85.76	2.69	5.4	79.91	518.68	5.22	3.1	45.06	330.29	9.03	9.6	140.54	938.76	16.94
		Total	0.1	0.91	8.52	0.47	1.4	19.86	115.27	5.00	5.6	85.10	562.69	5.33	4.0	59.66	418.16	10.13	11.1	165.53	1,104.64	20.93
West Cascades Total	NSO Groups	Interior	1.3	15.83	128.17	8.04	2.6	38.33	252.92	15.91	1.1	17.29	114.62	3.75	2.7	38.21	287.46	13.10	7.8	109.65	783.17	40.79
		Other	1.4	15.75	129.40	5.39	3.3	42.58	298.82	13.68	3.7	53.90	331.84	7.79	6.7	113.39	512.67	19.42	15.1	225.62	1,272.73	46.28
		Subtotal	2.7	31.57	257.56	13.43	5.9	80.90	551.74	29.59	4.9	71.19	446.46	11.54	9.4	151.60	800.13	32.52	22.9	335.27	2,055.90	87.08
	Outside NSO Groups	Interior	0.0	0.00	3.23	0.02	0.4	5.44	32.23	0.51	0.0	0.14	6.71	0.03	0.2	3.21	22.09	0.54	0.6	8.79	64.25	1.10
		Other	0.0	0.00	1.49	0.00	3.0	43.50	260.87	7.41	3.7	54.34	373.62	3.20	0.8	8.68	156.14	1.75	7.5	106.52	792.12	12.36
		Subtotal	0.0	0.00	4.72	0.02	3.4	48.94	293.09	7.92	3.7	54.48	380.33	3.23	1.0	11.89	178.23	2.29	8.1	115.31	856.38	13.47
	West Cascades Total	Interior	1.3	15.83	131.40	8.06	3.0	43.77	285.14	16.41	1.1	17.43	121.33	3.79	2.9	41.42	309.55	13.64	8.4	118.44	847.42	41.90
		Other	1.4	15.75	130.89	5.39	6.3	86.08	559.69	21.09	7.5	108.25	705.47	10.99	7.5	122.07	668.81	21.17	22.6	332.14	2,064.86	58.64
		Total	2.7	31.57	262.29	13.46	9.3	129.84	844.83	37.51	8.6	125.68	826.79	14.77	10.4	163.49	978.36	34.81	31.0	450.58	2,912.28	100.54

TABLE 3.3.4-16 (continued)

Other Indirect Effects from Construction of the Pipeline Project to Northern Spotted Owl Habitat (High NRF, NRF, Dispersal Only, Capable), Including Interior Forest within and outside Northern Spotted Owl Groups by Landowner

			High NRF Habitat d/ Construction				NRF Habitat e/ Construction				Dispersal Only Habitat f/ Construction				Capable Habitat g/ Construction				Total Acres h/ Construction			
Landowner a/	General Location b/	Interior Forest c/	Miles Crossed	Removed i/ (acres)	Indirect j/ (acres)	UCSA k/ (acres)	Miles Crossed	Removed i/ (acres)	Indirect j/ (acres)	UCSA k/ (acres)	Miles Crossed	Removed i/ (acres)	Indirect j/ (acres)	UCSA k/ (acres)	Miles Crossed	Removed i/ (acres)	Indirect j/ (acres)	UCSA k/ (acres)	Miles Crossed	Removed i/ (acres)	Indirect j/ (acres)	UCSA k/ (acres)
East Cascades Physiographic Province																						
Federal	NSO Groups	Interior	0.1	1.53	14.20	0.79	0.6	6.99	47.46	2.59	0.1	1.38	13.95	0.58	0.6	7.30	70.00	2.77	1.5	17.20	145.61	6.74
		Other	0.3	3.31	10.56		1.4	18.54	94.32	1.15	0.1	1.40	21.17	0.34	1.5	20.82	100.19	1.69	3.3	44.07	226.23	3.18
		Subtotal	0.4	4.84	24.75	0.79	2.0	25.53	141.78	3.75	0.2	2.78	35.12	0.92	2.1	28.12	170.19	4.47	4.8	61.27	371.85	9.92
	Outside NSO Groups	Interior	0.0	0.21	2.29	0.02	0.1	1.38	21.33	0.59		0.02	2.19				8.12		0.1	1.61	33.93	0.61
		Other	0.1	1.50	6.62	0.24	1.7	22.76	88.76	1.35	0.3	5.02	32.29	0.17	0.0	0.32	23.69	0.01	2.2	29.60	151.36	1.77
		Subtotal	0.1	1.71	8.92	0.26	1.8	24.14	110.08	1.93	0.3	5.04	34.48	0.17	0.0	0.32	31.80	0.01	2.3	31.21	185.29	2.38
	Federal Subtotal	*Interior*	*0.1*	*1.74*	*16.49*	*0.81*	*0.7*	*8.36*	*68.79*	*3.18*	*0.1*	*1.41*	*16.15*	*0.58*	*0.6*	*7.30*	*78.12*	*2.77*	*1.6*	*18.81*	*179.54*	*7.35*
		Other	*0.4*	*4.81*	*17.18*	*0.24*	*3.1*	*41.30*	*183.07*	*2.50*	*0.4*	*6.42*	*53.46*	*0.50*	*1.5*	*21.14*	*123.88*	*1.70*	*5.5*	*73.67*	*377.59*	*4.95*
		Total	*0.6*	*6.55*	*33.67*	*1.05*	*3.8*	*49.67*	*251.86*	*5.68*	*0.6*	*7.83*	*69.61*	*1.09*	*2.2*	*28.43*	*201.99*	*4.48*	*7.1*	*92.48*	*557.14*	*12.30*
Non-Federal	NSO Groups	Interior					0.0	0.06	0.28	0.02			5.12		0.1	1.47	18.35	0.78	0.1	1.52	23.76	0.81
		Other					0.0	0.29	0.77		0.1	2.09	8.01		1.3	18.96	87.30	1.50	1.4	21.35	96.08	1.50
		Subtotal					0.0	0.35	1.06	0.02	0.1	2.09	13.13		1.4	20.43	105.65	2.28	1.6	22.87	119.84	2.30
	Outside NSO Groups	Interior							0.03		0.3	4.16	22.58		0.2	3.18	91.77		0.5	7.34	114.38	0.00
		Other					0.1	1.15	1.12	0.01	4.0	51.33	170.06		5.3	67.40	590.89	0.38	9.4	119.88	762.07	0.39
		Subtotal					0.1	1.15	1.15	0.01	4.3	55.49	192.63		5.5	70.58	682.66	0.38	10.0	127.23	876.44	0.39
	Non-Federal Subtotal	*Interior*	*0.0*	*0.00*	*0.00*	*0.00*	*0.0*	*0.06*	*0.32*	*0.02*	*0.3*	*4.16*	*27.70*	*0.00*	*0.4*	*4.65*	*110.12*	*0.78*	*0.7*	*8.86*	*138.14*	*0.81*
		Other	*0.0*	*0.00*	*0.00*	*0.00*	*0.1*	*1.44*	*1.89*	*0.01*	*4.2*	*53.43*	*178.07*	*0.00*	*6.6*	*86.36*	*678.19*	*1.88*	*10.8*	*141.23*	*858.15*	*1.88*
		Total	*0.0*	*0.00*	*0.00*	*0.00*	*0.1*	*1.49*	*2.21*	*0.03*	*4.5*	*57.59*	*205.77*	*0.00*	*6.9*	*91.01*	*788.31*	*2.66*	*11.5*	*150.10*	*996.28*	*2.69*
East Cascades Total	NSO Groups	Interior	0.1	1.53	14.20	0.79	0.6	7.04	47.75	2.61	0.1	1.38	19.08	0.58	0.8	8.77	88.35	3.56	1.6	18.72	169.37	7.55
		Other	0.3	3.31	10.56	0.00	1.5	18.83	95.09	1.15	0.2	3.49	29.18	0.34	2.8	39.78	187.49	3.19	4.7	65.42	322.31	4.68
		Subtotal	0.4	4.84	24.75	0.79	2.0	25.88	142.84	3.77	0.4	4.88	48.26	0.92	3.5	48.55	275.84	6.75	6.3	84.14	491.69	12.23
	Outside NSO Groups	Interior	0.0	0.21	2.29	0.02	0.1	1.38	21.36	0.59	0.3	4.18	24.77	0.00	0.2	3.18	99.88	0.00	0.7	8.95	148.31	0.61
		Other	0.1	1.50	6.62	0.24	1.8	23.91	89.87	1.36	4.4	56.36	202.35	0.17	5.3	67.72	614.58	0.39	11.6	149.49	913.43	2.16
		Subtotal	0.1	1.71	8.92	0.26	1.9	25.29	111.23	1.94	4.7	60.54	227.12	0.17	5.6	70.90	714.46	0.39	12.3	158.44	1,061.73	2.76
	East Cascades Total	*Interior*	*0.1*	*1.74*	*16.49*	*0.81*	*0.7*	*8.42*	*69.11*	*3.20*	*0.4*	*5.57*	*43.85*	*0.58*	*1.0*	*11.95*	*188.23*	*3.56*	*2.3*	*27.67*	*317.68*	*8.15*
		Other	*0.4*	*4.81*	*17.18*	*0.24*	*3.3*	*42.74*	*184.96*	*2.51*	*4.6*	*59.85*	*231.53*	*0.50*	*8.1*	*107.50*	*802.07*	*3.58*	*16.4*	*214.90*	*1,235.74*	*6.84*
		Total	*0.6*	*6.55*	*33.67*	*1.05*	*4.0*	*51.16*	*254.07*	*5.71*	*5.0*	*65.42*	*275.37*	*1.09*	*9.1*	*119.45*	*990.30*	*7.14*	*18.6*	*242.58*	*1,553.42*	*14.99*
Entire Northern Spotted Owl Range																						
Federal	NSO Groups	Interior	6.1	78.73	651.99	37.84	6.3 (0.9)	88.99 (12.84)	605.93 (111.28)	62.48 (26.82)	3.7	55.07	407.84	21.82	4.6	64.33	490.56	21.71	20.7	287.12	2,156.32	143.86
		Other	4.6	57.23	477.14	23.30	8.5 (0.9)	120.81 (12.75)	655.83 (42.68)	38.36 (10.43)	5.6	92.68	587.15	17.92	11.1	183.64	783.93	32.71	29.8	454.36	2,504.05	112.30
		Subtotal	10.7	135.96	1,129.13	61.15	14.7 (1.8)	209.80 (25.59)	1,261.76 (153.95)	100.85 (37.25)	9.3	147.74	994.99	39.74	15.7	247.98	1,274.49	54.42	50.4	741.48	4,660.37	256.16
	Outside NSO Groups	Interior	0.4	4.88	45.53	0.45	1.6	21.08	162.69	4.91	3.1	43.58	336.14	6.44	0.9	13.49	157.47	6.33	5.9	83.04	701.82	18.13
		Other	0.4	5.53	31.56	0.95	4.9	70.37	375.67	10.81	3.5	47.34	224.61	3.17	2.0	25.55	119.55	6.01	10.8	148.79	751.39	20.94
		Subtotal	0.8	10.41	77.09	1.40	6.4	91.45	538.36	15.72	6.6	90.93	560.74	9.61	2.9	39.04	277.02	12.34	16.7	231.82	1,453.21	39.07
	Federal Subtotal	*Interior*	*6.4*	*83.62*	*697.51*	*38.29*	*7.9 (0.9)*	*110.07 (12.84)*	*768.62 (111.28)*	*67.40 (26.82)*	*6.8*	*98.65*	*743.98*	*28.26*	*5.5*	*77.82*	*648.03*	*28.04*	*26.6*	*370.16*	*2,858.14*	*161.99*
		Other	*5.1*	*62.76*	*508.70*	*24.26*	*13.3 (0.9)*	*191.18 (12.75)*	*1,031.50 (42.68)*	*49.17 (10.43)*	*9.1*	*140.02*	*811.76*	*21.09*	*13.1*	*209.19*	*903.48*	*38.72*	*40.6*	*603.15*	*3,255.44*	*133.24*
		Total	*11.5*	*146.38*	*1,206.22*	*62.55*	*21.2 (1.8)*	*301.25 (25.59)*	*1,800.13 (153.95)*	*116.57 (37.25)*	*15.9*	*238.67*	*1,555.74*	*49.35*	*18.6*	*287.02*	*1,551.50*	*66.76*	*67.2*	*973.30*	*6,113.58*	*295.23*
Non-Federal	NSO Groups	Interior	0.1	1.45	23.14	1.70	0.5	7.64	54.87	3.15	2.7	41.13	378.32	45.36	3.5	54.21	383.64	19.14	6.9	104.43	839.98	69.34
		Other	0.2	6.23	60.99	7.78	1.4	24.90 (0.12)	169.65 (0.92)	16.95 (0.11)	8.2	127.83	781.15	48.49	21.5	344.94	1,881.13	140.78	31.4	503.89	2,892.93	214.00
		Subtotal	0.4	7.68	84.14	9.48	1.9	32.54 (0.12)	224.53 (0.92)	20.10 (0.11)	10.9	168.95	1,159.47	93.84	25.0	399.15	2,264.78	159.92	38.3	608.33	3,732.91	283.34
	Outside NSO Groups	Interior	0.0	0.32	6.09	0.03	0.2	2.81	35.74	1.25	2.9	39.57	265.73	11.01	2.0	29.08	320.78	7.30	5.0	71.78	628.35	19.59
		Other	0.0	1.19	8.49	0.48	1.6	24.62	91.70	3.39	13.8	193.62	1,166.08	13.42	13.9	203.53	1,552.77	25.68	29.3	422.95	2,819.05	42.97
		Subtotal	0.0	1.50	14.59	0.51	1.8	27.43	127.44	4.65	16.7	233.19	1,431.81	24.43	15.8	232.61	1,873.55	32.98	34.4	494.73	3,447.39	62.57

TABLE 3.3.4-16 (continued)

Other Indirect Effects from Construction of the Pipeline Project to Northern Spotted Owl Habitat (High NRF, NRF, Dispersal Only, Capable), Including Interior Forest within and outside Northern Spotted Owl Groups by Landowner

			High NRF Habitat d/				NRF Habitat e/				Dispersal Only Habitat f/				Capable Habitat g/				Total Acres h/			
				Construction				Construction				Construction				Construction				Construction		
Landowner a/	General Location b/	Interior Forest c/	Miles Crossed	Removed i/ (acres)	Indirect j/ (acres)	UCSA k/ (acres)	Miles Crossed	Removed i/ (acres)	Indirect j/ (acres)	UCSA k/ (acres)	Miles Crossed	Removed i/ (acres)	Indirect j/ (acres)	UCSA k/ (acres)	Miles Crossed	Removed i/ (acres)	Indirect j/ (acres)	UCSA k/ (acres)	Miles Crossed	Removed i/ (acres)	Indirect j/ (acres)	UCSA k/ (acres)
	Non-Federal Subtotal	*Interior*	*0.1*	*1.77*	*29.24*	*1.72*	*0.7*	*10.46*	*90.61*	*4.41*	*5.6*	*80.70*	*644.05*	*56.37*	*5.5*	*83.29*	*704.43*	*26.43*	*11.9*	*176.21*	*1,468.33*	*88.94*
		Other	*0.3*	*7.41*	*69.48*	*8.27*	*3.0*	*49.52 (0.12)*	*261.36 (0.92)*	*20.34 (0.11)*	*22.1*	*321.44*	*1,947.23*	*61.90*	*35.4*	*548.47*	*3,433.90*	*166.46*	*60.7*	*926.85*	*5,711.98*	*256.97*
		Total	*0.4*	*9.18*	*98.72*	*9.99*	*3.7*	*59.98 (0.12)*	*351.97 (0.92)*	*24.74 (0.11)*	*27.6*	*402.14*	*2,591.28*	*118.27*	*40.9*	*631.76*	*4,138.33*	*192.89*	*72.6*	*1,103.06*	*7,180.30*	*345.90*
Total NSO Range	NSO Groups	Interior	6.2	80.19	675.13	39.54	6.8 (0.9)	96.63 (12.84)	660.81 (111.28)	65.64 (26.82)	6.4	96.19	786.16	67.18	8.1	118.55	874.20	40.85	27.5	391.55	2,996.30	213.20
		Other	4.9	63.46	538.13	31.08	9.9 (0.9)	145.71 (12.88)	825.48 (43.60)	55.31 (10.53)	13.8	220.50	1,368.30	66.41	32.6	528.59	2,665.06	173.49	61.1	958.25	5,396.98	326.29
		Subtotal	11.1	143.64	1,213.26	70.62	16.6 (1.8)	242.34 (25.72)	1,486.29 (154.87)	120.94 (37.36)	20.2	316.70	2,154.46	133.59	40.7	647.13	3,539.26	214.34	88.7	1,349.81	8,393.27	539.49
	Outside NSO Groups	Interior	0.4	5.20	51.62	0.47	1.8	23.89	198.43	6.17	5.9	83.15	601.87	17.46	2.9	42.57	478.25	13.63	11.0	154.81	1,330.17	37.73
		Other	0.5	6.71	40.05	1.44	6.5	94.99	467.38	14.20	17.3	240.96	1,390.69	16.58	15.9	229.08	1,672.32	31.69	40.1	571.74	3,570.44	63.91
		Subtotal	0.8	11.91	91.67	1.91	8.2	118.88	665.80	20.37	23.3	324.11	1,992.56	34.04	18.8	271.65	2,150.57	45.32	51.1	726.55	4,900.61	101.64
	NSO Range Total	**Interior**	**6.6**	**85.39**	**726.75**	**40.01**	**8.6 (0.9)**	**120.52 (12.84)**	**859.23 (111.28)**	**71.80 (26.82)**	**12.3**	**179.35**	**1,388.03**	**84.63**	**11.1**	**161.11**	**1,352.45**	**54.48**	**38.5**	**546.37**	**4,326.47**	**250.93**
		Other	**5.3**	**70.17**	**578.18**	**32.52**	**16.3 (0.9)**	**240.70 (12.88)**	**1,292.86 (43.60)**	**69.51 (10.53)**	**31.2**	**461.46**	**2,758.99**	**82.99**	**48.4**	**757.66**	**4,337.38**	**205.18**	**101.3**	**1,529.99**	**8,967.41**	**390.20**
		Total	**11.9**	**155.55**	**1,304.94**	**72.54**	**24.9 (1.8)**	**361.22 (25.72)**	**2,152.09 (154.87)**	**141.31 (37.36)**	**43.5**	**640.81**	**4,147.02**	**167.63**	**59.5**	**918.78**	**5,689.84**	**259.66**	**139.8**	**2,076.36**	**13,293.88**	**641.13**

a/ Landowner is summarized by Federal (BLM Districts and National Forests) and Non-Federal (Private, State, Corps of Engineers, and Bureau of Indian Affairs Land).
b/ General Location identifies areas within Northern Spotted Owl Groups (areas within NSO home ranges; see table Q-10 in appendix Q) and areas outside of NSO groups (outside of NSO home ranges).
c/ Interior Forest: forested habitat farther than 100 meters (328 feet) from existing disturbance (i.e., wide-surface roads, existing corridors) or adjacent land use/vegetation type (i.e., agriculture, non-forest, early regenerating forest), and/or farther than 50 feet from smaller roads with existing canopy cover (FWS 2014c). Other Forest Type includes forested habitat that is currently affected by existing disturbance or adjacent land use/vegetation types within 100 meters (328 feet) of disturbance
d/ High NRF (FWS 2014c): forested habitat that is characterized by large trees (> 32 inches dbh), high canopy cover (>60 percent), and multistoried structure with sufficient down wood and snags to support prey species.
e/ NRF (FWS 2012e, 2014c; North et al. 1999): conifer-dominated forested habitat greater than 80 years that does not meet the definition of High NRF but has multi-storied structure with large overstory trees (20-30 inches dbh), moderate to high canopy closure greater than 60 percent, and sufficient snags and down wood. Acreage in parenthesis identifies the area of NRF (or High NRF) prior to the 2015 Stouts Creek fire that are currently dead standing trees (i.e., “post-fire NRF”).
f/ Dispersal ONLY (FWS 2012e, 2014c): an average tree diameter of 11 inches dbh or greater; conifer overstory trees; canopy closure greater than 40 percent in moist forests and greater than 30 percent in dry forests; open space beneath the canopy to allow for NSO to fly; High NRF and NRF provide dispersal habitat, as well.
g/ Capable Habitat (FWS 2014c): habitat that is forested or could become forested (i.e., recently harvested timberlands) that do not provide dispersal or NRF characteristics.
h/ Total habitat only considers forested NSO habitat within the range of the NSO; non-capable habitat affected in range of NSO is included in table Q-9 in appendix Q.
i/ Project components considered in calculation of habitat “Removed”: construction right-of-way, temporary extra work areas, aboveground facilities, permanent and temporary access roads (PAR, TAR), pipe storage yards, rock source/disposal sites, and hydrostatic test locations.
j/ Other Indirect Effects considers habitat within 100 meters (328 feet) of habitat removal as measured from the edge of habitat removal/edge of right-of-way/TEWA.
k/ Acres identified as UCSAs have been incorporated into the 100-meter other indirect effects. UCSAs would not be cleared of trees during construction and would not affect nesting structures or characteristics. These areas would be used to store forest slash, stumps and dead and downed log materials that would be removed and scattered across the right-of-way after construction during restoration and are considered as temporary insignificant understory habitat effects.

Summarized from table Q-9 in appendix Q.

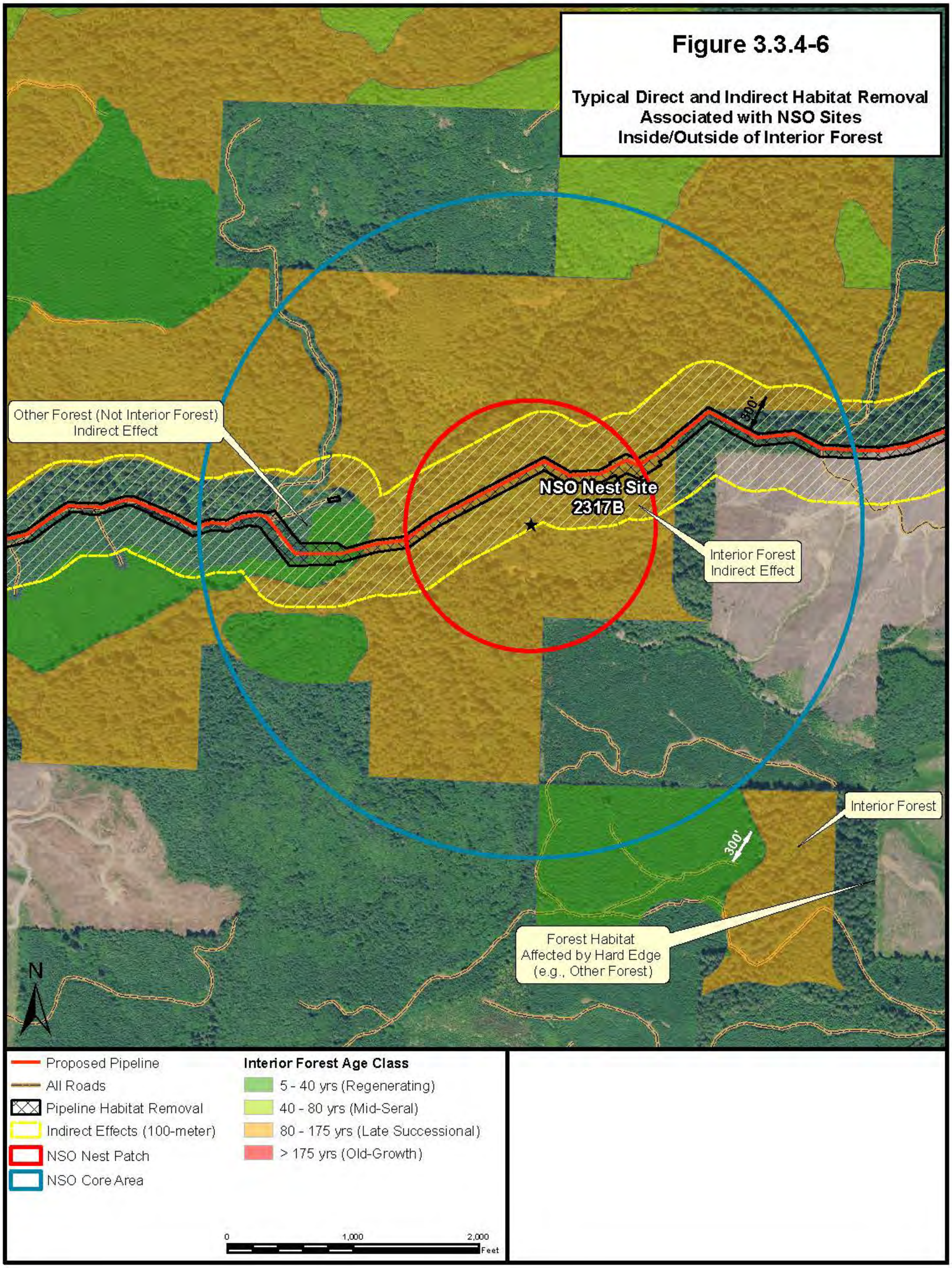


Figure 3.3.4-6
Typical Direct and Indirect Habitat Removal Associated with NSO Sites Inside/Outside of Interior Forest
Other Forest (Not Interior Forest) Indirect Effect
NSO Nest Site 2317B
Interior Forest Indirect Effect
300'
Interior Forest
Forest Habitat Affected by Hard Edge (e.g., Other Forest)
N
Proposed Pipeline
All Roads
Pipeline Habitat Removal
Indirect Effects (100-meter)
NSO Nest Patch
NSO Core Area
Interior Forest Age Class
5 - 40 yrs (Regenerating)
40 - 80 yrs (Mid-Seral)
80 - 175 yrs (Late Successional)
> 175 yrs (Old-Growth)
0
1,000
2,000
Feet

Predation

Few empirical studies exist to confirm that habitat fragmentation contributes to increased levels of predation on NSOs (Courtney et al. 2004). Great horned owls are known and potential predators of NSO (Johnson 1992; Gutiérrez et al. 1995), particularly in the context of effects of forest fragmentation on predation response, since great horned owls appear closely associated with forest openings and clearcuts (Johnson 1992; Laidig and Dobkin 1995). However, after a review of available evidence including predation by great horned owls, Courtney et al. (2004, pages 8–30) conclude: "there appears to be no reasonable basis for regarding an effect of fragmentation on predation levels as a primary or significant effect on NSO populations. Absent new information, the indirect effects of fragmentation through predation remains an untested hypothesis." Also, the FWS (2004c) 5-Year Review stated that indirect evidence from demography studies suggests that predation, particularly by great horned owls, is not a major influence on NSO populations as was originally considered in the 1990 ESA listing.

Tables 3.3.4-13 and 3.3.4-14 indicate that 97 home ranges would be affected from habitat removal by the proposed action and may experience additional fragmentation with construction of the Pipeline, including 40 core areas and eight nest patches (see also table Q-7 in appendix Q). It is possible that the 58 NSO sites that are below recommended threshold of available NRF habitat in the core area and/or home range (table 3.3.4-14), and/or would have interior forest habitat removed (86 NSO sites; see table 3.3.4-17) could experience a greater increase of predation, as great horned owls have been identified throughout the provincial analysis area during surveys in 2007, 2008, and 2015. Table 3.3.4-17 summarizes the number of home ranges that would have interior forest habitat (late regenerating forest to old growth) removed (86 home ranges) by the proposed action and could experience additional fragmentation.

Competition

Since the listing of the NSO, FWS (2011 and 2017) has identified competition from intrusive, non-native barred owls as a foremost threat, second only to habitat loss, contributing to the demise of NSO in the Pacific Northwest. Early investigations of interactions between spotted owls and barred owls indicated the barred owls should be considered a threat to spotted owls (Kelley et al. 2003). Gutierrez et al. (2007) documented multiple competitive advantages of barred owls (a niche generalist) over spotted owls (a niche specialist). Specifically, barred owls have a wider range in clutch size than NSO and have smaller home ranges than NSO, indicative of their use of wider variety of habitats and more varied diet than NSO (Gutierrez et al. 2007). Barred owls may reduce the density of prey species utilized by NSO (resource competition) and have been documented being aggressive to NSO with consequences to NSO social interactions (e.g., reduced NSO vocalizations in vicinity of barred owls), potentially interference competition (Gutierrez et al. 2007). Similar observations have been reported by Hamer et al. (2007), Sovern et al. (2014), and Dugger et al. (2016) which similarly conclude that NSO are being displaced, perhaps forced to extinction, by barred owls (Yackulic et al. 2012; Kroll et al. 2016; Dugger et al. 2016).

TABLE 3.3.4-17

Number of NSO Home Ranges by Physiographic Province that Could Experience Additional Fragmentation (i.e., interior forest removed by Project) a/

Suitable NRF Habitat Condition within Owl Home Ranges b/	Owl Status c/	Physiographic Province				
		Coast Range	Klamath Mountains	West Cascades	East Cascades	Total
Home Range >40%	Known	1	15	10	3	29
AND	Best Location	–	3	4	–	7
Core Area >50%	"PCGP Assumed"	–	–	–	–	0
(*Above Threshold)*	*Total*	*1*	*18*	*14*	*3*	36
Home Range >40%	Known	–	4	2	–	6
AND	Best Location	–	–	–	–	–
Core Area <50%	"PCGP Assumed"	–	1	–	–	1
(*Below Threshold)*	*Total*	*0*	*5*	*2*	*0*	7
Home Range <40%	Known	2	6	1	–	9
AND	Best Location	–	1	–	–	1
Core Area >50%	"PCGP Assumed"	–	–	–	–	–
(*Below Threshold)*	*Total*	*2*	*7*	*1*	*0*	10
Home Range <40%	Known	7	10	4	1	22
AND	Best Location	–	6	1	–	7
Core Area <50%	"PCGP Assumed"	3	1	–	–	4
(*Below Threshold)*	*Total*	*8*	*17*	*5*	*1*	33
Overall Total	**Known**	**10**	**35**	**17**	**4**	**66**
	Best Location	–	**10**	**5**	**0**	**15**
	"PCGP Assumed"	**3**	**2**	–	**0**	**5**
	Total	**13**	**47**	**22**	**4**	**86**

a/ Interior Forest: forested habitat farther than 100 meters (328 feet) from existing disturbance (i.e., wide-surface roads, existing corridors) or adjacent land use/vegetation type (i.e., agriculture, non-forest, early regenerating forest), and/or farther than 50 feet from smaller roads with existing canopy cover (FWS 2014c). Other Forest Type includes forested habitat that is currently affected by existing disturbance or adjacent land use/vegetation types within 100 meters (328 feet) of disturbance. Interior forest includes habitat from late regenerating to old-growth.

b/ FWS et al. (2008) consider core areas with 50 percent or greater suitable NRF habitat and home ranges with at least 40 percent suitable NRF habitat to be necessary to maintain NSO life history function. For detailed NRF/High NRF habitat available for each individual NSO and its habitat type (nest patch, core area, home range), refer to "pre-action" suitable habitat acres in table Q-7 in appendix Q.

c/ Owl Status: 1) Known sites represent NSO activity sites provided by BLM and Forest Service biologists within the provincial analysis area; 2) Best Location sites represent pairs or resident singles documented by PCGP during surveys in 2007 and 2008 with no nest site/activity center located, and; 3) PCGP assumed sites considered for analysis in this BA in areas that may provide nesting habitat for NSO.

Barred owls are known to use a wide variety of forest types, including early successional habitats, and some authors have suggested that timber harvest activities may favor the species. For instance, fragmentation of forest habitat may have created favorable conditions for survival and reproduction of barred owls. By contrast, NSOs appear to be more generally associated with old-growth forest or forests that are structurally complex (Courtney et al. 2004). Therefore, timber harvest may have increased overlap of the two species' preferred and potential habitats which has led to increased competition.

Gutierrez et al. (2007) and Buchanan et al. (2007) considered management and research options that lead to understanding how to deal with the invasion of barred owls and competition with northern spotted owls. Both authors concluded that removal experiments (whether through translocations or lethal elimination) would provide the strongest approach for understanding barred owl effects on NSO populations. Results of removal experiments would lead to control of barred owls through some portion of NSO's range (Gutierrez et al. 2007; Buchanan et al. 2007). To this end, a pilot study was initiated in California in 2009 with an appropriate before-after/control-treatment study design with the treatment as lethal removal of barred owls (Dugger et al. 2016).

Demographic parameters including annual rate of population change (λ), fecundity, and survival of NSO in the California study were compared to other locations across the species' range. The study found that the only instances of an increasing population rate of change for NSO in all locations occurred after lethal control of barred owls began in 2009 in the pilot study; barred owl removal combined with habitat conservation may slow or reverse declines of NSO populations on a local scale (Dugger et al. 2016). Other experimental study areas were initiated in Washington and Oregon in 2015 and scheduled to continue for five years (Wiens et al. 2017). Preliminary results indicate ambiguous responses of spotted owls to removing barred owls during the first study year (Wiens et al. 2017).

Barred owls are present within the Pipeline Project NSO provincial analysis area. Although survey design was not intended to locate or census barred owls or barred owl pairs, during surveys for NSOs conducted along the Pipeline route, barred owls were documented 79 times in 14 survey areas in 2007 (4 pairs), 115 times in 14 survey areas in 2008 (8 pairs), and 19 times in eight survey areas (3 pairs) in 2015 along the Blue Ridge portion of the proposed route – none within NSO home ranges. Of the barred owls documented, 27 were documented within the Coast Range, 56 were documented within Klamath Mountains mostly along the eastern portion of the province, 21 were located in West Cascades, and 25 documented sites were located within the western portion of East Cascades province (see table 3.3.4-18). Davis (2007) provided an analysis using partial data (only 36 barred owl sites) that demonstrated barred owls located along the Pipeline occurred more often in marginal NSO suitable nesting, roosting, and foraging habitat than the NSOs documented during 2007 surveys, which were generally located within the more contiguous and suitable NRF habitat within the Pipeline Project area. Reduction of suitable NSO habitat may have an effect on the NSO by providing a competitive advantage for barred owls, since some research and preliminary modeling by Davis (2007) has demonstrated that barred owls have a wider breadth of habitat use than the NSO and are more often located in marginal habitat than the NSO (Courtney et al. 2004).

TABLE 3.3.4-18

Summary of Barred Owls Detected During 2007, 2008, and 2015 Northern Spotted Owl Surveys

Barred Owls Documented in 2007/2008	Coast Range		Klamath Mountains		West Cascades		East Cascades		Total NSO Range	
	# NSO Home Ranges	# of Barred Owls	# NSO Home Ranges	# of Barred Owls	# NSO Home Ranges	# of Barred Owls	# NSO Home Ranges	# of Barred Owls	# NSO Home Ranges	# of Barred Owls
Total Documented outside of NSO Home Ranges	N/A	26	N/A	2	N/A	0	N/A	25	N/A	57
Total Documented within < 40 percent suitable NRF Habitat	7	26	8	17	1	5	1	7	17	55
Total Documented within > 40 percent suitable NRF Habitat	1	2	14	45	10	21	4	22	29	90
Total Documented within NSO Home Ranges	8	27	22	56	11	21	5	25	46	129

Note:
Table Q-7 in appendix Q provides a subscript "B" where barred owls were documented in the home range, core area, and/or nest patch.

Barred owls were documented in 46 of the 105 NSO home ranges during 2007/2008 Pacific Connector survey efforts (see superscript "B" next to Site Name in table Q-7 in appendix Q), including five nest patches (two known NSO – UMP 0408 and UMP 0401), and three best location sites (PCGP 084.6, PCGP 097.6, and PCGP 165.8). A summary of barred owl locations for each physiographic province in respect to NSO home ranges and available suitable NRF habitat (high NRF and NRF) greater or less than 40 percent is provided in table 3.3.4-18. Habitat below the 40 percent available NRF habitat in the home range could be considered "marginal" habitat. Approximately 37 percent of the barred owls documented within NSO home ranges were documented in "marginal" habitat, and 63 percent of barred owls documented were located in NSO home ranges with more suitable NRF available (see >40 percent suitable NRF Habitat; table 3.3.4-18).

It is conceivable that construction of the Pipeline may serve as a corridor for barred owl expansion, but this is speculative. Review of available literature did not indicate that linear transportation corridors increase barred owl presence/expansion. If inclusion of these additional barred owl locations indicates that barred owls do occur more often in marginal NSO habitat than NSOs do, then focus should be on currently suitable NSO habitat (see Habitat Condition 1 in table Q-7 in appendix Q) being brought below FWS recommended thresholds by the proposed Project, and areas currently below thresholds that the proposed Project could further impact (see Habitat Conditions 2 through 4 in table Q-7 in appendix Q). With the exception of the Coast Range physiographic province, the majority of barred owls documented were located within NSO home ranges with adequate amounts of suitable habitat (greater than 40 percent suitable habitat available in home range and greater than 50 percent suitable habitat available in the core area).

Wildfire

Research demonstrates that NSO populations have declined following wildfires in previously occupied habitats. Clark (2007) documented declining occupancy in burned habitats with lower survival rates of spotted owls that had recently emigrated out of the burned habitat. Also, home ranges of spotted owls that persisted in the burned habitat were characterized by larger amounts of hard edges compared to home ranges outside of burned areas (Clark 2007). However, Roberts et al. (2011) found that densities of California spotted owls inhabiting low to moderate severity burned habitat were similar to densities in unburned habitat. California spotted owls foraged in high-severity burned forest more than in all other burn categories; high-severity burned forests had greater amounts of snags and higher shrub and herbaceous cover, which would likely be associated with increased abundance or accessibility of prey (Bond et al. 2009). High severity fires likely eliminate protective cover or perch sites for spotted owls compared to unburned or low to moderate severity fire that support intact forest canopy with protective cover or high prey availability (Eyes 2014). Additional observations from these studies indicate that activities associated with post-fire timber salvage also pose a significant risk to displacing spotted owls from otherwise occupied habitats.

In 2015, a large stand-replacing fire (Stouts Creek fire) occurred within the range of the NSO, burning approximately 26,452 acres on the Roseburg BLM District, Umpqua National Forest, and some private landowners' land in the Days Creek-South Umpqua River and Elk Creek watersheds (Northwest Interagency Coordination Center 2015). On private lands, burned trees were harvested following the fire, whereas on federal lands, burned trees were left to stand. Approximately 10.7 miles (227 acres) of the Pipeline crosses the area burned by the Stouts Creek fire, generally from MP 95.5 through MP 108.8, including approximately 1.6 miles (57.36 acres) of burned forest that was harvested on private lands, and approximately 2.3 miles (73.95 acres) of burned forest that is still standing on federal lands: 1.57 miles (57.15 acres) in old-growth forest/late successional forest, 0.42 mile (13.16 acres) in mid-seral forest, and 0.24 mile (3.64 acres) in clearcut/regenerating forest. Additionally, Umpqua National Forest created a fire break within the fire boundary that would be crossed by the Pipeline Project from approximately MP 106.8 to MP 108.8. In one location crossed by the Pipeline, the Stouts Creek fire burned an area that was dominated by contiguous, LSOG forest that provided highly suitable NRF habitat for the NSO. As noted earlier, areas where NRF habitat had been burned but was still standing has been identified as "post-fire NRF" in this BA: approximately 4,404 acres of "post-fire NRF" are present in the NSO provincial analysis area (approximately eight percent of all NRF in the analysis area; see table 3.3.4-5), of which 25.72 acres of "post-fire NRF" would be removed (seven percent of all NRF removed) by the Pipeline (table 3.3.4-13). Based on available sources, the Pipeline effects to "post-fire NRF" would primarily be to foraging habitat with some capability of providing suitable roosting structures.

Twenty NSO home ranges included for analysis within this BA had habitat affected by the Stouts Creek fire to varying degrees, and at least three activity centers analyzed in this BA either occur within habitat completely burned to the ground, within harvested habitat, or within post-fire NRF (see table Q7 in appendix Q and appendix Z.2). Based on the information presented above, it is likely that NSOs using habitat affected by the Stouts Creek fire are still present, but utilize habitat in a different capacity. For example, "post-fire NRF" is likely used for foraging and possibly roosting, but may no longer provide the characteristics necessary for nesting. However, without additional surveys and per direction by the FWS, Pacific Connector conservatively assumes NSO activity centers and supporting home ranges affected by Stouts Creek fire still support active NSO nests.

Construction of the Pipeline could increase the risk of fires; however, the exact risk of fires (either natural, or caused by human and/or pipeline activities) would be dependent on local conditions. Certain activities associated with construction and operation of the Pipeline, such as mowing, welding, and parking on dry, tall grass could increase the risk of starting wildland fires, especially if these activities occur within the fire season. Pacific Connector has prepared a *Fire Prevention and Suppression Plan* (see Appendix K to the POD) in consultation with the BLM and Forest Service to reduce the risk of wildland and structural fires. This Plan is consistent with National Forest policies, BLM policies, and current practices and plans. Conversely, the Pipeline right-of-way could also reduce or minimize the spread of fires by creating a fire break in forested areas similar to fire breaks constructed by Umpqua National Forest to control the 2015 Stouts Creek Fire along the proposed route between MPs 106.8 and 108.8.

Effects to Prey

Cleared areas would remove suitable habitat for arboreal prey species (flying squirrels, red tree voles), but could improve habitat for non-arboreal species (western red backed voles, deer mice) adjacent to cleared areas. NSOs seldom venture far into non-forested areas to hunt, although it is likely they would cross the Pipeline corridor at night to forage on both sides of the right-of-way. Edges can be areas of high prey availability, but also increased vulnerability (Zabel et al. 1995). Prey animals could be more exposed in the disturbed area and may move away from edges in the short term. Some minor changes in prey availability could occur as cover is disturbed and animals redistribute within the understory. Conversion of habitat on the right-of-way to non-forested conditions might attract other predators such as other owls, hawks, and mammals. This could increase competition for NSOs in the cleared right-of-way, but the exposure of prey could also benefit NSOs.

Some disturbance of habitat could improve forage conditions in remaining stands on both sides of the Pipeline corridor by bringing more light and resources into the stands and by stimulating forbs, shrubs, and other prey food. Once the initial impact of disturbance recovers (6 months to two years), the understory habitat conditions for prey food would increase over the next few years, until shrubs and residual trees create canopy and become more contiguous with adjacent forest stands.

Critical Habitat

The FWS (1992c) determined that the physical and biological habitat features (PCEs) that are essential for the recovery of the spotted owl are forested lands used or potentially used for nesting, roosting, foraging, and dispersal; more specificity to PCEs was provided in the revised critical habitat in 2012. Based on more current information on the life history, biology, and ecology of the species, the revised PCEs are summarized as (FWS 2012e): PCE-1 – forested habitat in a variety of seral stages that support the NSO across its geographical range; PCE-2 – forested habitat that provides for nesting and roosting, and could provide for foraging; PCE-3 – habitat the provides for foraging; and PCE4 – habitat that supports dispersal of spotted owls, which could provide NRF habitat, but could also be composed of other forest types between larger blocks of NRF habitat. Within this analysis, PCEs would be similar to NSO habitat mapped for the Pipeline: PCE-1 would be all forested habitat affected within the range of the NSO; PCE-2 would include high NRF as well as NRF; PCE-3 would include NRF and high NRF; and PCE-4 would include dispersal only habitat, as well as high NRF and NRF that provide dispersal habitat for the NSO.

Activities that disturb or remove the PCEs within designated CHUs might adversely modify NSO critical habitat. These activities may include effects to early-, mid-, or late-seral forests that support the NSO across its geographical range; nesting and roosting habitat; foraging habitat; and habitat to support the transience and colonization phases of dispersal (FWS 2012e). Approximately 37.4 miles of the proposed route cross seven designated critical habitat sub-units ORC-6, KLE-1, KLE-2, KLE-3, KLE-4, KLE-5, and ECS-1 (see table 3.3.4-19 and table Q-11 in appendix Q), within which 35.0 miles cross NSO habitat. Table Q-11 in appendix Q provides the amount of high NRF, NRF, dispersal only, capable, and non-capable habitat within each CHU by landowner that would be removed and modified, which is summarized below in table 3.3.4-19. With the exception of CHU ECS-1, all CHU subunits occur completely within NSO home ranges, and partially within LSRs and Forest Service unmapped LSRs (see table Q-9 in appendix Q for overlap of CHUs with LSRs and unmapped LSRs).

Overall, the Project would remove 488.72 acres of NSO habitat from CHUs (86.43 acres of high NRF, 160.70 acres of NRF [includes 24.56 acres of "post-fire NRF"], 72.65 acres of dispersal only habitat, and 168.94 acres of capable habitat), of which 128.28 acres (25.07 acres in high NRF, 43.34 acres in NRF [includes 6.27 acres of "post-fire NRF"], 17.85 acres in dispersal only habitat, and 42.03 acres in capable) would be kept within an early seral state within the 30-foot operational corridor for the life of the Project (see table 3.3.4-19). Over the long term, 360.44 acres of NSO habitat within CHUs would return to their original state (outside of the 30-foot operational corridor) and begin functioning as dispersal only habitat (see table 3.3.4-19). Table Q-11 in appendix Q provides further detail of CHUs affected, including landowner by physiographic province within or outside of interior forest and identifies the acres of non-capable habitat affected within designated CHUs.

In addition to direct loss of critical habitat and effects to PCEs due to losses that were summarized in table 3.3.4-19, the Project's other indirect effects within 100 meters (328 feet) of habitat removal to NSO that were discussed above (fragmentation, edge, and interior forest) indirectly affect designated critical habitats and PCEs. Edge effects and effects to interior forest may induce changes to forest characteristics later in time and would indirectly affect PCEs. In particular, creation of isolated forest patches with large edge areas can create changes in microclimate, vegetation species, and predator-prey dynamics. Two main physical factors affecting and creating an edge microclimate are sun and wind (Forman 1995; Chen et al. 1995; Harper et al. 2005), which could directly affect characteristics of nesting trees and decrease canopy cover and stand conditions for future NSO habitat components described in the PCEs.

Interior forest has been defined as 100 meters (328 feet) from any existing edge of a contiguous forested stand (50 feet from canopy covered roads), including edges created by adjacent regenerating stands approximately 10 to 20 years old (see Harper et al. 2005). However effects of strong wind may extend beyond that distance (see Chen et al. 1995). Such effects are dependent on local conditions such as orientation of an edge; the magnitudes of change in humidity with distance from an edge are most extreme with south-facing edges, compared to east- and west-facing edges (see Figure 6 in Chen et al. 1995). Such effects may induce changes within PCEs. Long-term effects on edges and interiors of NSO habitat are less well defined and over time, edge effects would diminish as edges evolve from "hard" to "soft" (see for example, Peery and Henry 2010).

There is considerable overlap of forest habitat, including interior forest that is within NSO CHUs and within LSRs. Long-term effects from removal of forest within critical habitat and LSRs by the Project would be expected. Most indirect effects to forested habitat within 100 meters (328 feet) of habitat removal occur in NSO habitat that has been previously affected by existing edge, such as roads, waterbodies, early seral forest, and nonforested habitat (see "other interior forest" in table 3.3.4-16). Table Q-9 in appendix Q provides a more detailed tabulation of indirect effects to interior forest habitat within NSO CHUs and NWFP LSRs/unmapped LSRs by landowner and physiographic province.

Late-Successional Reserves

Additional habitat protection for the NSO was established when LSRs were adopted in the NWFP, and continued to be included in BLM 2016 RMPs. Within the provincial analysis area, NSO CHUs overlap with LSRs to varying degrees (see table Q-9 in appendix Q). The Pipeline crosses 27.6 miles of LSRs, including two allocated LSRs on Forest Service land: RO 223 (Umpqua National Forest) and RO 227 (Rogue River National Forest); see table 3.3.4-20.

TABLE 3.3.4-19

Summary of High NRF, NRF, Dispersal Only, and Capable Habitat by Physiographic Province Impacted within Northern Spotted Owl Critical Habitat Units during Construction and Operation of the Project

Critical Habitat Subunit	General Location a/	Miles of NSO Habitat Crossed	High NRF b/				NRF c/				Dispersal Only d/				Capable e/				Total Acres f/			
			Construction			Operation	Construction			Operation	Construction			Operation	Construction			Operation	Construction			Operation
			Removed g/	Other Indirect Effects h/	UCSA i/	30-foot Corridor j/	Removed g/	Other Indirect Effects h/	UCSA i/	30-foot Corridor j/	Removed g/	Other Indirect Effects h/	UCSA i/	30-foot Corridor j/	Removed g/	Other Indirect Effects h/	UCSA i/	30-foot Corridor j/	Removed g/	Other Indirect Effects h/	UCSA i/	30-foot Corridor j/
ORC 6	NSO Groups	1.7	2.66	24.52		0.72	5.84	37.93		1.77	9.68	54.60	1.26	2.76	3.84	24.14	0.06	0.74	22.03	141.19	1.33	5.99
	Outside NSO Groups																		0.00	0.00	0.00	0.00
	Total	1.7	2.66	24.52		0.72	5.84	37.93		1.77	9.68	54.60	1.26	2.76	3.84	24.14	0.06	0.74	22.03	141.19	1.33	5.99
KLE 1	NSO Groups	10.1	41.36	321.02	9.82	11.37	36.88 (12.63)	186.76 (70.01)	24.21 (22.15)	9.06 (3.40)	30.37	275.56	7.59	6.04	35.22	134.60	0.07	10.19	143.83	917.95	41.70	36.66
	Outside NSO Groups																		0.00	0.00	0.00	0.00
	Total	10.1	41.36	321.02	9.82	11.37	36.88 (12.63)	186.76 (70.01)	24.21 (22.15)	9.06 (3.40)	30.37	275.56	7.59	6.04	35.22	134.60	0.07	10.19	143.83	917.95	41.70	36.66
KLE 2	NSO Groups	2.2	6.24	61.16	0.67	1.82	16.83 (11.93)	94.47 (77.27)	15.11 (15.10)	4.07 (2.87)	7.02	22.05	1.52	1.36	1.50	19.95	2.23	0.79	31.59	197.63	19.52	8.04
	Outside NSO Groups																		0.00	0.00	0.00	0.00
	Total	2.2	6.24	61.16	0.67	1.82	16.83 (11.93)	94.47 (77.27)	15.11 (15.10)	4.07 (2.87)	7.02	22.05	1.52	1.36	1.50	19.95	2.23	0.79	31.59	197.63	19.52	8.04
KLE 3	NSO Groups	0.2	0.07	2.20			3.31	17.68		0.69									3.38	19.87	0.00	0.69
	Outside NSO Groups																		0.00	0.00	0.00	0.00
	Total	0.2	0.07	2.20			3.31	17.68		0.69									3.38	19.87	0.00	0.69
KLE 4	NSO Groups	13.1	30.76	248.55	13.20	9.51	48.07	329.87	22.79	13.84	17.17	108.37	7.33	5.46	80.11	436.74	24.08	18.42	176.11	1,123.53	67.41	47.23
	Outside NSO Groups																		0.00	0.00	0.00	0.00
	Total	13.1	30.76	248.55	13.20	9.51	48.07	329.87	22.79	13.84	17.17	108.37	7.33	5.46	80.11	436.74	24.08	18.42	176.11	1,123.53	67.41	47.23
KLE 5	NSO Groups	1.6	0.09	1.07	0.02	0.04	2.80	28.28	0.86	0.86	0.57	2.70		0.14	22.08	100.90	0.44	4.69	25.53	132.94	1.31	5.72
	Outside NSO Groups																		0.00	0.00	0.00	0.00
	Total	1.6	0.09	1.07	0.02	0.04	2.80	28.28	0.86	0.86	0.57	2.70		0.14	22.08	100.90	0.44	4.69	25.53	132.94	1.31	5.72
ECS 1	NSO Groups	4.3	3.55	16.39	0.13	1.11	24.07	128.54	3.27	6.79	2.78	35.12	0.92	0.84	25.86	156.43	3.95	7.08	56.26	336.49	8.27	15.82
	Outside NSO Groups	2.2	1.71	8.92	0.26	0.49	22.90	99.55	1.93	6.26	5.06	33.38	0.17	1.24	0.32	31.84	0.01	0.12	29.98	173.69	2.38	8.12
	Total	6.6	5.26	25.30	0.39	1.60	46.97	228.09	5.21	13.05	7.84	68.50	1.09	2.08	26.18	188.28	3.96	7.20	86.24	510.17	10.64	23.94
Total CHU	**NSO Groups**	**33.3**	**84.72**	**674.91**	**23.84**	**24.57**	**137.80 (24.56)**	**823.52 (147.28)**	**66.25 (37.250**	**37.08 (6.27)**	**67.59**	**498.41**	**18.62**	**16.61**	**168.62**	**872.77**	**30.83**	**41.91**	**458.73**	**2,869.61**	**139.53**	**120.16**
	Outside NSO Groups	**2.2**	**1.71**	**8.92**	**0.26**	**0.49**	**22.90**	**99.55**	**1.93**	**6.26**	**5.06**	**33.38**	**0.17**	**1.24**	**0.32**	**31.84**	**0.01**	**0.12**	**29.98**	**173.69**	**2.38**	**8.12**
	Total	**35.5**	**86.43**	**683.82**	**24.10**	**25.07**	**160.70 (24.56)**	**923.07 (147.28)**	**68.18 (37.25**	**43.34 (6.27)**	**72.65**	**531.79**	**18.79**	**17.85**	**168.94**	**904.61**	**30.84**	**42.03**	**488.72**	**3,043.29**	**141.91**	**128.28**

a/ General Location identifies areas within Northern Spotted Owl Groups (areas within NSO home ranges; see table Q-10 in appendix Q) and areas outside of NSO groups (outside of NSO home ranges).
b/ High NRF (FWS 2014c): forested habitat that is characterized by large trees (> 32 inches dbh), high canopy cover (>60 percent), and multistoried structure with sufficient down wood and snags to support prey species.
c/ NRF (FWS 2012e, 2014c; North et al. 1999): conifer-dominated forested habitat greater than 80 years that does not meet the definition of High NRF but has multi-storied structure with large overstory trees (20-30 inches dbh), moderate to high canopy closure greater than 60 percent, and sufficient snags and down wood. Acreage in parenthesis identifies the area of NRF (or High NRF) prior to the 2015 Stouts Creek fire that are currently dead standing trees (i.e., "post-fire NRF").
d/ Dispersal ONLY (FWS 2012e, 2014c): an average tree diameter of 11 inches dbh or greater; conifer overstory trees; canopy closure greater than 40 percent in moist forests and greater than 30 percent in dry forests; open space beneath the canopy to allow for NSO to fly; High NRF and NRF provide dispersal habitat, as well.
e/ Capable Habitat (FWS 2014c): habitat that is forested or could become forested (i.e., recently harvested timberlands) that do not provide dispersal or NRF characteristics.
f/ Total habitat only considers forested NSO habitat within NSO critical habitat units; non-capable habitat affected NSO critical habitats is included in table Q-11 in appendix Q.
g/ Project components considered in calculation of habitat "Removed": construction right-of-way, temporary extra work areas, aboveground facilities, permanent and temporary access roads (PAR, TAR), pipe storage yards, and hydrostatic test locations.
h/ UCSAs would not be cleared of trees during construction and would not affect nesting structures or characteristics. These areas would be used to store forest slash, stumps and dead and downed log materials that would be removed and scattered across the right-of-way after construction during restoration and are considered as temporary insignificant understory habitat effects.
i/ Other Indirect Effects considers habitat within 100 meters (328 feet) of habitat removal as measured from the edge of habitat removal/edge of right-of-way/TEWA.
j/ 30-foot Maintenance Corridor would be kept in a shrub/sapling state for the life of the project; all other habitat outside of the 30-foot maintenance corridor would be revegetated, except for those habitats on non-federal or matrix/harvest-based lands where there is less certainty that replanting would occur or be maintained on the landscape.

Note: More detailed information on BLM Districts and National Forests impacted in critical habitat units is located in table Q-11 in appendix Q. Overlap with LSRs can be reviewed in table Q-9 in appendix Q.

TABLE 3.3.4-20

Summary of High Nesting, Roosting, and Foraging (NRF), NRF, Dispersal, and Capable Northern Spotted Owl (NSO) Habitat Impacted within Northwest Forest Plan Late-Successional Reserves (LSRs) and Unmapped LSRs, Including Area within and outside of NSO Groups

			High NRF Habitat b/				**NRF Habitat c/**				**Dispersal Only Habitat d/**				**Capable Habitat e/**				**Total Acres f/**			
			Construction			**Operation**	**Construction**			**Operation**	**Construction**			**Operation**	**Construction**			**Operation**	**Construction**			**Operation**
Land Use Allocation	**General Location a/**	**Miles of NSO Habitat Crossed**	**Removed g/ (acres)**	**Other Indirect h/ (acres)**	**UCSA i/ (acres)**	**30-foot Corridor j/**	**Removed g/ (acres)**	**Other Indirect h/ (acres)**	**UCSA i/ (acres)**	**30-foot Corridor j/**	**Removed g/ (acres)**	**Other Indirect h/ (acres)**	**UCSA i/ (acres)**	**30-foot Corridor j/**	**Removed g/ (acres)**	**Other Indirect h/ (acres)**	**UCSA i/ (acres)**	**30-foot Corridor j/**	**Removed g/ (acres)**	**Other Indirect h/ (acres)**	**UCSA i/ (acres)**	**30-foot Corridor j/**
BLM-Managed Lands Late Successional Reserves																						
LSRs	NSO Groups	3.8	15.75	174.62	4.48	4.95	8.21	78.77	1.54	2.55	9.26	63.55	3.74	2.36	22.83	70.53	1.95	4.20	56.05	387.47	11.71	14.06
	Outside NSO Groups	6.3	3.79	32.11	0.88	1.09	18.03	106.15	6.30	4.77	42.23	236.36	5.99	10.79	24.15	115.57	6.60	6.30	88.21	490.19	19.76	22.95
	Subtotal	10.1	19.54	206.74	5.35	6.04	26.25	184.92	7.83	7.32	51.49	299.90	9.74	13.14	46.98	186.10	8.55	10.50	144.26	877.66	31.47	37.00
Forest Service Managed Lands Late Successional Reserves																						
LSR RO 223	NSO Groups	4.5	18.51	168.05		4.93	18.87 (8.89)	124.54 (57.31)	17.23 (17.23)	4.80 (2.53)	2.77	91.04		0.69	20.88	71.98		6.01	0.00	0.00	0.00	0.00
	Outside NSO Groups																		61.03	455.61	17.23	16.43
	Subtotal	4.5	18.51	168.05		4.93	18.87 (8.89)	124.54 (57.31)	17.23 (17.23)	4.80 (2.53)	2.77	91.04		0.69	20.88	71.98		6.01	0.00	0.00	0.00	0.00
LSR RO 227	NSO Groups	12.9	30.58	245.22	13.08	9.48	47.60	326.15	22.43	13.68	17.13	111.42	7.33	5.46	78.49	432.01	23.71	18.05	61.03	455.61	17.23	16.43
	Outside NSO Groups																		173.80	1,114.79	66.55	46.68
	Subtotal	12.9	30.58	245.22	13.08	9.48	47.60	326.15	22.43	13.68	17.13	111.42	7.33	5.46	78.49	432.01	23.71	18.05	0.00	0.00	0.00	0.00
Unmapped LSR	NSO Groups											6.63							173.80	1,114.79	66.55	46.68
	Outside NSO Groups																		0.00	6.63	0.00	0.00
	Subtotal											6.63							0.00	0.00	0.00	0.00
Total Late Successional Reserves																						
Total LSRs and Unmapped LSRs	**NSO Groups**	**21.3**	**64.84**	**587.89**	**17.55**	**19.37**	**74.69 (8.89)**	**529.46 (57.31)**	**41.19 (17.23)**	**21.03 (2.53)**	**29.16**	**272.64**	**11.08**	**8.51**	**122.20**	**574.51**	**25.66**	**28.26**	**290.88**	**1,964.50**	**95.49**	**77.17**
	Outside NSO Groups	**6.3**	**3.79**	**32.11**	**0.88**	**1.09**	**18.03**	**106.15**	**6.30**	**4.77**	**42.23**	**236.36**	**5.99**	**10.79**	**24.15**	**115.57**	**6.60**	**6.30**	**88.21**	**490.19**	**19.76**	**22.95**
	NSO Range Total	**27.6**	**68.63**	**620.00**	**18.43**	**20.46**	**92.72 (8.89)**	**635.61 (57.31)**	**47.49 (17.23)**	**25.80 (2.53)**	**71.39**	**509.00**	**17.07**	**19.29**	**146.36**	**690.08**	**32.26**	**34.56**	**379.09**	**2,454.69**	**115.25**	**100.11**

a/ General Location identifies areas within Northern Spotted Owl Groups (areas within NSO home ranges; see Table Q10 in Appendix Q) and areas outside of NSO groups (outside of NSO home ranges).
b/ High NRF (FWS 2014c): forested habitat that is characterized by large trees (> 32 inches dbh), high canopy cover (>60 percent), and multistoried structure with sufficient down wood and snags to support prey species.
c/ NRF (FWS 2012e, 2014c; North et al. 1999): conifer-dominated forested habitat greater than 80 years that does not meet the definition of High NRF but has multi-storied structure with large overstory trees (20-30 inches dbh), moderate to high canopy closure greater than 60 percent, and sufficient snags and down wood. Acreage in parenthesis identifies the area of NRF (or High NRF) prior to the 2015 Stouts Creek fire that are currently dead standing trees (i.e., "post-fire NRF").
d/ Dispersal ONLY (FWS 2012e, 2014c): an average tree diameter of 11 inches dbh or greater; conifer overstory trees; canopy closure greater than 40 percent in moist forests and greater than 30 percent in dry forests; open space beneath the canopy to allow for NSO to fly; High NRF and NRF provide dispersal habitat, as well.
e/ Capable Habitat (FWS 2014c): habitat that is forested or could become forested (i.e., recently harvested timberlands) that do not provide dispersal or NRF characteristics.
f/ Total habitat only considers forested NSO habitat within the range of the NSO; see table Q-12 in appendix Q for effects to non-capable habitat in NWFP LSRs and unmapped LSRs.
g/ Project components considered in calculation of habitat "Removed": construction right-of-way, temporary extra work areas, aboveground facilities, permanent and temporary access roads (PAR, TAR), pipe storage yards, and hydrostatic test locations.
h/ Other Indirect Effects considers habitat within 100 meters (328 feet) of habitat removal as measured from the edge of habitat removal/edge of right-of-way/TEWA.
i/ Acres identified as UCSAs have been incorporated into the 100-meter other indirect effects. UCSAs would not be cleared of trees during construction and would not affect nesting structures or characteristics. These areas would be used to store forest slash, stumps and dead and downed log materials that would be removed and scattered across the right-of-way after construction during restoration and are considered as temporary insignificant understory habitat effects.
j/ 30-foot Maintenance Corridor would be kept in a shrub/sapling state for the life of the project; all other habitat outside of the 30-foot maintenance corridor would be revegetated, except for those habitats on non-federal or matrix lands where there is less certainty that replanting would occur or be maintained on the landscape.

Note: More detailed information on BLM Districts and National Forests impacted in critical habitat units is located in table Q-12 in appendix Q. Overlap with CHUs can be reviewed in table Q-9 in appendix Q.

Table 3.3.4-20 summarizes the impact to NSO high NRF, NRF, dispersal, and capable habitat within each LSR and Forest Service unmapped LSRs impacted (i.e., habitat affected [within 100 meters of habitat removal including UCSAs] or habitat removed) by the proposed Project. Overall, the Pipeline would remove 442.44 acres from LSRs (table Q-12 in appendix Q), of which 379.09 acres is NSO habitat or capable of becoming NSO habitat (68.63 acres of high NRF, 92.72 acres of NRF (includes 8.89 acres of "post-fire" NRF), 71.39 acres of dispersal only habitat, and 146.36 acres of capable habitat). After construction, approximately 100.23 acres (20.46 acres of high NRF, 25.80 acres of NRF [includes 2.53 acres of "post-fire NRF"], 19.29 acres of dispersal only habitat, and 34.56 acres of capable habitat) would be kept within an early seral state within the 30-foot-wide operational right-of-way for the life of the Project (see table 3.3.4-20). Over the long term, 278.98 acres of forested habitat within LSRs would return to their original state (outside of the 30-foot operational right-of-way) and begin functioning as dispersal only habitat (see table 3.3.4-20). Table Q-12 in appendix Q provides NSO habitat affected within NWFP LSRs and unmapped LSRs, by landowner and physiographic province within and outside of interior forest.

LSRs and Forest Service unmapped LSRs cover approximately 61,278 acres within the provincial analysis area and provide approximately 36,826 acres of high NRF and NRF habitat (includes 2,317 acres of "post-fire NRF;" see table 3.3.4-7). The proportional amount of available NRF habitat that would be removed (161.35 acres, including 8.89 acres of "post-fire NRF") within LSRs in the provincial analysis area is 0.4 percent, while 0.2 percent of available NRF would be affected in the short term within UCSAs (65.92 acres, including 17.23 acres of "post-fire NRF").

3.3.4.4 Conservation Measures

Pacific Connector has implemented or proposed conservation measures including avoidance, minimization, and rehabilitation/restoration as described below.

Avoidance, Minimization, and Rehabilitation / Restoration

Conservation measures have been proposed by Pacific Connector to minimize construction and operational impacts to NSO habitat within the provincial analysis area. Those measures have been compiled in table 2C in appendix N. Specific conservation measures that minimize project impacts on NSOs include those that:

- avoid timber clearing during the breeding and nesting season;
- avoid construction activities within 0.25 mile of NSO activity sites during the critical breeding season (March 1 – July 15);
- route the Pipeline through previously disturbed lands near LSRs so that impacts to these areas are minimized;
- minimize removal of forest by incorporating UCSAs into the Pipeline Project design;
- utilize two-year construction schedule to minimize the overall TEWAs;
- flag large diameter trees on edges of construction right-of-way or temporary work areas where feasible to save from clearing, as outlined in the POD's *Leave Tree Protection Plan*;
- ensure that all trash, food waste, and other items attractive to crows, jays, and other corvids would be contained and removed from the project area on a daily basis to minimize potential predation of spotted owl nestlings;

- utilize logging methods to minimize damage to adjacent trees when clearing the right of way to reduce potential infestation from forest pathogens and insects; and
- minimize potential for establishment of invasive vegetation and establish control of noxious weeds.

Plans included in the appendices to Pacific Connector's POD identify methods that would minimize effects to NSO habitat and/or nesting NSOs. The *Leave Tree Protection Plan* describes the preconstruction surveys that would be completed to clearly mark the boundaries of the Pipeline Project's certificated working limits, and procedures to identify individual trees within and along the edges of the certificated work limits that can be conserved or left standing, as well as BMPs that would be employed to minimize damage to trees within UCSAs and protect trees not removed from the construction right-of-way (see Appendix P to the POD [in appendix B of this BA]). An *Integrated Pest Management Plan* (see Appendix N to the POD) describes BMPs to address the control of noxious weeds, invasive plants, forest pathogens, and soil pests, as well as measures to minimize the potential spread of invasive species and potential adverse effects of control treatments. The *Blasting Plan* and *Air Noise and Fugitive Dust Plan* (see Appendices C and B to the POD, respectively) provide mitigation measures and monitoring plans to minimize noise effects to nesting spotted owls during construction of the Pipeline.

During the Pipeline Project route selection and construction footprint design processes (e.g., placement and sizing of temporary extra work areas), Pacific Connector determined an alignment that would ensure the long-term safety and integrity of the proposed Pipeline through geotechnical evaluations while attempting to minimize adverse impacts to NSO nest patches, core areas, critical habitat, LSRs, and otherwise potential suitable habitat. However, not all designated critical habitat, LSRs, suitable habitat, and known NSO nest patches and core areas could be avoided. Major and minor route alternatives have been considered and incorporated into the proposed route that minimize effects to NSO and habitat (see section 3 of our EIS).

Pacific Connector prepared an *Avoidance and Minimization Plan for MAMU and NSO* (see appendix V,1) that identifies the additional measures that have been incorporated into the project design to reduce impacts to both MAMUs and NSOs. This avoidance plan was developed through consultations with the FWS and the cooperating agencies (Interagency Habitat Quality Subgroup-Micro Siting Working Group, June 4, 2008). Application of measures outlined in the plan would minimize the impacts to suitable NSO habitat by 1) converting TEWAs to UCSAs to reduce the amount of suitable habitat removed by the Pipeline Project, 2) moving TEWAs to avoid impacts to suitable habitat within core areas, and 3) moving the alignment to avoid NSO nest patches. A "Standard Rules Set" was developed during the meeting to further minimize effects to NSO nest patches, and this Standard Rules Set would be implemented prior to or concurrent with tree felling. The Standard Rules Set measures include:

- identify potential nest trees to be allowed to remain standing within TEWAs or edge of right-of-way;
- identify TEWAs to be reduced in size or eliminated to reduce removal of suitable habitat;
- identify any additional minor route adjustments that would not alter constructability but would further reduce removal of suitable habitat;

- identify any previously unknown nest trees discovered and assure that they are properly protected by applying seasonal restrictions associated with similar locations along the project alignment; and
- provide support to EIs by qualified biologists to identify habitat or potential nest trees.

Prior to timber clearing, Pacific Connector would have experienced biologists cruise NSO core areas and nest patches where high NRF and NRF habitat would be modified by construction of the Pipeline and mark trees that have potential NSO nesting structures (i.e., snags, large cavities). Pacific Connector would avoid removal of those marked trees, if feasible. Additionally, to minimize disturbance within forested areas, Pacific Connector has designated nearly 676.44 acres (see table 3.3.4-12) of UCSAs within the range of NSOs that would not be cleared of trees but would be used to store forest slash, stumps, and dead and downed log materials during construction that would be scattered across the right-of-way after construction and during restoration. The UCSAs would be useful for the construction of the Pipeline Project while not requiring removal of trees or understory vegetation and allowing the maintenance of high NRF, NRF, dispersal, and capable habitat function. Where feasible, Pacific Connector would leave large trees on the edges of the construction right-of-way and TEWAs throughout the Project area to benefit the NSO and other late-successional-dependent wildlife species.

To minimize impact to NSOs potentially nesting within 0.25 mile of the Pipeline, Pacific Connector would remove timber outside of the NSO breeding season (after September 30 and before February 28) within at least 0.25 mile of activity centers (known, best location, and "PCGP assumed" sites) to ensure that trees with nesting NSO and owlets are not felled. To minimize disturbance and/or disruption to potentially nesting NSO within 0.25 mile of Pipeline construction, Pacific Connector would construct the Pipeline where activity centers (known, best location, "PCGP assumed") occur within 0.25 mile of the Pipeline Project after the critical breeding period (after July 15), and only after timber has been felled outside of the breeding season. If Pacific Connector decides to construct within 0.25 mile of NSO activity centers during the NSO critical breeding period (March 1 through July 15), Pacific Connector would conduct reproductive follow-up surveys at NSO activity centers that are within 0.25 mile of the construction right-of-way the year of construction to determine if documented nest sites and/or pairs within 0.25 mile of construction activities are active. The follow-up surveys would either consist of two visits before May 1 at least one week apart or one survey after May 1 as described by the revised NSO survey protocol (FWS 2012f). If spotted owls are determined to not be nesting during reproductive follow-up surveys, construction of the Pipeline Project could occur during the breeding season with no expected impact to nesting NSO; however, reproductive follow-up surveys should be repeated each year if construction activities during the critical breeding season are proposed within 0.25 mile of NSO activity centers (FWS 2012f).

To ensure that minimization measures would be applied to all potentially nesting NSO within 0.25 mile of the Pipeline Project, one year prior to construction activities, Pacific Connector would conduct spot check surveys within 0.25 mile of the construction right-of-way in known, best location, and assumed NSO home ranges, where permitted, as well as previously surveyed NRF habitat outside of analyzed NSO home ranges, to supplement the full survey efforts conducted in 2007 and 2008, as recommended by FWS. These surveys would determine if sites are still occupied or have moved, attempt to locate nest trees per protocol, determine if best location or assumed owl sites are occupied, adjust the construction schedule to apply seasonal constraints, if necessary, and apply minor route adjustments to further minimize impact, if feasible. The spot check surveys would include at least three night visits spaced a minimum of seven days apart to confirm occupancy status (FWS 2012f).

During construction, Pacific Connector would ensure that construction contracts include stipulations ensuring that all trash, food waste, debris, and other items attractive to crows, jays, and other corvids would be picked up and removed from the project area on a daily basis during the breeding season to minimize potential predation of northern spotted owlets. Pacific Connector's EIs would be responsible for confirming that the construction contractor is following these stipulations.

Measures have also been proposed to rectify, repair, and rehabilitate and otherwise reduce impacts to forested habitats once construction of the Pipeline is complete. Those measures have been compiled in table 3C in appendix N. Specific conservation measures that would benefit NSOs include those that:

- replant conifer species outside of the 30-foot-wide maintenance corridor after construction, where feasible, which would contribute to the reestablishment of native vegetation and soften the edge effect created from construction of the Pipeline;
- contribute to forest habitat structural diversity (e.g., snags and downed timber); and
- minimize potential for increased human use of the reclaimed construction right-of-way and intrusion into undisturbed habitats.

Following construction, a maximum of approximately 1,568 acres of affected forested lands (the construction right-of-way and temporary extra work areas outside of the 30-foot-wide operational right-of-way; NSO habitat in table 3.3.4-12) would be replanted and allowed to return to pre-construction condition where possible with tree species in the approximate proportion to those species removed. This replanting would occur on certain federal lands and non-federal lands on a case-by-case basis. Replanted trees may also be harvested from non-federal lands or federal lands slated for timber harvest (i.e., Matrix and Harvest Land Base lands). Tree establishment would be allowed to occur up to within 15 feet on either side of the centerline. Over the long term (80 years or more), revegetated areas outside of the 30-foot maintenance corridor may achieve tree structural characteristics comparable to those removed, had they not been affected, which could serve as NSO suitable habitat. Although nesting function may not be reestablished over the long term, the habitat may provide structures suitable for foraging, roosting, and dispersal as it regrows.

As part of the EIS prepared for the Project, FERC staff recommended that Pacific Connector adhere to FWS-recommended timing restrictions within threshold distances of NSO sites during construction, operations, and maintenance of the pipeline facilities (as outlined in FWS 2016c). If the Commission authorizes the Project, it is expected that these measures would be incorporated as conditions of the authorization, and therefore the effects described in this BA would be reduced. Specifically, adherence to FWS-timing restrictions would reduce impacts by eliminating the disruption and disturbance effects described above in section 3.3.4.3 (tables 3.3.4-9 and 3.3.4-10, respectively), and summarized below in section 3.3.4.5 (Determination of Effects). We anticipate that the direct removal and modification of habitat described above and below would still occur, and would result in long-term adverse effects to the species (e.g., long-term loss of habitat), but that the noise and visual effects associated with helicopter use, blasting, and existing road use, would be unlikely to occur. Therefore, the Project would still adversely affect NSO, but these effects would be reduced by avoiding direct effects to breeding individuals during construction.

Jordan Cove and Pacific Connector have indicated an interest in working with the FWS to discuss possible mitigation for NSO, but have not proposed such mitigation at this time. Therefore, the effects described in this BA, including the determination of effects summarized below, are in the absence of applicant-proposed mitigation other than industry standard avoidance and minimization measures. If additional mitigation is subsequently proposed by the applicant and deemed appropriate by the FWS, it is assumed that the overall effects to NSO would be reduced.

Mitigation

The Forest Service has proposed a suite of mitigation projects to address the effects of the Pipeline Project on various resources on NFS lands and to ensure that construction and operation of the pipeline would be consistent with the objectives of the respective Forest Service LRMPs (appendix O.4). These mitigation actions would be a condition of the Forest Service letter of concurrence and would be included in the Right-of-Way Grant, if one were issued for this Project. Implementation and funding of these actions would be carried out through negotiated agreements between the Forest Service and Pacific Connector.

In general, the mitigation measures proposed for NFS land have the potential to result in short-term impacts to NSOs, such as temporary disturbance from equipment and people, but would result in beneficial effects in the long term by improving habitat through, for example, fire risk reduction, and increased habitat connectivity. The Forest Service has proposed mitigation in the following mitigation categories to ensure consistency with the objectives of Forest Service LRMPs that may benefit NSO:

- habitat enhancement,
- fire suppression,
- fuels reduction, and
- re-allocation matrix to LSR.

Habitat enhancement projects would include silvicultural treatments to accelerate development of LSOG conditions, snag creation, and off-site pine removal. These projects would benefit NSO by creating habitat or improving existing habitat quality. Noise associated with these restoration activities, especially if they require helicopters, has the potential to disturb NSO. However, Project design features would focus disturbance outside the critical nesting period and beyond critical distances for NSO, and would reduce impacts from noise to acceptable levels. Overall, the species is expected to benefit from these projects.

Fire suppression and fuels reduction projects would reduce the future risk of fire and thus potential NSO habitat loss. Fire suppression projects would create noise from heavy equipment in the short term that could disturb NSO. The potential for disturbance is mainly associated with breeding behavior at active nest sites. These project design features would focus disturbance outside the critical nesting period and beyond critical distances for NSO, and would reduce impacts from noise to acceptable levels. Overall, the species is expected to benefit from these mitigation projects.

Re-allocation of Matrix to LSR would result in habitat creation for NSO as LSOG conditions develop. In addition, the selected parcels reduce the potential edge effects caused by management of Matrix lands adjacent to occupied NSO sites by reallocating the entire parcel to LSR. A summary of all Forest Service mitigation projects and their potential impacts to all relevant species and habitats is provided in table 2.1.5-1 in chapter 2 of our EIS (FERC 2019) and table 2.8-1 of this BA.

Currently, these projects lack the site-specific details needed for implementation; however, the Forest Service is seeking consultation at a programmatic level for these and other proposed Forest Service actions described in this BA. It is anticipated that these projects would require a secondary site-specific project-level ESA consultation prior to implementation.

3.3.4.5 Determination of Effects

Species

The Project **may affect** NSOs because:

- suitable habitat is available within the provincial analysis area, and
- NSO pairs and resident singles have been located within the provincial analysis area during survey efforts.

The Project is **likely to adversely affect** NSOs for the following reasons:

- Noise from construction of the pipeline (including access road use, helicopter use, and blasting) within 0.25 miles of NSO sites during the breeding season would occur and would disturb or disrupt NSOs and interfere with essential nesting behaviors.
- Construction of the Pipeline would remove approximately 516.77 acres of high NRF and NRF habitat (including 25.72 acres of "post fire NRF" within the 2015 Stouts Creek fire area) within the provincial analysis area. This would result in effects to NSO nest patches, core areas, and home ranges of known, best location, and "PCGP assumed" owls, some of which are currently below thresholds needed to sustain NSOs. Once suitable NRF habitat is reduced or modified in NSO home ranges, there is an increased likelihood that NSOs remaining in the Pipeline Project area would be subject to:
  - displacement from nesting areas;
  - concentration into smaller, fragmented areas of suitable nesting habitat that may already be occupied;
  - increased interspecific (with barred owls) and intraspecific competition for suitable nest sites;
  - decreased survival due to increased predation and/or limited resource (forage) availability; and
  - diminished reproductive success for nesting pairs.
- Construction of the Pipeline Project would remove and modify high NRF, NRF, dispersal only, and capable habitat for NSOs throughout the Project area, including removal of habitat within the home range of 97 NSOs, 58 of which are currently below sustainable threshold levels of suitable habitat for continued persistence in their home range and/or core area.
- Construction of the Pipeline Project would bring one NSO core area (best location activity center affected by 2015 Stouts Creek fire) below the 50 percent NRF threshold, and two

NSO home ranges (known activity centers, one of which was affected by the 2015 Stouts Creek fire) below the 40 percent NRF threshold.

- At least 38.5 miles of interior forest would experience fragmentation as a result of the Project, which may create favorable conditions for survival and reproduction of barred owls, a major threat to NSO.

Critical Habitat

The Project **may affect** NSO critical habitat because:

- the Project would be within designated NSO critical habitat; and
- the Project would affect habitat within designated critical habitat.

The Project is **likely to adversely affect** NSO critical habitat because:

- the Project would remove or potentially downgrade PCEs in critical habitat sub-units ORC-6, KLE-1, KLE-2, KLE-3, KLE-4, KLE-5, and ECS-1 as defined in the Final Rule designating critical habitat for the NSO (FWS 2012e).

3.4 HERPETOFAUNA

3.4.1 Green Turtle

3.4.1.1 Species Account and Critical Habitat

Status

Green turtles were listed as threatened under the ESA on July 28, 1978 (FWS 1978), except for an endangered population nesting on the Pacific Coast of Mexico. On March 23, 2015 the FWS and NMFS identified 11 DPS including the East Pacific DPS, which is found from the California/Oregon border southward along the Pacific coast of North, Central, and South America to Central Chile including Mexico's Revillagigedos Archipelago, and Ecuador's Galapagos Archipelago. East Pacific green turtles regularly strand along the Oregon shoreline (FWS and NMFS 2015). In April 2016, the 1978 ESA listing was revised by listing eight DPS as threatened (including the East Pacific DPS) and three DPS as endangered (FWS and NMFS 2016).

Threats

In addition to the general threats to marine turtles mentioned below, the primary cause of green turtle population decline has been the harvest of both eggs and adults on nesting beaches and juveniles and adults on feeding grounds (NMFS 2017c).

NMFS has identified eight general threats to marine turtles, including green turtles. These threats include:

- entanglement in and/or injury by fishing gear;
- ingestion or entanglement in marine debris;
- environmental contamination;
- disease, especially fibropapillomatosis in green turtles, but also reported in loggerhead and olive ridley turtles;
- loss or degradation of nesting habitat;
- beach armoring;
- artificial lighting; and
- non-native vegetation.

In addition, global climate change could also impact green turtles and other marine turtles' life cycles and could affect the abundance and distribution of prey items (NMFS 2017d).

Species Recovery

A Recovery Plan for U.S. Pacific green turtles was issued on May 22, 1998 (NMFS and FWS 1998a). The recovery goal is to delist the species, and the plan listed the following necessary actions:

- Minimize boat collision mortalities, particularly within San Diego County, California.
- Minimize incidental mortalities of turtles by commercial fishing operations.
- Support the efforts of Mexico and the countries of Central America to census and protect nesting East Pacific green turtles, their eggs, and nesting beaches.
- Determine population size and status in U.S. waters through regular surveys.

- Identify stock home range(s) using DNA analysis.
- Identify and protect primary foraging areas in U.S. jurisdiction.

The stepdown outline in the recovery plan included the following recommendations:

- Protect and manage turtles on nesting beaches.
- Protect and manage nesting habitat.
- Protect and manage East Pacific green turtle populations in the marine habitat.
- Protect and manage marine habitat, including foraging habitats.
- Develop standards for the care and maintenance of sea turtles, including diet, water quality, tank size, and treatment of injury and disease.
- Establish a catalog of all captive sea turtles to enhance use for research and education.
- Designate rehabilitation facilities.
- Support existing international agreements and conventions to ensure that turtles in all life-stages are protected in foreign waters.
- Encourage ratification of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) for all non-member Pacific countries, compliance with CITES requirements, and removal of sea turtle trade reservations held by member nations.
- Develop new international agreements to ensure that turtles in all life-stages are protected in foreign waters.
- Develop or continue to support informational displays in U.S. airports and ports of entry that have direct flights to Mexico and Latin America.

Life History, Habitat Requirements, and Distribution

The green turtle is globally distributed in tropical and subtropical waters generally between 30° north and 30° south of the equator. Many facets of the green turtle's life history and ecology remain unknown, including details of its residence in and use of the U.S. Pacific Coast. Green turtle nesting is widely dispersed in the Eastern Pacific Ocean. The two largest nesting aggregations for the East Pacific DPS are on the coast of Michoacán, Mexico and in the Galapagos Islands, with significant nesting on a variety of other beaches along the tropical eastern Pacific Coast.

Except during breeding migrations, green turtles tend to be found in shallow waters such as those inside reefs, bays, and inlets. The turtles are attracted to lagoons and shoals with an abundance of marine grass and algae. Seagrasses are the principal dietary component of juvenile and adult green turtles throughout the Caribbean region and degradation of seagrass beds has slowed recovery of green turtles due to reduced carrying capacity of seagrass meadows (NMFS 1998b). Green turtles apparently have strong nesting site fidelity and migrate long distances between feeding grounds and nesting beaches.

Green sea turtles grow to an average size of about three feet and weigh between 300 and 350 pounds. Hatchling green turtles eat a variety of plants and animals, but adults are vegetarian, feeding on sea grass and algae. The nesting season varies with the locality and clutch size varies from 75 to 200 eggs (FWS 2007d). Incubation of the eggs varies between 45 and 75 days. Age at sexual maturity is between 20 and 50 years (FWS 2007d).

Population Status

The mean annual number of nesting green turtle females has declined by 48 to 67 percent over the last three generations, which was estimated from index nesting sites (Marine Turtle Specialist Group 2004). East Pacific green turtles are widely distributed in coast waters south of the United States, in Mexico and Central America where the main aggregations are along the west coast of Baja California, in the Sea of Cortez, along the coast of Oaxaca, and breeding grounds of Michoacán, Mexico (NMFS and FWS 1998a). There is no known nesting by green turtles on the U.S. Pacific Coast (NMFS and FWS 1998a).

Critical Habitat

Critical habitat was established for this species on Culebra Island, Puerto Rico on September 2, 1998 (NMFS 1998b). No critical habitat for green sea turtles occurs on the U.S. Pacific Coast.

3.4.1.2 Environmental Baseline

Analysis Area

The analysis area applicable to green turtles is the area directly off Coos Bay out to the continental shelf break, which is represented as a depth of 200 meters. For this stretch of the Oregon coast, the shelf break is approximately 12 nmi offshore from the Coos Bay estuary, the same as described above for blue whales (see figure 3.2.1-1 in section 3.2.1). Within the marine analysis area, potential effects to green turtles would be associated with LNG carriers inbound and outbound from the LNG Project.

To date, the origins of LNG carriers arriving at the LNG Project and the destinations of LNG cargo that would be shipped from the LNG Project have not been identified. However, for the reasons discussed with respect to blue whales (see section 3.2.1.3), LNG carriers are assumed to traverse the marine analysis area perpendicularly (east and west) as they approach and depart from Coos Bay. The assumption of perpendicular transits is based on existing shipping traffic between Asia and the continental U.S. Pacific Coast travelling the "Great Circle route" (Pacific States/British Columbia Oil Spill Task Force 2002), as well information provided by the Coast Guard (Berg and Lawrenson 2015).

Species Presence

Green sea turtles have been sighted from Baja California to southern Alaska, but most commonly occur from San Diego south (NMFS 2007b). Green sea turtles primarily use three types of habitat: oceanic beaches (for nesting), convergence zones in the open ocean, and benthic feeding grounds in coastal areas (NMFS 2007b). Reports of strandings suggest that the green turtle is a frequent visitor off the California coast. The northernmost stranding was reported in 1993 in Homer, Alaska, although it was speculated that this turtle may have died farther to the south and drifted north (NMFS 1998b). Based on this data, green turtles are likely infrequent, transient visitors to the Oregon coast.

Habitat

Sightings offshore of the Pacific Coast have occurred but there are no known sea turtle nesting sites on the U.S. Pacific Coast (NMFS and FWS 1998a). The East Pacific green turtle was the most commonly observed hard-shelled sea turtle on the U.S. Pacific Coast (NMFS and FWS 1998a) but most of the sightings (62 percent) were reported from northern Baja California and southern California. The northernmost known resident population of East Pacific green turtles occurs in San Diego Bay, in the warm effluent of a power plant (NMFS and FWS 1998a).

Critical Habitat

No critical habitat for green turtles occurs on the U.S. Pacific Coast.

3.4.1.3 Effects of the Proposed Action

Direct and Indirect Effects

<u>Ship Strikes by LNG Carriers</u>

The proposed action would result in increased shipping traffic. Although green turtles are generally transient in the area, the potential for a ship strike would increase; however, the likelihood of a ship strike is discountable.

Boat collisions are listed as a major problem for green turtle recovery off the continental U.S. Pacific Coast (NMFS 1998b). Sea turtles can be injured or killed when struck by a boat, especially by an engaged propeller. Eighty percent of sea turtle deaths reported recently in San Diego Bay and Mission Bay, California were associated with evidence of boat collision. The proposed action is expected to increase traffic by 240 additional ship transits through the marine analysis area each year of operation (inbound and outbound transits by 120 LNG carriers). However, given the low population and occurrence of the green turtles in Oregon coastal waters and current estimate of vessel traffic, the addition of 240 LNG carrier transits through the marine analysis area is not expected to result in measurable additional ship strike-related mortality or injury to green turtles.

<u>Underwater Noise</u>

Green sea turtle hearing is most sensitive between 200 and 700 hertz (Hz; Bartol and Ketten 2006 cited in NSF 2011), which is within the same range of low frequencies generated by ships and sounds generated by large baleen whales (Würsig and Richardson 2009). However, most research has been related to sea turtles' responses to seismic noises while their responses to ship noise have not been studied or documented.

Ambient noise in the northeast Pacific Ocean has increased over the past several decades. Comparisons of ambient noise from the 1990s with noise measurements taken during the 1960s indicate ambient noise has increased by about 10 dB (Andrew et al. 2002) although analyses of more recent vessel-traffic related noise data indicate that such levels along the U.S. West Coast are holding steady or increasing slightly off southern California but decreasing in the area off Oregon and Washington (Andrew et al. 2011).

Existing commercial vessels within the marine analysis area produce underwater noise levels that are comparable or exceed noise from the LNG tanker described by Hatch et al. (2008). Noise generated by various types of commercial ships (container ships, crude oil tankers, product tankers, bulk carriers, and others) were recently evaluated by McKenna et al. (2012). Underwater noise levels varied by ship type and also by vessel length, gross tonnage, vessel speed, and to some extent, vessel age (older vessels tended to be louder than newer vessels). Potential effects of LNG tanker-related noise on green sea turtles are possible in the marine analysis area but any such noise would be commensurate with existing noise levels and would not be expected to cause injury or any measurable effect to green sea turtles if present.

Fuel Spills

Fuel or lubricants spilled from LNG carriers at sea, or released during normal operations such as bilge tank flushing, could adversely affect green turtles directly if ingested or if turtles become coated in oil. Effects of oil on turtles include direct mortality due to oiling in hatchlings, juveniles, and adults, and negative impacts to the skin, blood, digestive and immune systems, and salt glands (Milton et al. 2010). Effects of potential spills from LNG carriers are not comparable to spills from oil tankers because LNG carriers only carry quantities of oil used for propulsion fuel and not the quantities transported by oil tankers.

The Federal Water Pollution Control Act, as amended by the CWA (33 U.S.C. 1251–1387), prohibits the discharge of oil upon the navigable waters of the U.S., and where it can be determined that the natural resources of the United States are impacted, out to the EEZ (200 miles). LNG carriers calling on the LNG Project would be required by the Coast Guard to have a vessel response plan in order to be adequately prepared for accidental spills, and comply with the U.S. and International regulations discussed under the blue whales section that prohibit the release of oil at sea. Green turtle forage areas exist outside of the marine analysis area in bays and inlets along the coast of Baja California, Mexico, and southern California (NMFS and FWS 1998a). Additionally, there are no known sea turtle nesting sites on the continental U.S. Pacific Coast. As green turtles are likely infrequent, transient visitors to the marine analysis area and the Oregon coast, adverse effects of fuel and lubricants spilled from 120 LNG carriers transiting the marine analysis area annually are expected to be insignificant and discountable, especially given the required spill prevention measures.

Critical Habitat

No critical habitat would be affected by the proposed action because none occurs on the U.S. Pacific Coast.

3.4.1.4 Conservation Measures

No specific conservation measures have been proposed for the sea turtles.

3.4.1.5 Determination of Effects

Species

The Project **may affect** green turtles because:

- green turtles may infrequently occur within the marine analysis area as transients during operation of the proposed action; and
- the proposed action would increase shipping traffic (LNG carriers) within the marine analysis area.

However, the Project is **not likely to adversely affect** green turtles because:

- ship strike on green turtles would be highly unlikely;
- Jordan Cove would provide a ship strike avoidance measures package to LNG carrier operators transporting cargo from the terminal that consists of multiple measures to avoid striking marine mammals, which should also benefit sea turtles; and

- noise produced by LNG carriers would contribute to overall noise levels within the marine analysis area en route to the Port of Coos Bay and effects of ship noise on sea turtles could exceed NMFS interim noise exposure criteria for Level B single non-pulse noise (NMFS 2016a, 2017f, 2018), but would not exceed existing background ship noise levels and would not cause injury.

Critical Habitat

The Project would have **no effect** on critical habitat for the green turtle because none occurs on the U.S. Pacific Coast.

3.4.2 Leatherback Turtle

3.4.2.1 Species Account and Critical Habitat

Status

Leatherback turtles were listed as endangered under the ESCA on December 2, 1970 (FWS 1970) and have been listed under the ESA since its implementation in 1973. NMFS (2017e) recognizes two subpopulations of Pacific leatherback turtles, Eastern and Western. Eastern Pacific leatherbacks nest along the Pacific coast of the Americas in Mexico and Costa Rica whereas Western Pacific leatherbacks nest in the Indo-Pacific and migrate back to feeding areas off the Pacific coast of North America including the coast of Oregon (NMFS 2017e).

Threats

The NMFS and FWS (1998b) cited 22 general threats to leatherbacks; however, egg collection and bycatch in fishing gear are the primary reasons for the declines in Pacific leatherback turtle populations. Other threats include ingestion of debris, primarily plastics and plastic bags that are thought to be mistaken for jellyfish and eaten, leading to esophagus and stomach blockage and eventually death (Mrosovsky et al. 2009; Plotkin 1995). These deaths, and the evidence for this type of death by this specific type of ingestion, appear to be on the rise (Schuyler et al. 2013). Threats at nesting grounds outside the United States still remain from collection of eggs and development along coastal areas. In addition, artificial light (during egg hatch viewing) causes confusion of newly hatched turtles that head in the direction of the light rather than out to sea (Plotkin 1995; FWS 2012g; NMFS and FWS 1998b). Climate change is an emerging and major threat to the conservation and recovery of leatherbacks (NMFS and FWS 2013a).

Species Recovery

NMFS issued a recovery plan for the U.S. Pacific Coast population on May 22, 1998. The recovery goal (NMFS and FWS 1998b) is to delist the species, and the plan listed the following necessary actions:

- Eliminate incidental take of leatherbacks in United States and international commercial fisheries.
- Support the efforts of Mexico and the countries of Central America to census and protect nesting leatherbacks, their eggs, and nesting beaches.
- Determine movement patterns, habitat needs, and primary foraging areas for the species throughout its range.
- Determine population size and status in U.S. waters through regular aerial or on-water surveys.

- Identify stock home ranges using DNA analysis.

The stepdown outline in the recovery plan included the following recommendations:

- Protect and manage turtles on nesting beaches.
- Protect and manage nesting habitat.
- Protect and manage leatherback turtle populations in the marine habitat.
- Protect and manage marine habitat, including foraging habitats.
- Support existing international agreements and conventions to ensure that turtles in all life-stages are protected in foreign waters.
- Encourage ratification of CITES for all non-member Pacific countries, compliance with CITES requirements, and removal of sea turtle trade reservations held by member nations.
- Develop new international agreements to ensure that turtles in all life-stages are protected in foreign waters.
- Develop or continue to support informational displays in airports that provide connecting legs for travelers to the areas where leatherbacks occur.

Life History, Habitat Requirements, and Distribution

The leatherback is the largest, most migratory, and widest ranging of all extant sea turtles (NMFS 2017e). Leatherback sea turtle nesting grounds are located around the world, with the largest remaining nesting assemblages found on the coasts of northern South America and West Africa. Adult leatherback sea turtles are capable of tolerating a wide range of water temperatures, and have been sighted as far north as the Gulf of Alaska (NMFS and FWS 2007a). Their diet consists of soft-bodied prey, such as jellyfish and tunicates. Nesting occurs on sandy tropical beaches, with each female laying several clutches at intervals of 8 to 12 days. Mating occurs in the waters adjacent to nesting beaches within migration corridors. After nesting, female leatherbacks migrate from tropical waters to more temperate latitudes, which support high densities of jellyfish prey in the summer (NMFS and FWS 1998b). Incubation of eggs takes between 55 and 75 days, and hatching occurs at night. Sexual maturity is reached between 6 and 10 years (FWS 2012g). No known nesting locations occur on the U.S. Pacific Coast.

NMFS (2012d) defined nine geographic areas along the continental U.S. Pacific Coast from Washington to Northern California that are occupied by leatherback turtles. Areas 2 and 3 include nearshore waters from Point Arena in northern California to Cape Flattery in Washington, extending offshore to the 2,000-meter isobath. Area 2 (Cape Blanco to Cape Flattery) includes most of the Oregon coast and is a principal foraging area for leatherbacks. They feed on a variety of moon jellies and brown sea nettles that are present in high densities associated with the Columbia River Plume and Heceta Bank, Oregon (NMFS 2012d). Areas 4 and 5 extend offshore west of Areas 2 and 3 to the EEZ. Jellyfish densities in those areas are unknown and likely serve as secondary foraging areas and areas of passage to the primary foraging region in Area 2. The marine analysis area is located within Area 2.

Population Status

In recent decades, Western Pacific leatherbacks have declined more than 80 percent (NMFS 2017e). Turtles foraging along the California coast are part of the Western Pacific subpopulation (Harris et al. 2011), and the same is assumed for leatherbacks foraging along the Oregon and Washington coasts. Between 1984 and 2011, there was an overall significant decline of 78 percent in the number of leatherback turtle nests monitored in Papua Barat, Indonesia (Tapilatu et al. 2013). Approximately 75 percent of the leatherbacks nesting in the western Pacific nest at Papua Barat. In the Pacific, the International Union for Conservation of Nature estimated that leatherback turtle populations have declined by 80 percent over three generations (Wallace et al. 2013).

Critical Habitat

Critical habitat was established for the Atlantic population in the U.S. Virgin Islands on March 23, 1979 (NMFS 1979). NMFS designated critical habitat for the Pacific population in 2012 (77 *Federal Register* 4170), designating approximately 16,910 square miles as critical habitat for leatherback turtles along the California coast from Point Arena to Point Arguello and 25,004 square miles along the Washington and Oregon coasts from Cape Blanco, Oregon to Cape Flattery, Washington (NMFS 2012d).

NMFS (NMFS 2012d) originally identified two primary constituent elements (PCEs) to determine areas proposed as critical habitat for the Pacific population of leatherbacks: 1) occurrence of prey species, primarily jellyfish, of sufficient condition, distribution, diversity, and abundance to support individual as well as population growth, reproduction and development; and 2) migratory pathway conditions to allow for safe and timely passage and access to/from/within high use foraging areas. However, NMFS subsequently eliminated the second PCE, an identified migratory pathway. In the final designation, there is only one PCE, occurrence of prey species, primarily scyphomedusae of the order Semaeostomeae (especially brown sea nettles [*Chrysaora fuscescens*]) of sufficient condition, distribution, diversity, abundance and density necessary to support individual as well as population growth, reproduction, and development of leatherbacks.

3.4.2.2 Environmental Baseline

Analysis Area

The analysis area applicable to leatherback turtles is the area directly off Coos Bay out to the continental shelf break, which is represented as a depth of 200 meters. This is the same as the marine analysis area described above for green turtles and blue whales (see figure 3.2.1-1).

Species Presence

The leatherback sea turtle is the most common sea turtle in U.S. waters north of Mexico (NMFS and FWS 1998b). Leatherbacks occur as far north as Alaska, and numerous sightings have been documented off the Oregon coast. Green et al. (1992) observed 16 Pacific leatherback turtles off the Oregon and Washington coasts, all of them north of a point due west of Pacific City in Tillamook County, Oregon. Sixty-two percent of the sightings occurred over the continental slope, with the remainder occurring over the continental shelf. Incidental catch of leatherback turtles has also occurred in gill-nets off the coasts of Washington, Oregon, and California. Of 104 records of sea turtle strandings on the continental U.S. Pacific Coast between 1982 and 1991, 50 were leatherbacks (NMFS and FWS 1998b). No attempt has yet been made to assess the status of foraging populations. Despite occasional reports of leatherbacks sighted at sea, and a growing database documenting their incidental catch in coastal and pelagic fisheries, there are very few areas where the species is routinely encountered. An exception is Monterey Bay, California (NMFS and FWS 1998b).

Habitat

Adult leatherback turtles are highly migratory, and available information indicates that eastern Pacific migratory corridors exist along the U.S. Pacific Coast (NMFS and FWS 1998b). The continental U.S. Pacific Coast may represent some of the most important foraging habitat in the world for the leatherback turtle (NMFS and FWS 1998b). Therefore, the marine analysis area is assumed to provide important habitat for leatherback turtles. Coastal upwelling of the California Current occurs along the Oregon Coast north of Cape Blanco. Peak numbers of leatherback turtles (July to September) occur in neritic zones when there are intermittent decreases in upwelling that allow surface water temperatures to increase to their warmest annual levels. Leatherback turtles aggregate in the warm, highly productive coastal areas to forage on their preferred prey, scyphomedusae, the cnidarian jellies (NMFS 2012d).

Critical Habitat

Critical habitat occurs in nearshore waters through which LNG carriers would transit to Coos Bay and the LNG Project.

3.4.2.3 Effects of the Proposed Action

Direct and Indirect Effects

<u>Ship Strikes by LNG Carriers</u>

Sea turtles can be injured or killed when struck by a boat, especially if struck by an engaged propeller (NMFS and FWS 1998b). The proposed action would result in increased shipping traffic and may increase potential vessel strikes to leatherback sea turtles within the marine analysis area. While Harris et al. (2011) reports 2 of 19 leatherback turtles examined had multiple parallel lacerations in the carapaces that had healed and were consistent with wounds from boat propellers, boat collisions are not listed as a current threat to the recovery of leatherback populations (NMFS 2017e). Risk of collision increases with increased vessel speed (Hazel et al. 2007), as discussed for green sea turtles, above.

The addition of 240 LNG carrier transits through the marine analysis area may result in ship strike-related mortality or injury to leatherback turtles. The paucity of documented ship-strike incidences to sea turtles in general or frequencies of collision precludes any quantification of effects to leatherback turtles of additional vessel traffic due to LNG carriers. However, although the proposed action could result in additional potential for ship strike-related mortality or injury, these incidents are still expected to be rare occurrences, and thus the effects on leatherback turtles are discountable.

<u>Underwater Noise</u>

Loggerhead sea turtle hearing is most sensitive to lower frequencies below 1,000 Hz (Bartol et al. 1999; Martin et al. 2012; Dow Piniak et al. 2012), within the same range of low frequencies generated by ships and sounds generated by large baleen whales (Würsig and Richardson 2009). As with green sea turtles, the same hearing sensitivity is assumed to be the case for leatherback turtles, and the effects are expected to be similar. See section 3.4.1, Green Turtle, above for a full discussion of these effects. With the existing levels of background shipping noise and the expected increase in shipping traffic, effects by LNG carrier-related noise on leatherback sea turtles are possible in the marine analysis area, but the noise would be commensurate with existing noise levels and would not be expected to cause injury or any measurable effect.

Fuel Spills

Fuel or lubricants spilled from LNG carriers at sea, or released during normal operations such as bilge tank flushing, could impact both leatherback turtles and their jellyfish prey. Known effects of oil on turtles include direct mortality due to oiling in hatchlings, juveniles, and adults, and negative impacts to the skin, blood, digestive and immune systems, and salt glands (Milton et al. 2010). As described in section 3.4.1.3 for green turtles, direct effects of potential spills from LNG carriers are not comparable to spills from oil tankers because LNG carriers only carry quantities of oil used for propulsion fuel and not the quantities transported by oil tankers. However, low-level exposure to oil may still affect sea turtles, although effects related to specific toxicity levels have not been determined (Milton et al. 2010).

NMFS (2012d) identified LNG projects and oil spills as activities that may affect leatherback turtle prey within Area 2, which coincides with the nearshore habitat that would be transited by Project LNG carriers. Fuel and oil spilled by LNG carriers has the potential to affect leatherback turtles by altering prey abundance and prey contamination levels. However, as discussed above under green turtles, LNG carriers calling on the LNG Project would be required to comply with U.S. and International regulations regarding spill prevention. As a result, LNG carriers are not likely to contribute oil, fuel, or lubricants to the marine analysis area to the extent that would adversely affect leatherbacks or their prey species.

Critical Habitat

The single PCE for this leatherback turtle critical habitat is the occurrence of prey species, primarily jellyfish, of sufficient condition, distribution, diversity, and abundance to support individual as well as population growth, reproduction, and development (NMFS 2012d).

The proposed action could affect this PCE within critical habitat in the marine analysis area if a fuel or lubricant spill occurred from a LNG carrier. As discussed above under fuel spills, NMFS (2012d) identified LNG projects and oil spills as activities that may affect the PCE by altering prey abundance and prey contamination levels. However, with their spill prevention measures, LNG carriers are not likely to contribute oil, fuel, or lubricants to the marine analysis area to the extent that would adversely affect leatherback prey species. Fuels and lubricants are kept in relatively small quantities on ships and would not result in the types of effects associated with a spill from an oil tanker.

NMFS (2009d) stated that "Dredging and filling associated with construction and maintenance (to allow tanker passage) could have impacts on benthic habitat and possibly the early life stages of leatherback prey resources." However, the leatherback's prey species are open-ocean, broadcast spawners with pelagic larvae. There is no information in the literature that suggests the larvae would preferentially enter Coos Bay estuary, and if they did, there is likely nothing that would cause them to preferentially settle at the LNG Project. Also, Shanks et al. (2010 and 2011) did not report collection of significant numbers of larval scyphozoans that would support the polypoid stage of the jellyfish commonly consumed offshore by leatherback turtles. Given the aerial extent available for larval settlement and polyp development along the Oregon and Washington coast, the loss of substrate from the dredging for the LNG Project footprint would have no impact on leatherback foodstocks.

For the same reason that dredging would not measurably impact the larval stages of leatherback turtle's foods, noise levels associated with construction would also not measurably impact these life stages, and would therefore have no impact on leatherback food sources.

3.4.2.4 Conservation Measures

No specific conservation measures have been proposed for the sea turtles.

3.4.2.5 Determination of Effects

Species

The Project **may affect** leatherback turtles because:

- leatherback turtles may occur within the marine analysis area during operation of the proposed action;
- the proposed action would increase shipping traffic (LNG carriers) within the marine analysis area; and
- the continental U.S. Pacific Coast provides important foraging habitat for this species.

However, the Project is **not likely to adversely affect** leatherback turtles because:

- there is limited evidence that leatherback turtles have been struck by ships, and a measurable increase in collision potential as a result of the proposed action is expected to be highly unlikely;
- Jordan Cove would provide a ship strike avoidance measures package to LNG carrier operators transporting cargo from the terminal that consists of multiple measures to avoid striking marine mammals, which should also benefit sea turtles; and
- noise produced by LNG carriers would contribute to overall noise levels within the marine analysis area en route to the Port of Coos Bay and effects of ship noise on sea turtles could exceed NMFS interim noise exposure criteria for Level B single non-pulse noise (NMFS 2016a, 2017f, 2018), but would not exceed existing background ship noise levels and would not cause injury.

Critical Habitat

The Project **may affect** critical habitat for the leatherback turtle because:

- critical habitat coincides with nearshore waters in the marine analysis area through which LNG carriers would transit to Coos Bay and the LNG terminal.

However, the Project is **not likely to adversely affect** critical habitat for the leatherback turtle because:

- LNG carriers and the Jordan Cove LNG Project are not likely to contribute oil, fuel, lubricants, or other contaminants to critical habitat to the extent that would adversely affect the occurrence of prey species, primarily jellyfish, of sufficient condition, distribution, diversity, and abundance to support individual as well as population growth, reproduction, and development (PCE 1); and

- disturbance of benthic habitats within Coos Bay due to dredging would be of sufficiently short duration and small scale relative to the area available for settlement of larvae of the scyphozoan prey species within Area 2 that effects on PCE 1 would be unmeasurable and would therefore be insignificant.

3.4.3 Olive Ridley Turtle

3.4.3.1 Species Account and Critical Habitat

Status

Olive ridley turtles were listed as threatened, except for the breeding colony populations on the Pacific coast of Mexico, which were listed as endangered, under the ESA on July 28, 1978 (FWS 1978).

Threats

Direct threats to the species include the harvesting of sea turtles and their eggs and incidental capture in fishing gear (NMFS 2017g). Natural disasters, debris entanglement and ingestion, and incidental take from domestic fisheries are listed as minor threats to olive ridley turtles (NMFS and FWS 1998c). Primary threats to olive ridley turtles off the continental U.S. Pacific Coast include incidental take from commercial fishing and boat collisions usually involving smaller boats (NMFS and FWS 1998c). The more frequent occurrence of El Niño and general warming trends in the Pacific may be the reason that the zooplankton in the California Current are declining, resulting in the reduction of higher level vertebrates and other foods for the turtles to forage on (Plotkin 1995).

Species Recovery

A recovery plan was issued in 1998. The recovery goal (NMFS and FWS 1998c) is to delist the species, and the plan listed the following necessary actions:

- Minimize incidental mortalities of turtles by commercial fishing operations.
- Support the efforts of Mexico and the countries of Central America to census and protect nesting olive ridleys, their eggs, and nesting beaches.
- Identify stock home ranges using DNA analysis.

The stepdown outline in the recovery plan included the following recommendations:

- Protect and manage turtles on nesting beaches.
- Protect and manage nesting habitat.
- Protect and manage olive ridley populations in the marine habitat.
- Protect and manage marine habitat, including foraging habitats.
- Develop standards for the care and maintenance of sea turtles, including diet, water quality, tank size, and treatment of injury and disease.
- Establish a catalog of all captive sea turtles to enhance use for research and education.
- Designate rehabilitation facilities.
- Support existing international agreements and conventions to ensure that turtles in all life-stages are protected in foreign waters.

- Encourage ratification of CITES for all non-member Pacific countries, compliance with CITES requirements, and removal of sea turtle trade reservations held by member nations;
- Develop new international agreements to ensure that turtles in all life-stages are protected in foreign waters.
- Develop or continue to support informational displays in airports that provide connecting legs for travelers to the areas, which support olive ridleys.

Life History, Habitat Requirements, and Distribution

The olive ridley is primarily a pelagic sea turtle, but does occasionally inhabit coastal areas such as bays and estuaries. Olive ridleys undertake an annual migration from open-ocean foraging grounds to coastal breeding and nesting grounds. Olive ridley turtles are well known for their arribada behavior where hundreds to tens of thousands of ridley turtles emerge synchronously from the ocean over a few days to nest in close proximity (NMFS 2017g).

Olive ridleys have been observed as far as 2,400 miles from shore. Adult turtles are small compared to other sea turtles, with an average weight of approximately 100 pounds. The olive ridley feeds on a variety of food items, including algae, lobster, crabs, tunicates, mollusks, shrimp, and fish. Females nest each year after reaching sexual maturity at about age 15. They nest one to three times per season, producing clutches of approximately 100 eggs each time. Incubation of the eggs generally takes between 50 and 60 days.

Population Status

The olive ridley is considered the most abundant sea turtle in the world, with an estimated 800,000 females nesting annually. However, there has been an estimated 50 percent reduction in population since the 1960s (Marine Turtle Specialist Group 2004 in NMFS 2017g). The eastern Pacific population that nests in El Salvador, Guatemala, Costa Rica, and Panama has declined since the 1970s. However, since Mexico banned harvest of nesting females and eggs, the nesting population at La Escobilla, Oaxaca, Mexico increased from 50,000 nests in 1988 to more than 1 million nests in 2000 (NMFS 2017g). At-sea estimates of density and abundance of olive ridley turtles were conducted along the Mexico and Central American coasts from 1992 to 2006. The yearly weighted average was 1.39 million in the eastern Pacific and consistent with increased nesting prior to 2007 (NMFS and FWS 2007b).

Critical Habitat

Critical habitat has not been designated for this species.

3.4.3.2 Environmental Baseline

Analysis Area

The analysis area applicable to olive ridley turtles is the area directly off of Coos Bay out to the continental shelf break, which is represented as a depth of 200 meters. This is the same marine analysis area as described above for green sea turtles and blue whales (see figure 3.2.1-1).

Species Presence

At-sea occurrences in waters under U.S. jurisdiction are limited to the west coast of the continental United States and Hawaii, where the species is rare but possibly increasing. This species does not nest in the United States, but during feeding migrations, olive ridley turtles nesting in the East

Pacific may disperse into waters off the Pacific west coast as far north as Oregon (FWS 2013g). Olive ridleys have occasionally been killed by gill-nets and boat impacts as well as cold-stunning (or cold-stranding due to hypothermia by rapid decline of water temperatures) in Oregon and Washington (NMFS and FWS 1998c). Based on sightings off the Oregon coast, olive ridley turtles may occasionally occur in the marine analysis area.

Habitat

Little is known about the abundance and distribution of olive ridley turtles in the northeastern Pacific. Important foraging grounds have not been identified although forage areas most likely exist along the coast of Baja California and southern California (NMFS and FWS 1998c). Less is known about the potential importance of Oregon waters and the marine analysis area to olive ridley turtles.

Critical Habitat

Critical habitat has not been designated for this species.

3.4.3.3 Effects of the Proposed Action

Direct and Indirect Effects

Ship Strikes by LNG Carriers

The proposed action would result in increased shipping traffic. Although olive ridley turtles are generally transient in the area, the potential for a ship strike would increase; however, the likelihood of a ship strike is discountable.

Boat collisions are listed as a moderate problem for olive ridley turtle recovery off the continental U.S. Pacific Coast (NMFS and FWS 1998c). Sea turtles can be injured or killed when struck by a boat, especially by an engaged propeller. Risk of collision with sea turtles increases with increased vessel speed (Hazel et al. 2007), as discussed for green sea turtles, above. However, methods for reducing boat collisions are not included in recovery objectives, and based on their warm water requirements, olive ridley sea turtles are likely only occasional, transient visitors to waters as far north as Oregon. Given the low population and occurrence of the olive ridley turtles in Oregon coastal waters and current estimate of vessel traffic, the addition of 240 LNG carrier transits through the marine analysis area is not expected to result in measurable additional ship strike-related mortality or injury to olive ridley turtles.

Underwater Noise

The same hearing sensitivity as noted for green sea turtles is assumed for olive ridley turtles, and the effects are expected to be similar. See section 3.4.1, Green Turtle, above for a full discussion of these effects. With the existing levels of background shipping noise and the expected increase in shipping traffic, effects by LNG carrier–related noise on olive ridley turtles are possible in the marine analysis area but the noise would be commensurate with existing noise levels and would not be expected to cause injury.

Fuel Spills

Oil, fuel, or lubricant spills from an LNG carrier at sea could impact both olive ridley turtles and forage species such as benthic invertebrates and fish as described above for green turtles. However, these products are kept in relatively small quantities onboard LNG carriers. Additionally, LNG carriers carry spill kits to prevent or minimize the release of oil, fuel, and lubricants as described under blue whales in section 3.2.1.3. As a result, effects of oil, fuel, and lubricants on olive ridley turtles are expected to be insignificant and discountable.

Critical Habitat

No critical habitat would be affected by the proposed action as none has been designated.

3.4.3.4 Conservation Measures

No specific conservation measures have been proposed for the sea turtles.

3.4.3.5 Determination of Effects

Species

The Project **may affect** olive ridley turtles because:

- olive ridley turtles may infrequently occur within the marine analysis area during operation of the proposed action; and
- the proposed action would increase shipping traffic (LNG carriers) within the marine analysis area.

However, the Project is **not likely to adversely affect** olive ridley turtles because:

- the increase in annual ship traffic due to the proposed action is expected to cause an immeasurable increase for potential ship strikes to olive ridley turtles;
- Jordan Cove would provide a ship strike avoidance measures package to LNG carrier operators transporting cargo from the terminal that consists of multiple measures to avoid striking marine mammals, which should also benefit sea turtles; and
- noise produced by LNG carriers would contribute to overall noise levels within the marine analysis area en route to the Port of Coos Bay and effects of ship noise on sea turtles could exceed NMFS interim noise exposure criteria for Level B single non-pulse noise (NMFS 2016a, 2017f, 2018), but would not exceed existing background ship noise levels and would not cause injury.

Critical Habitat

No critical habitat has been designated or proposed for the olive ridley turtle.

3.4.4 Loggerhead Turtle

3.4.4.1 Species Account and Critical Habitat

Status

Loggerhead turtles were listed as threatened under the ESA in 1978 (FWS 1978). In 2011, NMFS (2011e) published a final rule in which the agencies determine loggerhead sea turtles are composed of nine DPSs distributed worldwide; four DPSs are listed as threatened and five are listed as endangered. The North Pacific Ocean DPS is listed as endangered (NMFS 2017h).

Threats

The two biggest threats to the loggerhead turtle are incidental capture in fishing gear and directed harvesting. There is no information about direct harvest of the loggerhead turtle, although is it assumed to be nonexistent in the continental U.S. Pacific Coast because of the species' rarity. Direct harvest occurs in the Bahamas, Cuba, and Mexico as well as incidental capture of turtles in commercial fishing gear (NMFS 2017h).

The primary threats to loggerhead turtles on the continental U.S. Pacific Coast include natural disasters and incidental take from commercial fishing operations (NMFS and FWS 1998d). Other threats to loggerhead turtles include environmental contaminants, debris entanglement and ingestion, power plant entrapment (i.e., entrainment and entrapment of juvenile and sub-adult loggerhead turtles in the saltwater cooling intake systems of coastal power plants), predation, boat collision, and oil exploration and development (NMFS and FWS 1998d). Dredging is also listed as a potential threat to loggerhead turtles (Plotkin 1995).

Species Recovery

A recovery plan was issued on May 22, 1998 (NMFS and FWS 1998d). The recovery goal is to delist the species, and the plan listed the following necessary actions:

- Reduce incidental capture of loggerheads by coastal and high seas commercial fishing operations.
- Establish bilateral agreements with Japan and Mexico to support their efforts to census and monitor loggerhead populations and to minimize impacts of coastal development and fisheries on loggerhead stocks.
- Identify stock home ranges using DNA analysis.
- Determine population size and status (in U.S. jurisdiction) through regular aerial or on-water surveys.
- Identify and protect primary foraging areas for the species.

The stepdown outline in the recovery plan included the following recommendations:

- Protect and manage turtles on nesting beaches.
- Protect and manage nesting habitat.
- Protect and manage loggerhead populations in the marine habitat.
- Protect and manage marine habitat, including foraging habitats.
- Develop standards for the care and maintenance of sea turtles, including diet, water quality, tank size, and treatment of injury and disease.
- Establish a catalog of all captive sea turtles to enhance use for research and education.
- Designate rehabilitation facilities.
- Support existing international agreements and conventions to ensure that turtles in all life-stages are protected in foreign waters.
- Encourage ratification of CITES for all non-member Pacific countries, compliance with CITES requirements, and removal of sea turtle trade reservations held by member nations.
- Develop new international agreements to ensure that turtles in all life-stages are protected in foreign waters.

- Develop or continue to support informational displays in airports and other ports of call that provide connecting legs for travelers to the area.

Life History, Habitat Requirements, and Distribution

Loggerhead turtles occur throughout temperate and tropical regions of the Atlantic, Pacific, and Indian Oceans. They are the most abundant sea turtle found in U.S. coastal waters, although they are much more prevalent on the Atlantic than Pacific Coasts, with major nesting areas being present in Florida. In the North Pacific, loggerhead nesting has only been documented in Japan but may also occur on beaches of the South China Sea (NMFS 2011e). Turtles hatching on Japanese beaches enter the Kuroshio and North Pacific Currents and develop during migration; some reach the eastern Pacific and Baja California. Foraging areas have been documented off the coast of Baja California, Mexico (NMFS 2011e). Adult loggerheads typically prey on benthic invertebrates in hard bottom habitats, although fish and plants are occasionally taken (NMFS and FWS 1998d). Evidence indicates that loggerhead turtles hatching in Japan remain in the North Pacific Basin for their entire life cycle, never crossing the equator into the South Pacific Basin (NMFS 2011e).

Loggerheads reach sexual maturity at around 35 years of age. In the southeastern United States, mating occurs in late March to early June and females lay eggs between late April and early September. Females generally lay three to five nests per season. The eggs incubate approximately 2 months before hatching between late June and mid-November. Hatchlings move from their nest to the surf, swim and are swept through the surf zone, and continue swimming away from land for about one to several days. Post-hatchlings within this habitat are float-and-wait foragers feeding on a wide variety of floating food items. From these relatively nearshore habitats, juvenile turtles are swept into the open ocean by currents. Between the ages of 7 and 12 years, oceanic juveniles migrate to nearshore coastal areas where they remain until reaching adulthood.

Population Status

In the United States, loggerhead turtles lay an estimated 68,000 to 90,000 eggs per year on the east and Gulf coasts. There is no known nesting of loggerhead turtles on the U.S. Pacific Coast. Occasional cold-strandings occur in Washington and Oregon and incidental take by fisheries probably occurs (NMFS and FWS 1998d). In the eastern Pacific, loggerheads have been reported as far north as Alaska. In the U.S., occasional sightings are reported from the coasts of Washington and Oregon, but most records are of juveniles off the coast of California. The west coast of Mexico, including the Baja Peninsula, provides critically important developmental habitats for juvenile loggerheads. Records of females in the North Pacific Oceans DPS nesting on Japanese beaches indicate numbers increased from the late 1990s through 2005 but declined in 2006 and 2007 (Conant et al. 2009).

Critical Habitat

Critical habitat has not been designated for this DPS.

3.4.4.2 Environmental Baseline

Analysis Area

The analysis area applicable to loggerhead turtles is the area directly off Coos Bay out to the continental shelf break, which is represented as a depth of 200 meters. This is the same marine analysis area as described above for green turtles and blue whales (see figure 3.2.1-1).

Species Presence

Loggerhead turtles are rarely sighted along the Pacific Coast near the Project area. Individuals found in western U.S. Pacific Coast waters likely originate on Japanese nesting grounds (NMFS and FWS 1998d). In the United States, occasional sightings are reported from the coasts of Washington and Oregon, but most records are of juveniles off the coast of California. The most recent record of a loggerhead in Oregon waters was on February 13, 2017 of a nearly comatose individual that died shortly after being rescued by the Oregon Coast Aquarium (KCBY 2017). Therefore, based on sightings and documented strandings, loggerhead turtles are likely infrequent visitors to the marine analysis area. The California/Oregon (CA/OR) drift gillnet fishery (for swordfish and thresher shark) was observed to incidentally capture 17 loggerheads (12 released alive, one injured, and four killed) from 1990 to 2000. Based on a worst-case scenario, NMFS estimated that a maximum of 33 loggerheads in a given year are possibly incidentally taken by the CA/OR drift gillnet fleet (Conant et al. 2009).

Habitat

The fact that juveniles are captured incidentally in longlines and driftnets in the pelagic Pacific indicates that the species' range includes coastal and pelagic waters (NMFS and FWS 1998d). The potential importance of Oregon waters and the marine analysis area to loggerhead turtles is unknown. Loggerheads are likely to move into the U.S. Pacific coast from Baja California as they follow preferred prey species, the pelagic red crab (Conant et al. 2009).

Critical Habitat

Critical habitat has not been designated for this DPS.

3.4.4.3 Effects of the Proposed Action

Direct and Indirect Effects

<u>Ship Strikes by LNG Carriers</u>

The proposed action would result in increased shipping traffic. Although olive ridley turtles are generally transient in the area, the potential for a ship strike would increase; however, the likelihood of a ship strike is discountable.

Given the low population and occurrence of the loggerhead turtles in Oregon coastal waters and current estimate of vessel traffic, the addition of 240 LNG carrier transits through the marine analysis area is not expected to result in measurable additional ship strike-related mortality or injury to loggerhead turtles.

<u>Underwater Noise</u>

Loggerhead sea turtles can detect sound and their hearing is most sensitive to lower frequencies below 1,000 Hz (Bartol et al. 1999; Martin et al. 2012), within the same range of low frequencies generated by ships and sounds generated by large baleen whales (Würsig and Richardson 2009). Effects of underwater noise to loggerhead sea turtles are expected to be similar to those described above under the green turtle (section 3.4.1). With the existing levels of background shipping noise, effects by project LNG tanker-related noise on loggerhead sea turtles are possible in the marine analysis area but the noise would be commensurate with existing noise levels and would not be expected to cause injury.

Fuel Spills

Environmental contaminants are listed as a minor threats to loggerhead turtles on the continental U.S. Pacific Coast (NMFS and FWS 1998d). Oil, fuel, or lubricant spills from an LNG carrier at sea could impact both loggerhead turtles and forage species such as benthic invertebrates and fish as described above for green turtles. However, these products are kept in relatively small quantities onboard LNG carriers. Additionally, LNG carriers carry spill kits to prevent or minimize the release of oil, fuel, and lubricants as described under blue whales in section 3.2.1.3. As a result, effects of oil, fuel, and lubricants on loggerhead turtles are expected to be insignificant and discountable.

Dredging

Loggerhead turtles are not likely to occur either offshore or within Coos Bay; therefore, dredging activities would not affect loggerhead individuals or have an effect on the population of loggerheads.

Critical Habitat

No critical habitat would be affected by the proposed action because none has been designated.

3.4.4.4 Conservation Measures

No specific conservation measures have been proposed for the sea turtles.

3.4.4.5 Determination of Effects

Species

The Project **may affect** loggerhead turtles because:

- loggerhead turtles may infrequently occur within the analysis area during operation of the proposed action; and
- the Project would increase shipping traffic (LNG carriers) within the analysis area.

However, the Project is **not likely to adversely affect** loggerhead turtles because:

- ship strike on loggerhead turtles would be highly unlikely;
- Jordan Cove would provide a ship strike avoidance measures package to LNG carrier operators transporting cargo from the terminal that consists of multiple measures to avoid striking marine mammals, which should also benefit sea turtles; and
- noise produced by LNG carriers would contribute to overall noise levels within the marine analysis area en route to the Port of Coos Bay and effects of ship noise on sea turtles could exceed NMFS interim noise exposure criteria for Level B single non-pulse noise (NMFS 2016a, 2017f, 2018), but would not exceed existing background ship noise levels and would not cause injury.

Critical Habitat

No critical habitat has been designated or proposed for the loggerhead turtle.

3.4.5 Oregon Spotted Frog

3.4.5.1 Species Account and Critical Habitat

Status

The Oregon spotted frog was listed as threatened under the ESA in August 2014 (FWS 2014e).

Threats

Oregon spotted frogs may be extirpated from as much as 90 percent of their historically documented range including all historical locations in California (FWS 2014e). Thirty to 85 percent of the species' wetland habitats have been lost across its range. Sources of loss include draining wetlands, water diversions, conversion of wetlands to agriculture and livestock grazing, developments adjacent to occupied habitats that alter seasonal hydrology (through creation of impervious surfaces), and occurrence of droughts which have become more frequent in parts of the species' range. Additionally, introductions of exotic species, including reed canarygrass that degrades native wetland vegetation, and nonnative predators including bullfrogs and warm water fish species have been and continue to threaten the species. Chytrid fungus infections have been documented in Oregon spotted frog populations in all of the sites sampled, including five sites located in the Klamath Basin (Pearl et al. 2009). Declines in various amphibian populations have been associated with fungal infections and may have contributed to the demise of Oregon spotted frog populations although some populations appear to be resistant (Padgett-Flohr and Hayes 2011). There may be additional pathogens that affect Oregon spotted frogs (FWS 2013i).

Species Recovery

The species has been listed as threatened; however, no recovery plan has been published. A Conservation Agreement to conserve Oregon spotted frogs in the Klamath Basin has been developed by the FWS, Forest Service, and BLM (FWS et al. 2010) with the objectives to:

> *1) manage occupied habitat in a manner that sustains and/or restores its ability to support Oregon spotted frog populations; 2) stabilize or increase populations within the Klamath Basin; 3) reduce threats; and 4) increase distribution among available suitable habitats by restoring or creating habitat.*

Implementing the conservation agreement has focused on a bullfrog eradication program on Crane Creek since bullfrogs appeared in 2010, and controlling and reducing bullfrogs and analyzing the gut contents of bullfrogs at all life stages on BLM lands at Wood River. Although the number of bullfrogs removed and seen at that site has decreased, bullfrog removal has also focused on areas outside the Oregon spotted frog site that are considered to be the strongest source areas for movement into the Oregon spotted frog site (FWS 2013i). Despite these efforts, bullfrogs continue to persist in these Oregon spotted frog habitats in the Klamath Basin (FWS 2013i).

Life History, Habitat Requirements, and Distribution

The current range of Oregon spotted frogs extends from the Fraser River subbasin in southern British Columbia (Haycock 2000) and adjacent areas in Whatcom County, Washington, south through the Puget Trough lowlands, through the Willamette Valley, to southeast Oregon including

Jackson and Klamath Counties, and adjacent areas in the Pit River subbasin of northern California (FWS 2011e).

Spotted frogs inhabit perennial waterbodies such as springs, ponds, lakes, or slow-moving streams and are usually associated with nonwoody, herbaceous wetland vegetation communities composed of sedges, rushes, and grasses (Leonard et al. 1993). Several aspects of the Oregon spotted frog's life history have been proposed as contributing to the species' vulnerability to habitat alterations (FWS 2011e): 1) communal egg laying at sites used year after year restricts the number of reproductive sites; 2) the species' warm water requirement results in habitat overlap with introduced warm water fish; 3) the active season warm water requirement may limit suitable habitat in the cool climates of the Pacific Northwest; 4) the species may be vulnerable to the potential loss or alteration of springs used for overwintering; and 5) changes that increase deep, permanent water components are likely to favor establishment of non-native bullfrogs and fish, both of which may be detrimental to Oregon spotted frogs.

In lower elevations of Washington and Oregon, breeding occurs during February and March; at higher elevations breeding occurs in late May or early June (Leonard et al. 1993). Oregon spotted frogs typically oviposit communally; males may gather in large groups at a location and females lay eggs adjacent to or attached to other egg masses which are only partially submerged. These aggregations can contain eggs from 100 or more females in larger populations (FWS 2011e). Spotted frogs use traditional oviposition sites, year after year. Such sites may have limited availability because of unique characteristics and adults may have limited flexibility to switch sites if they become unsuitable. That possibility makes the Oregon spotted frog particularly vulnerable to habitat changes at oviposition sites (FWS 2011e).

Population Status

Population estimates in most subbasins inhabited by Oregon spotted frogs are insufficient to derive any trends (FWS 2013i). The best available information indicates declining populations in the lower Fraser River in British Columbia and Middle Klickitat subbasin in Washington, but an undetermined trend in Oregon (FWS 2013i).

In 2012, there were an estimated 7,368 breeding adults at five extant population sites in Washington and 12,847 breeding adult Oregon spotted frogs at 8 extant population sites in Oregon (FWS 2014e). In Oregon, the species' extant distribution includes 22 sites in the Central Oregon Cascades (with the largest population of 500 to 2,500 breeding females at two sites) and nine sites in the Klamath Basin (FWS 2011e). In 2005, personnel with the Forest Service surveyed 28 different sites in Lake, Klamath, and Jackson Counties but no new Oregon spotted frogs were found. Data from the Klamath Basin suggest that one population has declined since 2000, two populations appear stable, and five sites do not have enough data to determine trend, including the Buck Lake site. However, FWS (2014e) note that surveys conducted at Buck Lake suggest a population decline and have documented most recently small numbers of egg masses (38 masses in 2010), or the equivalent of 76 breeding individuals (male and female) (cited in FWS 2014e). The minimum population estimate for this Klamath subbasin was estimated to be 112 breeding individuals in 2014 suggesting drastic population declines since 1998 (FWS 2014e). The Buck Lake site is isolated from all other Oregon spotted frog populations with little or no chance for genetic interchange or re-colonization; there is no hydrologic connectivity to other occupied habitats in the Klamath Basin (FWS 2011e).

Critical Habitat

Critical habitat for the Oregon spotted frog was finalized in May 2016 (FWS 2016d). The units include critical habitat in Washington (Units 1 through 6) and in Oregon (Units 7 through 14). The Buck Lake site is within designated critical habitat Unit 14: Upper Klamath, Oregon. The Upper Klamath Unit 14 consists of 262 acres of lakes and creeks in Klamath and Jackson Counties, Oregon. In Klamath County, Oregon, Buck Lake critical habitat includes seasonally wetted areas adjacent to the western edge of Buck Lake encompassing Spencer Creek downstream due west of Forest Service Road 46, three unnamed springs, and Tunnel Creek (FWS 2016d), shown in figure 3.4.5-1.

FWS (2016d) determined that the PCEs specific to the Oregon spotted frog are:

1. PCE-1 (applicable to the following seasonal life stage periods – Nonbreeding (N), Breeding (B), Rearing (R), and Overwintering Habitat (O)) is <u>ephemeral or permanent bodies of freshwater</u>, including, but not limited to natural or manmade ponds, springs, lakes, slow-moving streams, or pools or oxbows within or adjacent to streams, canals, and ditches, that have one or more of the following characteristics:
   - inundated for a minimum of four months per year (B, R) (timing varies by elevation but may begin as early as February and last as long as September);
   - inundated from October through March (O);
   - if ephemeral, areas are hydrologically connected by surface water flow to a permanent waterbody (e.g., pools, springs, ponds, lakes, streams, canals, or ditches) (B, R);
   - shallow water areas (less than or equal to 30 centimeters (cm) (12 inches), or water of this depth over vegetation in deeper water (B, R);
   - total surface area with less than 50 percent vegetative cover (N);
   - gradual topographic gradient (less than 3 percent slope) from shallow water toward deeper, permanent water (B, R);
   - herbaceous wetland vegetation (i.e., emergent, submergent, and floating leaved aquatic plants), or vegetation that can structurally mimic emergent wetland vegetation through manipulation (B, R);
   - shallow water areas with high solar exposure or low (short) canopy cover (B, R); and/or
   - an absence or low density of nonnative predators (B, R, N).
2. PCE 2 is <u>aquatic movement corridors</u>. Ephemeral or permanent bodies of fresh water that have one or more of the following characteristics:
   - less than or equal to 5 kilometers (3.1 miles) linear distance from breeding areas; and
   - impediment free (including, but not limited to, hard barriers such as dams, biological barriers such as abundant predators, or lack of refugia from predators).
3. PCE 3 is <u>refugia habitat</u>. Nonbreeding, breeding, rearing, or overwintering habitat or aquatic movement corridors with habitat characteristics (e.g., dense vegetation and/or an abundance of woody debris) that provide refugia from predators (e.g., nonnative fish or bullfrogs).

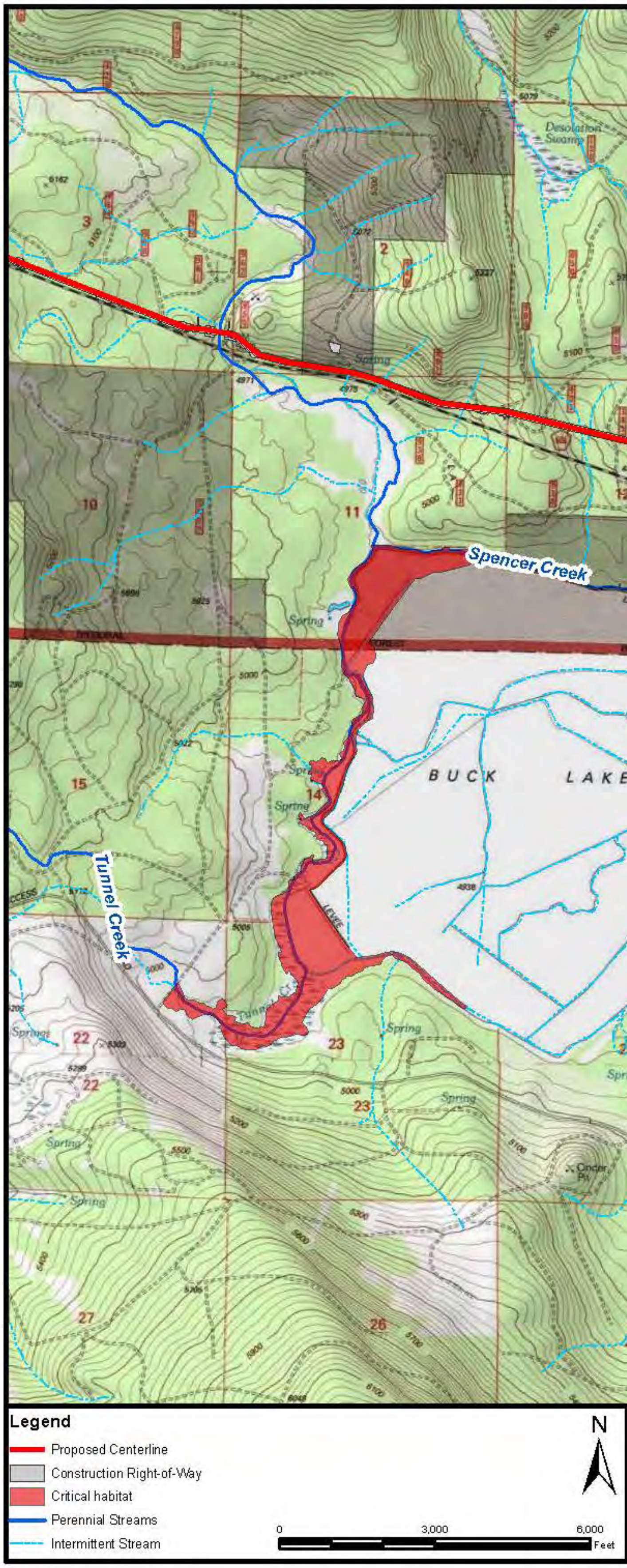


Figure 3.4.5-1

Critical Habitat for Oregon Spotted Frog at Buck Lake

3.4.5.2 Environmental Baseline

Analysis Area

The analysis area for Oregon spotted frogs includes two components: 1) the pipeline centerline plus a 1,500-foot buffer within the Spencer Creek fifth-field watershed, and 2) Buck Lake, where this species is currently known to occur in the vicinity of the Pipeline Project.

The first component encompasses the following:

- Spencer Creek from the point where it is proposed to be crossed by the Pipeline, downstream to the maximum extent of Pipeline Project effects (1,450 feet);
- the riparian zone associated with Spencer Creek;
- all tributaries to Spencer Creek that would be crossed by the Pipeline; and
- occupied habitat across paved Clover Creek road from the Pipeline.

Similar to listed fish species, the first component of the analysis area for Oregon spotted frogs is the Spencer Creek riverine analysis area associated with Spencer Creek and Buck Lake. This component of the analysis area includes the water column and substrate of Spencer Creek to the extent downstream of the proposed crossing where water quality could be adversely affected by turbidity generated during construction, and from sediment generated by runoff from the construction right-of-way. The associated riparian zone of Spencer Creek is included in the analysis area over the short term during construction, and in the long term by operation.

Construction across Spencer Creek is expected to mobilize silt, assumed to be the predominant substrate particle at the crossing location. As discussed below in the description of potential effects, the downstream distance that silt particles would be expected to settle out of the water column during construction using the proposed dam-and-pump crossing method, is estimated to be 1,450 feet (based on assumptions and estimation procedures below). Consequently, the Spencer Creek riverine analysis area would extend 1,450 feet downstream from the point of construction.

Buck Lake is additionally included in the analysis area because it is downstream of the proposed Pipeline crossing of Spencer Creek and is currently occupied by Oregon spotted frogs.

Species Presence

As of 2016, Oregon spotted frogs continued to inhabit Buck Lake. Oregon spotted frogs were first documented in 1994 at Buck Lake in the Winema National Forest and adjacent private lands in a canal on the northwestern edge of Buck Lake and on BLM lands within Tunnel Creek (Forest Service and BLM 1995), inhabiting the channelized portion of the perennial stream that enters the Buck Lake basin from the southwest. Forest Service and BLM (1995) indicated that these were the only sites in the Spencer Creek watershed likely to be inhabited by Oregon spotted frogs. However, FWS (2016d) indicated that Spencer Creek from Buck Lake downstream approximately 1.6 miles to the intersection of Forest Service Road 46 and Clover Creek Road is also occupied by the Oregon spotted frog (FWS 2016d), including 15 acres of BLM and NFS lands and two acres of private land. At its closest location to the Project, this occupied habitat is 280 feet from the right-of-way, although Clover Creek Road separates the right-of-way from Spencer Creek (figure 3.4.5-1).

A mark-recapture study to assess the Oregon spotted frog population in Buck Lake was conducted between 1995 and 1997 by Marc Hayes. The study results provided a population estimate of about 519 adults (with a range of 0 to 1,499, derived from 95 percent confidence intervals; Lerum 2012). Demographic information from this study showed limited evidence of recruitment likely attributable to the presence of resident brook trout (FWS 2011e). Observations of adult Oregon spotted frogs made between 1994 and 2001 ranged from 25 to 176, no adult frogs were observed in 2005 or 2009 (FWS 2011e; see figure 3.4.5-2). Since Hayes' study, various Forest Service, BLM, FWS, and USGS personnel have sporadically resurveyed this population documenting continued presence through 2011 (Lerum 2012). Since 2006, egg mass surveys have been conducted in addition to searches for adult frogs. Results are included in figure 3.4.5-2 and range from 6 egg masses in 2011 to 38 egg masses counted in 2010. However, the locations and search efforts varied from year to year, making inferences about trends based on egg masses counted inappropriate (Lerum 2012).

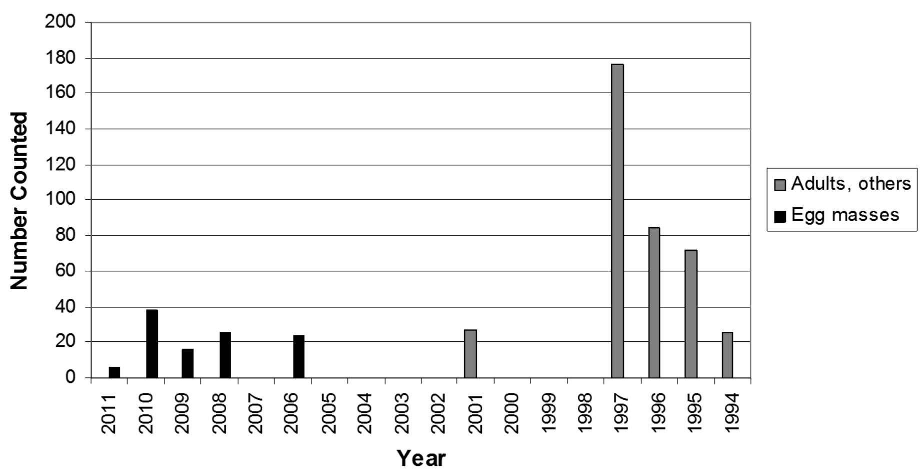


Figure 3.4.5-2 Observations of Oregon Spotted Frog Adults (Including Juveniles and Metamorphs) and Egg Masses at Buck Lake (Sources: FWS 2011e; Lerum 2012)

Oregon spotted frogs at Buck Lake have been consistently monitored from 2012 to 2016, along with other populations in the Oregon Cascades (Adams et al. 2017). Observations of frogs at two sites in Buck Lake and one in Tunnel Creek (both in CHU 14) indicate some variability in counts for each of several life stages but adults and larva or juveniles were found each year. Numbers of adults were highest in 2016 (table 3.4.5-1).

TABLE 3.4.5-1

Numbers of Oregon Spotted Frogs Counted within the Buck Lake Critical Habitat Unit (CHU 14) from 2012 to 2016

Surveyed Site	Legal Location	Survey Periods	Adults	Subadults Juveniles	Larva
1A Buck Lake	T38S,R5E,S14	Jun-Jul 2012	2		
		Jun-Aug 2013			
		Jun-Jul 2014	3		1
		Jun-Jul 2015	1		
		Jun-Aug 2016	3	2	1
2A Buck Lake	T38S,R5E,S14	Jun-Jul 2012	13	9	2
		Jun-Aug 2013	6	14	
		Jun-Jul 2014	4	1	2
		Jun 2015	7		1
		Jun-Aug 2016	14	2	
15A Tunnel Creek	T38S,R5E,S23	Jun-Jul 2015	1		
		Jun-Aug 2016	1		3

Source: Adams et al. 2017

Habitat

Historically, Buck Lake was likely a large, shallow marsh fed by springs and streams. Two perennial streams, Spencer Creek and Tunnel Creek, flow into Buck Lake but the basin is currently a meadow with drainage ditches, and at least two impounded areas fed by springs (Lerum 2012). ORBIC (2017c) has mapped Oregon spotted frog habitat at Buck Lake to include Spencer Creek from its inflow at the lake to approximately 6,100 feet upstream to where Spencer Creek passes through a culvert beneath Clover Creek Road. That segment of Spencer Creek is almost equally subdivided into Buck Marsh, closest to the highway, and Buck Meadow, closest to Buck Lake (Lerum 2012). Spencer Creek flows through Buck Marsh and Buck Meadow on Forest Service lands. Buck Marsh is fed by several springs with evidence of beaver activity, and Buck Meadow is a pasture that often floods in the spring but does not stay flooded long enough to provide Oregon spotted frog breeding habitat. Further, soils in Buck Marsh are dense, possibly compacted by past heavy livestock use, and provide little water infiltration. Riparian vegetation is sparse, and is unlikely to support beaver occupancy that could help to create suitable habitat (Lerum 2012). Neither Buck Marsh nor Buck Meadow currently provide habitat for Oregon spotted frogs (Lerum 2012). Spencer Creek upstream of Buck Lake is not currently suitable habitat for Oregon spotted frogs and is unlikely to become suitable habitat and support Oregon spotted frogs at the time of construction.

Some winters Spencer Creek freezes and flows cease. It is unknown if the site could provide overwintering habitat, and exactly where Oregon spotted frogs in the Buck Lake complex overwinter. Underwater video cameras installed in 2010 and 2011 did not detect Oregon spotted frogs at suspected overwintering sites until March when frogs began to move to breeding sites (Lerum 2012).

Lerum (2012) reported on a Level II stream survey of Spencer Creek flowing through Buck Marsh and Buck Meadow conducted by the Forest Service on June 28, 2010 (Forest Service 2011 cited in Lerum 2012). Spencer Creek characteristics in this area (Reach 5) were summarized as:

> *a Rosgen E6 stream channel type due to its gradient and silt dominated substrate. A large portion (3500') of reach 5 was determined to be a marsh. The average wetted width (Rosgen E channel only) is 6.4 feet. The reach averages 19 pools per*

mile with residual pool depth of 1.2 feet. Stream banks are 98 percent stable and 2 percent unstable with sections of unstable bank along both sides of the stream. The reach had six pieces of LWD per mile (zero large/medium and six small pieces per size class). The stream side vegetation was dominated by grass forbs with an overstory of grass forbs. There are some isolated pockets of lodgepole pine. The stream runs through a very large valley dominated by marshland. A channel begins to take shape at the end of the valley up to the road crossing. There are active beaver dams in the marsh. Unidentified fish were observed throughout the reach.

Typical Rosgen E6 channels (Wildland Hydrology 1994):

- are slightly entrenched (entrenchment ratio >2.2);
- have very low width to depth ratios (ratio <12);
- have high sinuosity (>1.5);
- have water surface slope gradients <2 percent; and
- channel substrate particles are predominantly silt and clay.

In 2002, lower Spencer Creek was listed by the ODEQ (303(d) List, ODEQ 2002) as impaired due to sediment based on the formation of appreciable bottom or sludge deposits. However, there are no estimates of ambient turbidity in Spencer Creek (Forest Service and BLM 1995) although intense cattle grazing around Buck Lake has contributed to elevated sediment in the creek, probably downstream from Buck Lake. Within the watershed, the principal causes of stream sedimentation are bank erosion and delivery of sediment from roads and stream crossings (BLM 2008).

There are no long-term discharge data for Spencer Creek. Flows were measured downstream from Buck Lake from 1992 to 1998 during which annual peak flows were from 150 to 200 cubic feet per second (cfs) and summer base flows were 20 cfs, with a minimum of 5 cfs following a dry winter (BLM 2008). Peak flows in the middle portion of the Spencer Creek watershed were caused by snowmelt and rain-on-snow events.

Critical Habitat

Critical habitat for the Oregon spotted frog was finalized in May 2016 (FWS 2016d). CHU 14 includes seasonally wetted areas adjacent to the western edge of Buck Lake encompassing Spencer Creek, three unnamed springs, and Tunnel Creek, as well as Spencer Creek downstream of Buck Lake as shown in figure 3.4.5-1. Buck Marsh and Buck Meadow are not included in the critical habitat. The designated critical habitat is approximately 6,400 feet downstream from where the Pipeline would cross Spencer Creek. The critical habitat downstream of Buck Lake is approximately 280 feet overland from the right-of-way at its closest location to the Project, although Clover Creek Road separates the right-of-way from Spencer Creek at this location and there is no hydrologic connection.

There are approximately 203 acres within CHU 14 at Buck Lake: approximately 53 acres are federally managed BLM and Winema National Forest land, and approximately 149 acres are privately owned (FWS 2014e). Another area, Keene Creek in Jackson County, is also included in CHU 14 but is approximately 14.5 miles from the critical habitat at Buck Lake. According to FWS (2013j: 53551), "all of the essential physical or biological features are found within the unit, but are impacted by woody vegetation succession, nonnative predators, lack of beaver, and hydrological changes. The essential features within this unit may require special management considerations or protection to ensure maintenance or improvement of the existing nonbreeding, breeding, rearing, and overwintering habitat; aquatic movement corridors, or refugia habitat, and to address any changes that could affect these features."

3.4.5.3 Effects of the Proposed Action

Direct and Indirect Effects

Timing

State guidelines (ODFW 2008) would allow in-stream construction across Spencer Creek (a tributary to the Klamath River below Keno) and tributaries to Spencer Creek from July 1 through September 30. Construction during that period would avoid any downstream effects to egg masses or spotted frogs during metamorphosis in Buck Lake, although sediment is not expected to travel this far as described below. Hydrostatic discharge is projected to occur in the late summer to early fall immediately following construction.

Acoustic Shock

The base material where the Pipeline is proposed to cross Spencer Creek is described as igneous rock and locally tuffaceous rock with local valley fill. There is a high potential that blasting would be needed to construct the trench across Spencer Creek if volcanic rocks cannot be excavated to the appropriate depth (GeoEngineers 2013). Effects of underwater blasting on frogs is generally unknown although effects on frogs' lungs are expected to be similar to effects on fish with swim bladders, and would cause mortality (Keevin and Hempen 1997). Effects of underwater blasts on coho salmon are discussed below in section 3.5.3.3. The analysis in that section identified straight line distances through rock and other materials for a single shot explosive charge, of given weight, to dissipate to an overpressure standard of 2.7 pounds per square inch (psi), the threshold for non-lethal pressure for anadromous fish, and assumed to be applicable to frogs. Pacific Connector may opt to blast across stream locations where consolidated rock makes traditional trenching methods unfeasible.

Typical trench blasting scenarios use multiple 1- to 2-pound charges separated by an 8-millisecond delay to excavate the trench. With use of 1- to 2-pound charges in rock, the setback distance (at which 2.7 psi would occur) from the blast trench to the aquatic habitat is between 34 and 49 feet (see Table 3, in ADFG 1991). Blasting would be conducted within dry streambanks isolated from the water column, most likely using dam-and-pump construction to bypass water around the dry workspace. Because no Oregon spotted frogs are expected in the vicinity of the Spencer Creek construction right-of-way, blasting is not expected to affect this species.

Suspended Sediment

Effects of turbidity on frogs have not been extensively reported. Densities of three amphibian species were significantly lower in streams impacted by sediment due to road construction than in non-impacted streams (Welsh and Ollivier 1998) and relative abundances in larvae of two frog species were less in wetlands impacted by turbidity caused by livestock than non-impacted wetlands (Schmutzer et al. 2008). As summarized by Henley et al. (2000), sedimentation can reduce food availability, water and environmental quality, and habitats used by aquatic organisms resulting in decreased plant, zooplankton, and insect abundance and biomass that would affect aquatic food chains and consequently would affect frogs during different life stages.

Although background levels of suspended sediment in Spencer Creek are unknown (Forest Service and BLM 1995), construction of the Pipeline would probably mobilize particles into the water column, primarily silt which is the predominant substrate material in Spencer Creek (see above and Lerum 2012). The distance downstream that silt particles would be transported can be estimated with the following equation:

$$L = (D\ V_A) / V_S$$

where L is the transported distance downstream (in feet); D is the average depth of stream flow (in feet), V_S is the particle size-specific settling velocity (in inches or feet per second), and V_A is the average streamflow velocity (in feet per second). The settling velocity (V_S) for medium silt is 0.009 inch per second or 0.00075 feet per second (see the Wentworth Grain Size Chart, USGS 2003). The average depth of streamflow within Spencer Creek at the time of construction is unknown but, using the average wetted width of 6.4 feet (see above and Lerum 2012) and a low width to depth ratio of 10 (for Rosgen E6 channels the width to depth ratios are less than 12), the average depth is estimated to be 0.64 feet (8 inches).

Assuming a rectangular channel cross section, the cross-sectional area is A = 4.1 square feet (ft^2). The estimated cross-sectional area (A) can be used in Manning's Formula (Limerinos 1970; Arcement and Schneider 1989) to estimate Q, the stream discharge rate (cfs) and ultimately to estimate V_A , the average streamflow velocity. Manning's Formula is:

$$Q = A\ (k/n)\ (R^{2/3})\ (S^{1/2})$$

with estimated A = 4.1 ft^2, R is the hydraulic radius (in feet, where R = A/P, and P is the wetted perimeter in feet), S is the slope of channel (vertical feet per horizontal feet), the constant *k* equals 1.486 if English units are used but *k* equals 1 with metric units, and n is Manning's roughness coefficient (Manning's n).

For Spencer Creek, the wetted perimeter P = (2 x 0.64 feet) + 6.4 feet = 7.68 feet so that the hydraulic radius R = 0.53 feet, the slope of channel S = 0.015 (or 1.5 percent, for Rosgen E6 channels the water surface slope gradient is <2 percent). Manning's n was estimated at n = 0.070, based on a natural stream channel with sluggish reaches, weedy, and with deep pools (Chow 1959).

With these parameters estimated, the solution for Manning's Equation is Q = 6.98 cfs. With the estimate for Q, and A = 4.1 ft^2, the estimated stream velocity is V_A = Q / A = 1.7 feet per second.

Solving the distance-rate-time equation (above) using the following values: D = 0.64 feet, V_S = 0.00075 feet per second, and V_A = 1.7 feet per second, the estimated distance downstream (L) that silt particles would settle out of the water column would be L = 1,453 feet from the location where the Pipeline crosses Spencer Creek. That distance would fall within Buck Marsh. Currently, there are no Oregon spotted frogs inhabiting Buck Marsh although the presence of beaver activity and spring flooding could provide suitable breeding habitat (Lerum 2012). Based on current information, however, sediment mobilized during construction is not expected to reach habitats occupied by frogs in Buck Lake.

Construction of the Pipeline Project is not expected to increase suspended sediment in Spencer Creek downstream of Buck Lake. Although the right-of-way occurs as close as 280 feet from Spencer Creek, the right-of-way and Spencer Creek are separated by Clover Creek Road (paved road) and are not hydrologically connected. BMPs,erosion control measures, and the presence of Clover Creek Road would prevent sediment from the construction right-of-way from entering Spencer Creek downstream of Buck Lake. Although a major precipitation event significant enough to wash out Project erosion control devices could cause sheet flow over Clover Creek Road to carry sediment into Spencer Creek, such an event is highly unlikely and not expected to occur.

The Pipeline route would cross two tributaries to Spencer Creek at MPs 171.57 and 173.74, approximately 740 and 5,900 feet upstream of the confluence with Spencer Creek, respectively. The stream at MP 171.57 was mapped as two feet wide fanning out into a wetland/stream complex and the stream at MP 173.74 was mapped as a four-foot-wide ephemeral snowmelt-fed stream. Both would be crossed using the dry-open cut method. They are expected to be dry at the time of construction (July 1 through September 30 per ODFW 2008), and thus are not expected to contribute sediment to Spencer Creek as a result of construction.

The proposed upland hydrostatic discharge site at MP 169.52 is approximately 1.6 miles from Spencer Creek. Water would be discharged at a rate to prevent scour, erosion, and sediment migration to sensitive resources such as wetlands and waterbodies, as described in the *Hydrostatic Test Plan* (appendix U). When discharged, the test water would be released into a dewatering device such as a straw bale structure or sediment bag to minimize possible peak flow effects by dissipating the energy of the test water flow, filtering the test water to avoid sedimentation, and by allowing release of the test water as sheet flow back into the ground. Therefore, effects to Oregon spotted frogs from hydrostatic discharge are not anticipated considering these procedures and BMPs, the distance between the discharge site and occupied habitat, and the extremely low likelihood of a test water spill.

Introduction of Non-Native Species and Disease

Non-indigenous aquatic species (NAS) are aquatic species that degrade aquatic ecosystem function and benefits, in some cases completely altering aquatic systems by displacing native species, degrading water quality, altering trophic dynamics, and restricting beneficial uses (Hanson and Sytsma 2001). FWS (2013k) identified warm water non-native fish (bullhead, fathead minnows), and cold water non-native brook trout that had been introduced to Buck Lake, although bullfrogs were absent. Non-native fish may limit numbers of juvenile frogs by predating larvae and/or juveniles. Bullfrogs also may act as direct predators on larval and juvenile frogs but bullfrogs are not known to occur on federal land in the Buck Lake complex (Lerum 2012). Given the distance to the nearest hydrostatic test water discharge site, the introduction of bullfrogs and/or other warm water predaceous fish species would not occur.

Similarly, the risk of introducing *Saprolegnia, Ribeiroia ondatrae*, and/or other pathogens into Buck Lake during construction appears to be low. Hydrostatic discharge water is not expected to reach Spencer Creek downstream of Buck Lake as described above under Suspended Sediment.

Pacific Connector has developed BMPs to avoid the potential spread of the aquatic invasive species and pathogens of concern (see their *Hydrostatic Test Plan*, appendix U). If determined to be feasible for hydrostatic testing requirements, all water used in hydrostatic testing would be returned to its withdrawal source location after use; however, cascading water from one test section to another to minimize water withdrawal requirements may make it impractical to release water within the same watershed where the water was withdrawn. If it is not possible to return the water to the same water basin from where it was withdrawn, various water treatment methods would be used to disinfect water that would be transferred across water basin boundaries including screening/filtering, chlorine treatment, and discharge to upland sites. After hydrostatic test water withdrawal, all equipment used in the withdrawal process would be cleaned and sanitized to prevent the potential spread of aquatic invasives and pathogens from the use of this equipment in other waterbody sources (see appendix U).

Fuel and Chemical Spills

Oregon spotted frog habitat in the Buck Lake complex could be adversely affected if petroleum products were accidentally discharged into aquatic environments. However, the likelihood of this occurring in sufficient amounts and travelling the several thousand feet to the Buck Lake complex is discountable. Additionally, Pacific Connector would implement numerous measures to reduce the potential for an inadvertent release and the impact of a release should one occur. Measure include, not storing hazardous materials, chemicals, fuels, lubricating oils near waterbodies nor conducting refueling operations within 150 feet of a wetland or waterbody (see appendix C) and the SPCCP (see appendix L).

Herbicide Application

Following construction, Pacific Connector would implement a *Noxious Weed Control Plan* in part through the application of herbicides. Herbicides have the potential to cause toxic effects to different salmonid life stages and to other aquatic species, causing direct impacts, if used improperly. When herbicides are properly used according to label restrictions and BMPs to control noxious weeds, the likelihood of adverse impacts on aquatic organisms is minimized. Additionally, the potential for adverse effects to Oregon spotted frogs and other aquatic species by these herbicides would be extremely remote, especially because application would be at least 100 feet from wetlands and waterbodies unless allowed by the land manager. Pacific Connector would not use aerial herbicide applications and would not use herbicides for general brush/tree control within the 30-foot maintained easement. Given low toxicities and short half-lives in soil and water, expected effects of herbicides to amphibians would be discountable and insignificant.

Pacific Connector has developed an *Integrated Pest Management Plan* (IPM) in consultation with the Oregon Department of Agriculture (ODA), BLM and Forest Service (see Appendix N to the POD [appendix B to the BA]) to address the control of noxious weeds and invasive plants across the project. The BMPs would minimize the potential spread of invasive species and minimize the potential adverse effects of control treatments.

In general, herbicides in waterbodies occurs from direct overspray or drift (aerial applications) as well as leaching through soils into groundwater or as they are carried by surface/subsurface runoff (Tu et al. 2001). The ester form of herbicides is more toxic to fish and other aquatic species than salt or acid forms because esters are readily adsorbed through skin and gills. Esters are also water insoluble so that they are not diluted in waterbodies (Tu et al. 2001).

Furthermore, Pacific Connector would employ a state or federally-licensed herbicide applicator to ensure that the appropriate herbicides are utilized for the targeted weed species during its proper phenological period and at the specified rate. The applicator would ensure that the herbicides and any adjuvants[30] are used according to the labeling restrictions and warnings, following all

[30] Adjuvant(s) are substances added to the pesticide formulation to enhance the toxicity of the active ingredient or to make the active ingredient easier to handle.

applicable laws and conforming to the appropriate land managing agency decision documents. The applicator would also ensure that the herbicides that are used are registered for their intended use. Permits or approvals for the use of herbicides and adjuvants on federal lands would be obtained prior to use/treatment, as detailed in the IPM (see Appendix N to the POD [appendix B to this BA]).

Critical Habitat

A portion of designated CHU 14 in Spencer Creek downstream of Buck Lake is within the Oregon spotted frog analysis area. CHU 14 contains all three PCEs identified by FWS (2013j), including suitable ephemeral or permanent bodies of freshwater (PCE 1), aquatic movement corridors (PCE 2), and refugia habitat (PCE 3). Construction of the Project could affect PCEs within CHU 14 by impacting site hydrology or introducing nonnative predators, although these effects are not expected as described below.

As described previously, the right-of-way occurs as close as 280 feet from designated critical habitat in Spencer Creek downstream of Buck Lake; however, the right-of-way and Spencer Creek are separated by Clover Creek Road and are not hydrologically connected. As a result, construction of the Project at this location is not expected to affect hydrology within the critical habitat.

3.4.5.4 Conservation Measures

Conservation measures have been proposed by Pacific Connector to minimize construction and operation impacts to waterbodies and riparian zones. Those measures have been compiled in table 2C in appendix N and would apply to Oregon spotted frogs.

Mitigation

The Forest Service has proposed a suite of mitigation projects to address the effects of the Pipeline Project on various resources on NFS lands and to ensure that construction and operation of the pipeline would be consistent with the objectives of the respective Forest Service LRMPs (appendix O.4). These mitigation actions would be a condition of the Forest Service letter of concurrence and would be included in the Right-of-Way Grant, if one were issued for this Project. Implementation and funding of these actions would be carried out through negotiated agreements between the Forest Service and Pacific Connector.

In general, the mitigation measures proposed for NFS land have the potential to result in short-term impacts to Oregon spotted frogs, such as temporary increases in suspended sediment, but would result in beneficial effects in the long term by improving habitat. The Forest Service has proposed mitigation in the following mitigation categories to ensure consistency with the objectives of Forest Service LRMPs that may benefit Oregon spotted frogs: habitat enhancement and road decommissioning. Habitat enhancement projects would include riparian planting, fencing, in-stream LW placement, and stream crossing repair.

Enhancing Spencer Creek habitat would benefit the downstream habitat of the Oregon spotted frog. Shade provided by riparian plantings along Spencer Creek would contribute to moderating water temperatures in Spencer Creek; root strength provided by new vegetation would increase bank stability, decrease erosion and sediment depositions to Spencer Creek, and benefit the downstream habitat of the Oregon spotted frog in Buck Lake. Fencing of Spencer Creek would divide the Buck Indian Allotment into pastures north and south at Clover Creek Road; this fence would keep cattle from grazing newly revegetated areas in the Right of Way corridor, including areas where the corridor crosses Spencer Creek, thus helping to ensure that erosion control and revegetation objectives are met. Placement of LW in Spencer Creek would add structural complexity, trap fine sediments, and may contribute to reductions in stream temperatures over time. Road decommissioning and ford hardening in Spencer Creek would benefit all downstream aquatic habitats and the species associated with those habitats, such as Oregon spotted frogs in Buck Lake.

These habitat enhancements and road decommissioning could result in a short term increase in suspended sediment in Spencer Creek; however, Oregon spotted frogs do not currently inhabit Spencer Creek, and Project design features would focus disturbance outside of the breeding period. Overall, the species is expected to benefit from these projects.

A summary of all Forest Service mitigation projects and their potential impacts to all relevant species and habitats is provided in table 2.1.5-1 in chapter 2 of our EIS (FERC 2019), and table 2.8-1 of this BA. Currently, these projects lack the site-specific details needed for implementation; however, the Forest Service is seeking consultation at a programmatic level for these and other proposed Forest Service actions described in this BA. It is anticipated that these projects would require a secondary site-specific project-level ESA consultation prior to implementation.

3.4.5.5 Determination of Effects

Species

The Project **may affect** Oregon spotted frogs because:

- the Pipeline route would cross Spencer Creek, which is hydrologically connected to Buck Lake and is occupied by the Oregon spotted frog; and
- the Pipeline route is within 280 feet of Spencer Creek and would cross tributaries to Spencer Creek downstream of Buck Lake, which is occupied by the Oregon spotted frog.

However, the Project **is not likely to adversely affect** Oregon spotted frogs for the following reasons:

- Buck Lake is approximately 6,400 feet downstream from where the pipeline route would cross Spencer Creek. Suspended sediment generated by the proposed action is expected to remain in the water column for up to 1,450 feet downstream from the construction site.
- Suspended sediment resulting from the crossing of Spencer Creek would pass through Buck Marsh, which Oregon spotted frogs do not currently inhabit. If the Oregon spotted frog does occur in Buck Marsh at the time of pipeline construction, conservation measures would limit potential effects due to acoustic shock, introduction of non-native species and/or disease, fuel and chemical spills, and herbicides.
- Future presence of Oregon spotted frogs in Spencer Creek upstream of Buck Lake (including the location of the proposed Pipeline crossing of Spencer Creek) at the time of construction is extremely unlikely, and is considered to be discountable.

- Although the right-of-way occurs as close as 280 feet from Spencer Creek downstream of Buck Lake, the right-of-way and Spencer Creek are separated by Clover Creek Road and BMPs and erosion control measures would prevent sediment from the construction right-of-way from entering Spencer Creek.

Critical Habitat

The Project **may affect** designated critical habitat for the Oregon spotted frog because:

- the Pipeline route is within 280 feet of designated critical habitat within Spencer Creek downstream of Buck Lake.

However, the Project is **not likely to adversely affect** designated critical habitat for the Oregon spotted frog because:

- the designated critical habitat within 280 feet of the right-of-way is not hydrologically connected to the right-of-way because it is separated by Clover Creek Road.

3.5 FISH

3.5.1 North American Green Sturgeon (Southern Distinct Population Segment)

3.5.1.1 Species Account and Critical Habitat

Status

On January 29, 2003 (NMFS 2003), NMFS determined that the North American green sturgeon consists of two DPSs that qualify as species under the ESA: 1) a northern DPS consisting of populations in coastal watersheds northward of and including the Eel River in California; and 2) a southern DPS consisting of coastal and Central Valley populations south of the Eel River, with the only known spawning population in the Sacramento River. At that time, however, neither DPS was listed because of the uncertainty about the population structure and status. There is overlap in ocean, nearshore marine, and estuarine distribution of the two DPSs.

In April 2006, NMFS listed the Southern DPS as threatened under ESA within California, including a spawning population of green sturgeon south of the Eel River, principally the Sacramento River green sturgeon spawning population (NMFS 2006c). The Pacific Northern DPS, which includes coastal spawning populations from the Eel River north to the Klamath and Rogue Rivers, remains unlisted but is a Species of Concern (NMFS 2007c, 2014c). NMFS performed a five-year status review in 2015, which determined that no change in status was needed for the Southern DPS (NMFS 2015c).

Threats

The Southern DPS was proposed for listing as threatened in 2005 (NMFS 2005b) because: 1) the majority of spawning adults were concentrated in one spawning river (Sacramento River), 2) threats since the first status review (see NMFS 2002) have not been adequately addressed, 3) there is new evidence of loss of spawning habitat in the upper Sacramento and Feather Rivers, and 4) data show a negative trend in juvenile green sturgeon abundance. One factor that was not considered a primary factor causing the decline of the Southern DPS, but likely poses a threat to the Southern DPS, was past and present commercial and recreational fishing, primarily ocean and estuarine bycatch of green sturgeon in the Oregon and Washington white sturgeon and salmonid fisheries; however, recent fishing regulations have reduced the risk for the Southern DPS in Oregon and Washington (NMFS 2006c). Actions that may negatively affect the Southern DPS include water diversion for human use, point and non-point source discharge of persistent contaminants, contaminated waste disposal, water quality standards, and fishery management practices (NMFS 2006c).

The principal threat to the Southern DPS green sturgeon remains as limited spawning habitat in the Sacramento River, California. Multiple dams on the river prevent adult migration to former spawning sites. Also, flow rates in the river and Delta have been affected by water diversions for agricultural, municipal and industrial uses, and insufficient flow rates in the Sacramento River system are likely a significant threat to green sturgeon (NMFS 2006c). In particular, entrainment of juveniles in water diversion structures has been identified though may not be as much as a problem as thought earlier (NMFS 2005b). Other threats within the Sacramento River system include elevated water temperatures and contamination from toxic materials (e.g., bioaccumulation of PCBs and selenium).

Species Recovery

No recovery plan has been drafted.

Life History, Habitat Requirements, and Distribution

Green sturgeons spawn in deep pools in large, turbulent river mainstems, generally from March through July with peak spawning from mid-April to mid-June (Moyle 2002). Adults migrate to/from spawning grounds during the spring and fall, consecutively, and juvenile migration occurs from April through November (Rien et al. 2001). Life history and habitat requirements are similar for the Northern and Southern green sturgeon DPSs; information on the Northern DPS is presented here where applicable. Northern DPS green sturgeons enter the Rogue River during March through June to spawn. Spawning appears to be related to water temperature (8.8° to 16.4 degrees Celsius [°C] or 48° to 62 degrees Fahrenheit [°F]) but low flows probably dictate how far upstream sturgeon are able to migrate to potential spawning habitat (Erickson and Webb 2007).

Little is known about sturgeon feeding, but some studies have found that adults and juveniles feed on benthic invertebrates including shrimp, mollusks, amphipods, and even small fish (Moyle 2002). Based on food habit studies in several Washington estuaries, adult and subadult green sturgeons fed on a variety of invertebrates such as crangonid shrimp, burrowing thalassinidean shrimp, burrowing ghost shrimp (*Neotrypaea californiensis*) and possibly other related species, amphipods, clams, and juvenile Dungeness crab (*Metacarcinus magister*) as well as vertebrates including anchovies, sand lance (*Ammodytes hexapterus*), lingcod (*Ophiodon elongatus*), and other fish (NMFS 2009c). They are thought to spend most of their lives in nearshore oceanic waters, bays, and estuaries (NMFS 2014c).

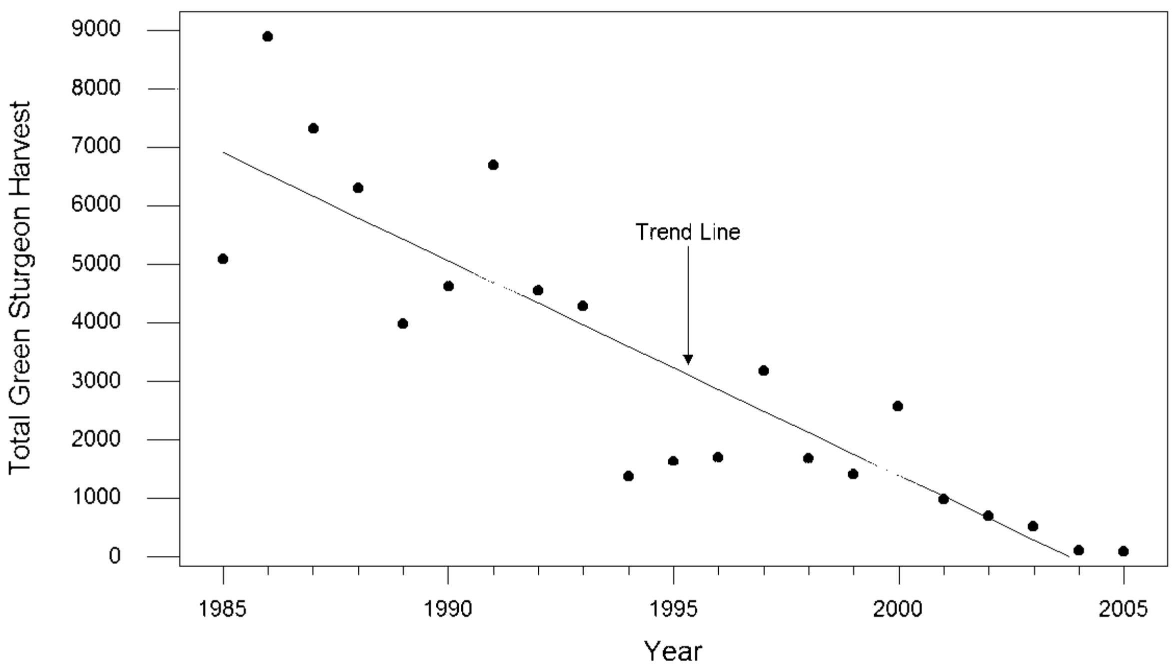
Green sturgeons move into estuaries of non-natal rivers to feed (Beamis and Kynard 1997). They occupy large estuaries during the summer and early fall in the Pacific Northwest. Green sturgeons enter Washington estuaries during summer when water temperatures are more than 4°F warmer than adjacent coastal waters (Moser and Lindley 2007). Green sturgeon abundance peaks during October in the Columbia River estuary, based on commercial catches. In Washington (Willapa Bay and Grays Harbor), green sturgeons appear to be present from June until October (Moser and

Lindley 2007). Sturgeons in the Southern DPS that originate in the Sacramento River have been found widely in Washington estuaries and the Columbia River. In the lower Columbia River (RM 0 to 35), between 77 and 88 percent of the green sturgeons collected originated from the Southern DPS (Israel and May 2007).

Data from tagged green sturgeons occurring offshore from the Klamath River in California suggest they are from the Northern and Southern DPSs (McCovey 2007). Tagged green sturgeons that utilize the lower Klamath River have been observed in Grays Harbor, Washington (McCovey 2007), approximately 400 nmi north of the Klamath River. There are no records of tagged green sturgeons from the Klamath River study occurring within Coos Bay, which is approximately 125 nmi from the Klamath River estuary (McCovey 2007).

Population Status

NMFS (2014c) reports that there are no good data on the current population of the green sturgeon. ODFW evaluated the presence of green sturgeon in coastal tributaries through 2005 and provided summaries of harvests of green sturgeon in California, Oregon, and Washington commercial and sport fisheries (Farr and Kern 2005). Although many factors contribute to annual catch of sturgeons in the three states whether in coastal, estuarine, or riverine habitats, the overall declining trend since 1985 (see figure 3.5.1-1) is probably indicative of the species' declining population.



Source: Farr and Kern 2005

Figure 3.5.1-1 Total Harvest of Green Sturgeon in California, Oregon, and Washington Commercial and Sport Fisheries from 1985 to 2005. The linear relationship is significant ($r^2 = 0.786$, $P<0.001$).

There are confirmed records of green sturgeons in the Umpqua River, captured above the zone of tidal influences. In 2000, two juvenile green sturgeons were regurgitated from a smallmouth bass caught in the Umpqua River (river kilometer 134 [RM 83.3]), and in 1979, a green sturgeon nearly

2 meters (6.6 feet) long was caught at river kilometer 164 (RM 101.9; NMFS 2005b). In addition, a possible juvenile green sturgeon was captured at Big Butte Creek, near Lost Creek Dam on the Rogue River (NMFS 2005b). From 2000 to 2004, 249 green sturgeons were captured in the Rogue River, while 33 fish were captured and two sturgeons that had been tagged were recaptured in the Umpqua River (Farr and Kern 2005). However, there is no indication which DPS any of those reported green sturgeons belonged to.

Critical Habitat

During reviews prior to designating critical habitat, NMFS (2008b) determined that subadult and adult Southern DPS green sturgeons inhabited certain estuaries along the coast of northern California, Oregon, and Washington during summer and inhabited coastal marine waters from central California to British Columbia over the winter. NMFS (2008b) noted large numbers of adult and subadult green sturgeons used Coos Bay as summer habitat, in particular Southern DPS green sturgeons tagged in San Pablo Bay, a northern extension of San Francisco Bay. Based on that information, NMFS (2009b) designated critical habitat for the Southern DPS of North American green sturgeon to include all tidally influenced areas of Coos Bay up to the elevation of mean higher high water, including the head of tide endpoint in the Coos River and Stock Slough both of which are crossed by the Pipeline. The Pipeline would cross Stock Slough approximately 220 feet upstream from the head of tide endpoint for critical habitat in Stock Slough.

PCEs have been identified for critical habitats including: 1) freshwater riverine systems, 2) estuarine habitats, and 3) nearshore coastal marine area. The freshwater riverine component includes the Upper and Lower Sacramento River, Lower Feather River, Lower Yuba River, and several bypasses in the Sacramento-San Joaquin Delta, all of which are in California.

The tidally influenced portions of the Coos River and Stock Slough, which include areas of freshwater habitat, are identified as part of the estuarine habitat components of designated critical habitat, although no spawning has been documented in either. Likewise, green sturgeon early life stages are within freshwater and affected by water flow and temperature, but post-larval juvenile sturgeons are not expected in the Coos River or Stock Slough because there are no spawning sites. PCEs essential for the conservation of the Southern DPS in freshwater riverine systems include:

1. Food resources. Abundant prey items for larval, juvenile, subadult, and adult life stages.
2. Substrate type or size. Substrates suitable for egg deposition and development, larval development, and subadults and adults.
3. Water flow. A flow regime (magnitude, frequency, duration, seasonality, and rate-of-change of fresh water discharge over time) necessary for normal behavior, growth, and survival of all life stages.
4. Water quality. Water quality, including temperature, salinity, oxygen content, and other chemical characteristics, necessary for normal behavior, growth, and viability of all life stages.
5. Migratory corridor. A migratory pathway necessary for the safe and timely passage of Southern DPS fish within riverine habitats and between riverine and estuarine habitats.
6. Water depth. Deep (≥5 meter) holding pools for both upstream and downstream holding of adult or subadult fish, with adequate water quality and flow to maintain the physiological needs of the holding adult or subadult fish.

7. Sediment quality. Sediment quality (i.e., chemical characteristics) necessary for normal behavior, growth, and viability of all life stages.

All of the riverine PCEs, except for PCE 2, are expected within the riverine analysis area (described below).

NMFS (2008b) determined that the Coos Bay estuary provided food resources, water flow, water quality, and migratory corridors to support migration and possibly feeding by subadult and adult green sturgeon. Estuarine PCEs include:

1. Food resources. Abundant prey items within estuarine habitats and substrates for juvenile, subadult, and adult life stages.
2. Water flow. Within bays and estuaries adjacent to the Sacramento River (i.e., the Sacramento-San Joaquin Delta and the Suisun, San Pablo, and San Francisco bays), sufficient flow into the bay and estuary to allow adults to successfully orient to the incoming flow and migrate upstream to spawning grounds.
3. Water quality. Water quality, including temperature, salinity, oxygen content, and other chemical characteristics, necessary for normal behavior, growth, and viability of all life stages.
4. Migratory corridor. A migratory pathway necessary for the safe and timely passage of Southern DPS fish within estuarine habitats and between estuarine and riverine or marine habitats.
5. Depth. A diversity of depths necessary for shelter, foraging, and migration of juvenile, subadult, and adult life stages.
6. Sediment quality. Sediment quality (i.e., chemical characteristics) necessary for normal behavior, growth, and viability of all life stages.

NMFS (2009e) identified coastal marine water depths within 110 meters (360 feet) as occupied areas necessary to critical habitat, including coastal waters segments from San Francisco Bay to Humboldt Bay, California and from Humboldt Bay to Coos Bay. Migratory corridors, water quality, and food resources are PCEs associated with coastal marine habitat components of critical habitat (NMFS 2009e).

The specific PCEs in coastal marine areas include:

1. a migratory pathway necessary for the safe and timely passage of Southern DPS fish within marine and between estuarine and marine habitats without human-induced impediments, either physical, chemical, or biological, that would affect the migratory behavior of the fish such that its survival or the overall viability of the species is compromised;
2. coastal marine waters with adequate dissolved oxygen levels and acceptably low levels of contaminants (e.g., pesticides, polycyclic aromatic hydrocarbons [PAH], and heavy metals that may disrupt the normal behavior, growth, and viability of subadult and adult green sturgeon); and
3. abundant prey items for subadults and adults, which may include benthic invertebrates and fish.

3.5.1.2 Environmental Baseline

Analysis Area

Three analysis areas within the overall action area are applicable to green sturgeons in the Southern DPS: the marine analysis area, the estuarine analysis area, and the riverine analysis area. The marine analysis area is a fan-shaped area spreading outward from the Coos Bay entrance to the outer continental shelf, which extends approximately 12 nmi offshore. Within the marine analysis area, LNG carrier traffic may have effects on green sturgeons within coastal marine waters up to 110 meters (about 360 feet) deep. This accounts for approximately half of the marine analysis area, or out to 7.5 nmi from the Coos Bay entrance. The LNG carriers are assumed to transect the marine analysis area mostly perpendicularly (east and west as they approach and depart from Coos Bay (see the discussion in section 3.2.1.3 for blue whales).

The Coos Bay estuarine analysis area includes: 1) the existing Federal Navigation Channel which forms part of the waterway for LNG carrier traffic to and from the LNG Project, 2) the proposed access channel to the terminal slip, 3) the marine waterway modifications, 4) the area of North Slough adjacent to the Trans-Pacific Parkway/US-101 Intersection Widening, 5) the Eelgrass Mitigation site, 6) the Kentuck project site, and 7) sites temporarily occupied during construction activities (see figure 3.2.1-1 under section 3.2.1, Blue Whale, and figure 3.3.3-3 under section 3.3.3, Marbled Murrelet).

The riverine analysis area includes accessible freshwater tributaries to Coos Bay that would be crossed or potentially affected by construction of the Pipeline below the head-of-tide influence with potential use by green sturgeon.

Species Presence

North American green sturgeon (both the unlisted Northern DPS and threatened Southern DPS) occur within Coos Bay and likely utilizes its adjacent waterbodies, such as the Coos River. Green sturgeons have also been documented traversing ocean water within the 60-fathom zone along the West Coast from Alaska to California areas..

Green sturgeons have been captured in almost all of the Oregon coastal estuaries from the Chetco River to Nehalem Bay (EPIC et al. 2001) and genetic studies indicate that both Northern DPS and Southern DPS occur in the Columbia River (Israel et al. 2004). There are historical records of green sturgeons caught in the Coos Bay commercial fishery (ranging from 67 to nearly 2,000 pounds of fish annually) between 1923 and 1949. Furthermore, ODFW has records of green sturgeons caught off Cooson Point, Hays Slough, at the confluence of the Millicoma and Coos Rivers, in Davis Slough, and South Coos River (Farr and Kern 2005). Furthermore, green sturgeon movements within the 100-meter (328-foot) isobath during migration along the West Coast were monitored using pinger-tags and hydrophone arrays. Although data are limited, tagged sturgeons moved from Seal Rock, Lincoln County, on the Oregon coast north of Coos Bay, south to Monterey Bay, California at the rate of 2 km (1.2 miles) per day and from Seal Rock north to Brooks Peninsula, B.C. at the rate of 4.2 km (2.6 miles) per day (Lindley et al. 2008). Migrating green sturgeons were documented along the Oregon coast (Seal Rock) mostly between October and June (Lindley et al. 2008).

Habitat

Coos Bay is known to support a small population of green sturgeon; however, natural reproduction in the estuary is considered low (Wagoner et al. 1990). However, historical records of the American shad gill-net fishery in the Isthmus Slough indicate that green sturgeons were incidentally captured nearly every year from 1980 to 1992 (Farr and Rien 2002). ODFW reported that many of these fish were probably younger than three years old based on their size and suggested that the Coos Bay system may provide spawning or at least rearing habitat for juveniles (Cummings and Schwartz 1971; ODFW 2006b). Green sturgeons may utilize both shallow and deep water habitats within the estuarine analysis area, though there is no information relating individuals' occurrence to DPS membership.

Coastal bays and estuaries provide habitats that support juvenile rearing and growth through the time when they enter coastal marine habitats (NMFS 2009c). Since no spawning has been recently documented in freshwater tributaries to Coos Bay, the estuary most likely provides feeding and migratory habitat for adult and possibly subadult green sturgeons.

Presence of potential forage species within the vicinity of the Federal Navigation Channel (Miller et al. 1990) is discussed below for Oregon Coast ESU coho salmon (see section 3.5.4). Total benthic invertebrate densities in Coos Bay were found to be lower than densities observed in the Umpqua River Estuary and the Columbia River Estuary (Bottom et al. 1985; Miller et al. 1989; Durkin and Emmett 1980). Benthic studies conducted by NMFS within and in the vicinity of Coos Bay found that the amphipod *Corophium salmonis* occurred in much lower densities than in other Oregon estuaries (Miller et al. 1990; Bottom et al. 1985; Miller et al. 1989; Durkin and Emmett 1980). Previous studies in Coos Bay have found that *Corophium* spp. were abundant in intertidal areas and constituted an important diet element for juvenile Chinook salmon and striped bass (BLM 1971); *Corophium* spp. is also a known food source for green sturgeon in other estuaries (NMFS 2008b).

Green sturgeons utilize West Coast estuaries during summer months when estuarine water temperatures exceed ocean coastal temperatures, perhaps optimizing their growth potentials by foraging in relatively warm, saline estuarine water (Moser and Lindley 2007). The ODEQ periodically monitored water temperatures in Coos Bay at Marker #23 (near Henderson Marsh), located just oceanward from the proposed LNG slip area, from 1957 to 2005 (ODEQ 2006). Although the data are not continuous, they provide a general range of water temperatures close to the Project site. Temperatures collected during the period of record ranged from 5°C to 13°C (41°F to 55°F) in the winter to 9°C to 20°C (48°F to 68°F) in the summer (ODEQ 2006).

Dissolved oxygen (DO) in lower Coos Bay is generally higher in the winter and lower in the summer. During winter, DO ranged from 8.9 to 10.4 milligrams per liter (mg/l) and averaged 9.4 mg/l. During summer, DO ranged from 6.0 to 9.6 mg/l and averaged 7.4 mg/l (ODEQ 2006). Arneson (1976) also sampled DO in the bay and reported that DO concentrations were slightly higher in December and March than in June and September. Lower DO levels in the summer are associated with lower freshwater inputs, but would be a "properly functioning" habitat indicator overall. These temperatures and DO levels would be suitable for sturgeon on a year-round basis.

Critical Habitat

NMFS (2009c) designated critical habitat for the Southern DPS of North American green sturgeon to include all tidally influenced areas of Coos Bay up to the elevation of mean higher high water, including the head of tide endpoints in the Coos River and Stock Slough, both of which are crossed by the Pipeline.

The Coos Bay estuary provides several PCEs including food resources, migratory corridors (passage) between estuarine and marine habitats, sediment quality and water quality (NMFS 2009c), all necessary to support various green sturgeon life stages. Similarly, coastal marine waters between Coos Bay and San Francisco Bay provide food, passage, and water quality as PCEs.

NMFS (2008b) determined that the Coos Bay estuary provided food resources, water flow, water quality, and migratory corridors to support rearing, migration, and possibly feeding by subadult and adult green sturgeon. Shallow water habitats near the Project site have been mapped as habitat for *Corophium* spp. by Coos County Planning Department (1979). Ghost shrimp more commonly inhabit tide flats closer to the ocean and in Coos Bay; ghost shrimp may be farther inland because of predation by the Pacific staghorn sculpin (Hornig et al. 1989; Posey 1986). Those species as well as bivalve mollusks (softshell, butter, littleneck, cockle, gaper piddocks and mussels) may provide food for migratory green sturgeon within the estuarine and nearshore marine analysis areas.

Lower Coos Bay provides unobstructed migratory access for green sturgeons. Within the estuarine analysis area and lower riverine analysis area entering Coos Bay, access for migrating fish species is uninhibited, and is therefore considered "properly functioning."

3.5.1.3 Effects of the Proposed Action

Analyses of effects of the proposed action on green sturgeon are addressed separately for the marine analysis area, estuarine analysis area, and riverine analysis area.

Direct and Indirect Effects – Marine Analysis Area

Potential Project-related effects to the Southern DPS of green sturgeon within the marine analysis area include the following : 1) acoustic effects to sturgeon from LNG carriers transiting the marine analysis area, and 2) inadvertent fuel and equipment fluid spills from LNG carriers at sea.

<u>Acoustic Effects</u>

Underwater noise produced by LNG carriers transiting the marine analysis area may affect green sturgeon. Underwater noise levels are expected to vary by ship type and also by vessel length, gross tonnage, and vessel speed (see discussion in section 3.2.1.3 for blue whales). Based on the general trend for higher underwater noise generated by larger vessels (McKenna et al. 2012), it is possible for some of the LNG carriers that would utilize the LNG Project to generate more noise than the LNG carriers built in 2003 with 138,028 m^3 capacity reported by Hatch et al. (2008) that produced sound levels (with 1 standard error) of 182 ± 2 dB re: 1 µPa @ 1 meter.

State agencies in Washington, Oregon, and California, along with federal agencies, have developed interim noise exposure threshold criteria for pile-driving effects on fish (WSDOT 2019; Fisheries Hydroacoustic Working Group 2008; Popper et al. 2006). These threshold criteria are considered levels below which injury effects would not occur to fish from in-water noise. These thresholds should thus be suitable for all forms of in-water noise. Interim noise exposure threshold criteria for pile driving effects on fish include: 1) a cumulative sound exposure level (SEL_{cum}) of 187 dB re 1 μPa^2 s for fishes weighing more than two grams, 2) a SEL_{cum} of 183 dB re 1 μPa^2 s for fishes less than two grams, and 3) a single-strike peak level (SPL_{peak}) of 206 dB re 1 μPa for all sizes of fishes (WSDOT 2019). The LNG carrier in the Hatch et al. (2008) study produced sound levels (with one standard error) of 182 ± 2 dB re: 1 μPa @ 1 meter that attenuated to 160 dB at 35 ± 11 meters and to 120 dB at 16,185 ± 5,359 meters (Hatch et al. 2008).

All Project vessel noise values generated in the marine analysis area would be less than those noted above as causing direct harm to fish, with the possible exception for very small fish within 1 meter (3 feet) of an LNG carrier hull for an extended period. Green sturgeon are generally epibenthic (living on or just above the bottom sediments of a waterbody) and would rarely be in the near surface waters. Additionally, because vessels are in transit, fish can easily move away from vessels, which would keep their exposure very brief and further reduce the chance for harmful exposure to sound and the potential for adverse noise effects.

LNG carriers would increase noise within the marine analysis area, While the background levels are not specifically known in the marine analysis area, analyses of more recent vessel-traffic related noise show that levels along the U.S. West Coast area holding steady or increasing slightly off southern California but decreasing in the area off Oregon and Washington (Andrew et al. 2011). As noted above, green sturgeon in the marine analysis area might detect noise from LNG carriers but are not expected to be adversely affected.

Fuel or Oil Spills at Sea

The LNG carriers use either a steam or DFDE propulsion system that is primarily fueled by natural boil-off gas. Fuel (e.g., diesel) used for back-up generation for LNG carrier propulsion and oil or hydraulic fluids used for mechanical equipment could possibly leak or be spilled while the carriers are in transit. The low volumes of petroleum oils and fuel on LNG carriers greatly reduces the risk of impacts in the marine environment or on green sturgeon from petroleum spills. The Federal Water Pollution Control Act, as amended by the CWA (33 U.S.C. 1251–1387), prohibits the discharge of oil upon the navigable waters of the U.S. Also, LNG carriers calling on the LNG Project would be required by the Coast Guard to have a vessel response plan in order to be adequately prepared for accidental spills, as described in section 3.2.1.4 for blue whales. As reported by Pacific States/British Columbia annual reports (2002), the number of oil spills reported from fishing, recreational, and other harbor marine vessels in Oregon ranged from about 9 to 65 per year, which is fairly infrequent considering that thousands of marine vessels (both recreational and commercial) utilize Oregon coastal marine waters. Therefore, neither fuel nor oil leaks from LNG carriers transiting in the waterway to and from the LNG Project are likely to have adverse effects on aquatic resources including green sturgeon.

Direct and Indirect Effects – Estuarine Analysis Area

Project-related effects to the Southern DPS of green sturgeon within the estuarine analysis area are summarized below:

1. Interference with key life history functions;

2. Turbidity from construction and maintenance dredging related to the LNG Terminal slip entrance, access channel, and marine waterway modifications, and the Eelgrass Mitigation site;
3. Turbidity effects from temporary in-water construction of other facilities;
4. Suspended sediment potentially released during HDD construction across Coos Bay Estuary and Coos River;
5. Turbidity from LNG carrier propeller wash (propwash) and ship wakes;
6. Erosion and runoff;
7. Stormwater discharge;
8. Stranding of juvenile sturgeons by LNG carrier ship wake;
9. Entrainment during dredging activities;
10. Entrainment and impingement of juvenile sturgeons and prey species at engine cooling water intake portals of LNG carriers while at berth;
11. Effects of lighting systems associated with construction and operation;
12. Effects of noise from dredging and other in-water construction;
13. Effects to habitat and temporary food source reduction from dredging; and

Other potential effects resulting from contaminants, exotic and invasive species, changes in temperature, and shading from structures are also addressed below.

Timing to Life History Functions

In-water construction of the Project within the Coos Bay estuary is planned from October 1 through February 15 following ODFW's recommendation. Because spawning is undocumented in freshwater tributaries to Coos Bay, the estuary most likely supports adult and possibly subadult green sturgeons by providing feeding and migratory habitat. Green sturgeon move into estuaries of non-natal rivers to feed (Beamis and Kynard 1997) and occupy large estuaries during the summer and early fall in the Pacific Northwest. Green sturgeon abundance peaks during October in the Columbia River estuary, but the same may not be true of green sturgeon abundance in Coos Bay. Nevertheless, the Southern DPS of green sturgeon could be present within the estuarine analysis area during in-water construction for the Project and experience interference with key life history functions.

Turbidity Effects from Construction and Maintenance Dredging in Coos Bay

Resuspension of sediments and temporary increases in turbidity above Coos Bay background levels would occur while: 1) installing and removing the temporary earthen berm at the LNG terminal slip, 2) dredging the access channel, 3) dredging marine waterway modification sites, and 4) developing the Eelgrass Mitigation site. Construction of the LNG Terminal slip would require the excavation and dredging of Coos Bay shoreline near Jordan Cove, including removal of about 5.7 mcy of sediment as part of the development of a slip and access channel. The 5.7 mcy of materials would be used to raise the elevation of the LNG Terminal and the South Dunes site to elevations above the tsunami inundation zone.

At least 3.6 mcy at the slip would be removed behind a berm in an upland area separated from the bay, with little potential for sediments to affect the marine environment. The remaining 1.9 mcy would be removed by saltwater dredging of the berm (0.5 mcy) and the new access channel (1.4 mcy) in the bay. The access channel would be dredged to a depth of minus 45 feet (NAVD88). Construction of the access channel and removal of the berm at the slip would require saltwater dredging using a combination of cutter suction and clamshell dredge methods. This would require about four to six months to complete over three in-water work windows (October 1 to February 15).

Aquatic organisms in Coos Bay are adapted to periods of high to moderate total suspended solids (TSS; measured as turbidity and is representative of total suspended solids concentrations[31]) during winter months. Dredge operations are expected to result in exposure to similar levels of TSS, with higher concentrations expected in the immediate area of dredging. Ambient background levels of TSS in water are created by flows, waves, and ship traffic. Within Coos Bay, ambient TSS levels have been assessed based on several studies. As described by Moffatt & Nichol (2006), the average concentration of TSS measured near the proposed LNG terminal site was 14 mg/l with a range of zero to 25 mg/l. This report also references a longer record of Coos Bay background data reported by the National Oceanic and Atmospheric Administration (NOAA) for the period of April 2002 to December 2004 at the Charleston Bridge station located closer to the bay entrance than the LNG terminal site. Based on results from this study, the average summer and winter TSS levels at the Charleston Bridge station were 10.1 and 27.3 mg/l, respectively, which are equivalent to 5.8 and 12.2 nephelometric turbidity units (NTU). Some individual events (e.g., winter storms) measured at the Charleston Bridge were recorded between 100 and 500 mg/l.

More recently, hourly turbidity readings taken at the North Spit-BLM boat ramp gauge were compiled between August 2013 and January 2015. Preliminary data processing was first conducted to remove high turbidity measurements obtained over extended periods of time because these typically occurred when dredging activities were ongoing. In addition, based on an empirical relationship developed for nine streams in the Pacific Northwest, turbidity values expressed in NTUs were converted to TSS in mg/l. Based on these data, the average natural turbidity level was calculated to be 40 mg/l at the North Spit-BLM boat ramp gauge (Moffatt & Nichol 2016).

Turbidity was modeled for the new construction and maintenance dredging operations based on the anticipated geotechnical and environmental conditions for this Project using the COE's DREDGE model and two-dimensional numerical model Mike21 (Moffatt & Nichol 2006, 2017a). Modeling results and additional information provided the basis for characterizing effects from turbidity generated by the various Jordan Cove dredging activities.

Jordan Cove conducted modeling to estimate turbidity and suspended sediment that would result from access channel construction (Moffatt & Nichol 2006) and the construction and maintenance dredging for all proposed bay activities (Moffatt & Nichol 2017b). They estimated the maximum TSS at a specific dredge site using a clamshell dredge to be about 6,000 mg/l, decreasing substantially away from the dredge location. Moffatt & Nichol (2006) also estimated that average turbidity levels during dredging operations (covering changing tidal directions) would not exceed background levels (about 10 to 30 mg/l) for the mechanical dredge at the slip. These levels would be even less for the hydraulic dredge beyond the actual dredge location, while elevated levels would occur outside of the actual dredge area for periods not exceeding 2 hours in duration

[31] Turbidity measurements (NTUs) can be used to estimate TSS concentrations (mg/l) by use of regression models. The term turbidity in the text is generally used to mean the level of TSS in water, unless specifically indicated as NTUs.

depending on tidal direction. At lower tidal velocities, values would not exceed 30 mg/l outside of 200 meters, and at high tidal velocity less than 50 mg/l in 200 meters.

The concentrations and distribution are partly dependent on the type of dredging method that would be used. Proposed methods for dredging include use of mechanical or hydraulic (suction) dredging equipment. While the hydraulic cutter suction dredge is preferred due to its lower turbidity generation, a type of mechanical dredge may be used, especially in portions of the nearshore area due to buried wood. Model results for the access channel and slip construction indicate that elevated TSS above background would extend about 0.2 to 0.3 mile beyond the dredge sites during a full tidal cycle with any method considered and would exceed about 500 mg/l for about 0.1 mile. Maximum concentrations outside of the specific dredge location would only occur for about 2 hours or less over the tidal cycle with the plume moving upstream or downstream of the dredge site on flood or ebb tide, respectively. Turbidity is expected to dissipate to background levels within a few hours after dredge operations cease (Moffatt & Nichol 2017a).

For the marine waterway modification sites, a total of approximately 584,300 cy of dredge material would be removed from four locations (referred to as Dredge Areas 1 through 4) adjacent to the existing Federal Navigation Channel between RM 2 and 7. These areas would be dredged to a controlled depth to match the adjacent Federal Navigation Channel, which is currently -37 feet MLLW. Construction at the four marine waterway modification areas would be done via hydraulic dredging (cutter suction or hopper) or clamshell dredging, or a combination of these. Jordan Cove has indicated hydraulic placement of materials at the upland sites (e.g., APCO Sites 1 and 2, and Kentuck project site) is the preferred method for dredging including material transport with temporary subtidal dredge material transport pipelines (see *Dredged Material Management Plan* [DMMP]; Moffatt & Nichol 2017a). Dredging is expected to require about five months to complete, with an additional 45-day mobilization period, based on an assumed production rate of 7,700 cy per day and could be spread over four in-water work windows. Extending this in-water work over four construction seasons also would improve the logistical feasibility of material placement at APCO Site 2.

Suspended sediment concentrations at the four marine waterway modification sites would reach background level (about 20 mg/l) over a distance of about 1.2 miles[32] with any of the dredging methods. However, hopper style suction dredging would have much higher concentrations during construction with TSS over 500 mg/l extending about 1.0 mile across the dredging site, while the hydraulic cutter suction dredge or mechanical clamshell dredge would produce TSS of 500 mg/l extending about 0.1 mile from the dredge site. The distribution of and concentrations of suspended sediment would be the same for construction and maintenance dredging.

At the Eelgrass Mitigation site, a total of 40,000 cy of dredge material would be removed most likely with a small hydraulic dredge. Modeled turbidity values were determined to be about 1,700 mg/l (about 270 to 290 NTUs) in the active dredging area from the excavator dredging. A turbidity plume having values above background values (20 mg/l [10 NTU]) would generally be limited to between 340 and 360 feet in all directions from the active dredge site (Moffatt & Nichol 2017b). If a mechanical excavator would be used for the Eelgrass Mitigation site construction, a confined area of elevated TSS would extend less than 0.1 mile from point of dredging (Moffatt & Nichol 2017b). Because the site is a more confined and shallow area with somewhat limited

[32] Plume distance noted includes total spread both upstream and downstream of dredge site.

circulation, the turbidity plume would be maintained within the local area of excavation. The duration of suspended sediment settling, therefore, is expected to be very short with turbidity dissipating to background levels within an hour after dredge operations cease, depending on the tidal cycle.

As indicated in Section 3.1.6 of the DMMP (Moffatt & Nichol 2017a) and Section 4 of the 10-17-17 Eelgrass Dredging/Excavation Means and Methods Feasibility Technical Memo, the design approach for dredging and turbidity management at the Eelgrass Mitigation site would involve:

- a hydraulic dredge pump system mounted on a long-reach excavator;
- a 3,900-foot-long, 14-inch-diameter, steel or anchored high-density polyethylene material transport pipeline;
- two booster pumps mounted on small anchored/spudded barges (or on small temporary platforms secured by three to four support piles);
- a loader operating on a 60-foot by 200-foot deck barge stationed near the Federal Navigation Channel in about 20 feet of water;
- several 10- to 24-inch-diameter moorage piles for stationing the deck barge; and
- scows and/or barges equipped with containment berms to accommodate hydraulic loading and settling of dredge material

The containment system on the scows and/or barges would minimize the release of turbid decant water back into the bay. If determined feasible, silt curtains at the dredge site also could be deployed to limit the dispersion of turbid waters to the local embayment as the bathymetry is modified to make it more suitable for eelgrass transplants the following year. As described in section 4.2.2.1 of this BA, other operational controls would be employed to ensure compliance with water quality criteria as would be stipulated in the Section 401 Certification that would be issued by ODEQ. As a result, these turbidity effects to listed fish would be minimal.

Maintenance dredging would occur every three to five years, with dredging taking about a month for the slip and access channel and a week for the marine waterway modifications. This would keep the Federal Navigation Channel depth as it is currently and the LNG slip depth as originally developed. Clamshell dredging is also proposed for maintenance dredging of the slip and access channel, which would result in higher suspended sediment levels than hydraulic dredging as noted above. Thus, after the project-developed initial widening, the current habitat structure of the Federal Navigation Channel would remain unchanged and slip area would be as originally developed following each maintenance dredging cycle.

Based on the DMMP prepared by Moffatt & Nichol (2017a), maintenance dredging is expected to occur every three years for the first 10 years of LNG Project operation. During this interval, dredge volumes are expected to be approximately 115,000 cy per dredging event. For the access channel, modeling results for maintenance dredging are the same as for construction dredging of the access channel, as noted above. However, the dredging of the slip would only be exposed to the larger bay during maintenance dredging. After the first 10 years of operation, maintenance dredging is expected to occur every five years, with an estimated total volume per dredging event of 160,000 cy. Future maintenance dredging of the slip and access channel would likely be conducted using a mechanical clamshell dredge, which consists of a close-lipped bucket operated from a floating barge. The close-lipped bucket is specifically designed to reduce sediment resuspension into the overlying water column by forming a seal when the bucket surfaces. The material removed by clamshell dredging would be placed on either a flat-deck barge with watertight sideboards, or a bin-barge with one or multiple cells. The material would be transported to the APCO sites. Saline decant water that does not evaporate or percolate into the sand below dredge disposal sites would be discharged back into the marine slip or bay at APCO via an outfall pipe. Return water from the decanted dredge material would be required to meet appropriate water quality standards (Moffatt & Nichol 2017a).

On average, the COE removes approximately 550,000 cy from the bar, 200,000 cy from Channel Mile (CM) 2 to 12, and 150,000 cy from CM 12 to 15 each year. The COE claims that its maintenance dredging of the Federal Navigation Channel does not significantly increase turbidity below CM 12 (Roye 1979).

If green sturgeon are exposed to moderate to high levels of suspended sediment for prolonged periods, adverse effects could occur to rearing fish. As noted, dredging is expected to create spikes of high to moderate turbidity in a localized area. However, effects to green sturgeon are expected to be insignificant and discountable because of the limited area affected, the low likelihood of individual fish being present in the estuary, and limitations on construction periods.

Contamination Effects from Dredging

Sediments within the proposed dredge prism for the access channel were sampled to determine whether they meet Dredged Material Evaluation Framework (DMEF) guidelines, as identified for the Lower Columbia River Management Area, for in-water disposal (SHN 2006). An analysis of grain size distribution and total volatile solids composition was initially performed to determine if the sediments require further testing for chemical analysis. All of the samples were primarily composed of medium to fine grained sand and had a very low percentage of total volatile solids. Since none of the samples exceeded 20 percent fines or 5 percent total volatile solids, no further chemical testing was required and the sediments were deemed suitable for in-water disposal, according to DMEF guidelines. These findings indicate that resuspension of sediments associated with the dredging for the access channel should not result in significant increases in the bioavailability of contaminants to fish and fish food organisms within the analysis areas. Therefore, there is little to no risk of contamination as a result of dredging the access channel.

This conclusion is further supported by previous sediment evaluations conducted by the COE in 2004 for Coos Bay channel maintenance and improvement dredging at various stations along the Federal Navigation Channel (COE 2005). Throughout the entire sampling area, only low levels of sediment contaminants were identified, with all levels well below their respective DMEF screening levels. One of the sampling stations (0915CB-BC-10) was located approximately 0.4 mile downstream of the LNG terminal. The 2004 sediment sampling effort found only low levels of chemical contaminants, with all levels below their respective DMEF screening levels. None of the samples contained dichlorodiphenyltrichloroethane (DDT) or its derivative by-products (dichlorodiphenyl-dichloroethylene [DDE], dichlorodiphenyldichloroethane [DDD]) at levels that could cause adverse effects to fish resources.

Turbidity Effects from Temporary In-water Construction

Additional in-water construction activities are likely to temporarily increase TSS concentrations and turbidity. Such increases would result from in-water construction related to the:

- Temporary Material Barge Berth (TMBB),
- MOF,
- Trans-Pacific Parkway/US-101 Intersection Widening,
- Pile dike rock apron installation at pile dike 7.3,
- APCO Site access bridge construction,
- Replacement of anchoring systems for existing three meteorological ocean data collection buoys as well as addition of anchoring systems for two new buoys near the access channel, and
- Establishment of hydraulic connections to the Kentuck project for estuarine habitat mitigation.

Turbidity increases would be localized and limited to the time required to complete each of the respective LNG Project components. Construction activities would occur within the ODFW in-water work window (October 1 to February 15). Effects to green sturgeon are expected to be insignificant and discountable because of the limited area affected, the low likelihood of individual fish being present in the estuary, and limitations on construction periods.

Suspended Sediment – HDD across Coos Bay Estuary and Coos River

Coos Bay would be crossed by two HDDs, one from MP 0.28 to MP 1.00 (West HDD) and the other from MP 1.46 to MP 3.02 (East HDD). The Coos River (a tributary to the estuary) would also be crossed using HDD at MP 11.13. At that location, the Coos River is under tidal influence and is addressed here in the estuarine analysis area rather than in the riverine analysis area.

An HDD involves drilling a pilot hole, then enlarging that hole through successive reaming. High pressure drilling fluids, usually consisting of a slurry made of bentonite clay mixed with water, would be jetted at the drill head to advance the hole. Pipe sections long enough to span the entire crossing would be staged and welded along the construction work area on the opposite side of the waterbody, hydrostatically tested, and then pulled through the drilled hole. The right-of-way between the entry and exit hole of an HDD would generally not need to be cleared or graded, except for the area of the guide wires. Additionally, direct impacts on the waterbody, adjacent riparian vegetation, and associated aquatic resources would be avoided through an HDD. An HDD should not result in an increase of suspended sediments into the stream crossed, unless there is an "inadvertent return" or release of drilling mud, as discussed below.

The horizontal crossing length of the West HDD would span 5,192 feet, extending from the North Spit to the southeast, crossing the Federal Navigation Channel and terminating at North Point in North Bend, Oregon. The feasibility analysis for the West HDD anticipates a relatively low risk of hydraulic fracture and drilling fluid surface releases occurring along most of the HDD alignment during construction. The horizontal crossing length of the East HDD would span 8,972 feet extending from North Point in North Bend, Oregon eastward across Coos Bay and ending at the mouth of Kentuck Slough. Surface conditions at North Point at the west end of the HDD consist of a relatively flat ground surface covered with fill stockpiles. The east end of the HDD would be located within a flat grass vegetated area in Kentuck Slough valley.

The alignment of the HDD would cross the Federal Navigation Channel and shallow tidal mud flats east of the Federal Navigation Channel. GeoEngineers (2017a) anticipates that the HDD would be completed using pilot hole intersect methods because of the substantial length. Because this crossing would be completed using pilot hole intersect methods, both ends are identified as entry points. For this design, the carrier pipe would be strung and fabricated along the Kentuck Slough valley floor on the east end of the crossing. The proposed carrier pipe stringing area would be located northeast of the east entry point along the Kentuck Slough valley floor. Kentuck Slough and Kentuck Way limit the available pipe string length to 5,293 feet, so a tie-in weld would be required during pullback operations. The orientation of the HDD alignment would require two horizontal curves in the pull section, making fabricating and handling the pipe more difficult and increasing the complexity and risks associated with this crossing.

Drilling fluid containment would be via relatively small fluid containment pits excavated adjacent to the entry points of the drill. These pits typically measure approximately 6 to 10 feet square and 4 to 6 feet deep. During drilling operations, drilling fluid returns and cuttings from downhole flow into the pits where the fluid is then pumped to a recycling system where most of the cuttings are removed and the drilling fluid can be recirculated downhole (GeoEngineers 2017a).

Because of the length of the HDD, there would be an increased risk of drilling fluid surface release during reaming operations. This risk can be reduced by reaming the hole from both ends of the crossing. Use of large-diameter casings near entry and exit locations would reduce the risk of fracing fluid reaching surface waters. This methodology helps reduce downhole annular drilling fluid pressures by shortening the flow path of the drilling fluid through the hole. Although this increased risk does not necessarily affect the technical feasibility of the proposed HDD, reaming from both sides of the crossing could potentially have cost impacts that may require consideration. In general, GeoEngineers (2017a) expects the risk of drill hole instability along the HDD drill paths to be relatively low. Minor hole instabilities may be encountered within the very loose to loose soils expected along the upper portions of the HDD profile at the east end near Kentuck Slough, but that condition would not jeopardize the successful installation of the product pipe. If hole instabilities are anticipated within the shallow portions of the drill profiles, large-diameter casing can be installed through the tangent sections of the drill profiles to stabilize those areas.

According to GeoEngineers' design (2017b) for construction using HDD across the Coos River (see appendix E), the design length of the Coos River HDD crossing would be approximately 1,602 feet. The proposed entry point would be located approximately 500 feet from the north bank of the Coos River and the exit point would be approximately 630 feet from the south bank. The entry and exit points would allow for adequate depth beneath the Coos River. The preliminary design provides a minimum of 50 feet of cover below the Coos River. GeoEngineers' evaluation determined that the construction of the Coos River HDD crossing is likely feasible. GeoEngineers state that there is a risk of hydraulic fracture and drilling fluid surface releases along the first 500 feet and last 300 feet of the HDD, respectively. However, the risk of drilling fluid surface release to the Coos River would be relatively low, partly because these high-risk regions are not under the river bed and are deep, except near the exit locations. As is typical with all HDDs, the risk of drilling fluid surface release increases within approximately 150 feet of the exit. Drilling fluid surface releases may occur within these zones even if the contractor maintains drilling fluid returns during construction and also maintains drilling fluid properties that are conducive to cuttings removal and formation of a "wall cake" to help stabilize the borehole and limit fluid interaction between the borehole and surrounding soils (GeoEngineers 2017b).

Inadvertent Release of Drilling Muds (Inadvertent Return)

The HDD installation method is considered an effective technique for significantly reducing in-stream impacts (Reid and Anderson 1998; Reid et al. 2004). Even with this technique, there is a potential for impact as a result of the HDD process. Drilling requires use of a drilling mud for lubrication of the bit and removal of cuttings. A biodegradable bentonite clay mixture makes up drilling mud; bentonite is considered to be "practically non-toxic" (Reid and Anderson 1998). Because the drilling mud is under pressure during drilling, if the bit encounters substrate fractures or channels, it is possible for bentonite to escape from the hole (termed an "inadvertent return"). Bentonite can escape to the surface through fractures in the drilled substrate.

Bentonite by itself is generally considered a non-toxic drilling mud (Breteler et al. 1985; Hartman and Martin 1984; Sprague and Logan 1979), although according to Reid and Anderson (1998), the toxicity of bentonite (sodium montmorillonite) in fresh water ranges from 5,000 to 19,000 parts per million (ppm; mg/l) based on 96-hour tests for LC_{50} (the concentration at which 50 percent of the test population dies after 95 hours of exposure) on rainbow trout. The toxicity classifications based on LC_{50} values ranged from "slightly toxic" (5,000 ppm) to "practically non-toxic" (19,000 ppm) (Reid and Anderson 1998). In other tests, toxicities to lake whitefish and rainbow trout demonstrated threshold concentrations of 16,613 and 49,838 ppm (mg/l), respectively (Reid and Anderson 1998). LC_{50} concentrations greater than 10,000 ppm would be considered "practically non-toxic". In marine water, a 96-hour LC_{50} bioassay for toxicity of bentonite on a mysid shrimp (*Mysidopsis bahia*) was greater than 1,000,000 ppm (Reid and Anderson 1998).

Bentonite, as with any fine particulate material, can interfere with oxygen exchange by the gills of aquatic organisms (EPA 1986). The degree of interference generally increases with water temperature (Horkel and Pearson 1976). Impacts would be localized and would normally be limited to individual fish in the immediate vicinity of the inadvertent return. The majority of highly mobile aquatic organisms, such as fish, would be able to avoid or move away from turbidity spots and plumes (Reid and Anderson 1999). Other less mobile or immobile organisms, such as clams, mussels, and other macroinvertebrates, would incur direct mortality (Wilbur and Clark 2001). Bentonite can smother macroinvertebrates and adversely affect filter-feeders (Falk and Lawrence 1973 in Hair et al. 2002 and Land 1974 in Cameron et al. 2002). Bentonite can also exacerbate or enhance the effects of toxic compounds to fish and aquatic invertebrates if those compounds are present in aquatic habitats (Hartman and Martin 1984). Similar to other fine-grained particulates, bentonite in flowing water is more likely to remain in suspension longer than in standing water. Consequently, effects to green sturgeon by a release of bentonite into a waterbody would ultimately depend on volume of the release, volume of water present, and current. Green sturgeon inhabiting the Coos Bay estuary would not be significantly affected. Green sturgeon spawning would not occur within the estuarine or riverine analysis areas and larval sturgeons are not expected in either area.

In the event an inadvertent return occurs into a waterbody, drilling fluid would enter the waterway causing short-term, temporary water quality impacts downstream of the project area including sedimentation and turbidity. The behavioral avoidance response of green sturgeon is presumed to be triggered within the immediate vicinity of the release, and the fish are expected to return and utilize the affected area shortly after the inadvertent release has been halted. Pacific Connector's *Drilling Fluid Contingency Plan for Horizontal Directional Drilling Operations* (see appendix D) describes how the drilling operations would be conducted and monitored to minimize the potential for inadvertent drilling mud releases. The HDD Contingency Plan also includes procedures for cleanup of drilling mud releases. If significant concentrations are found during monitoring as a result of a release, the following possible corrective measures would be taken:

1. Deployment of containment structures, if feasible, and removal of drilling mud from substrate and streambanks if possible.
2. Increase the drilling fluid viscosity in an attempt at sealing the point at which fluid is leaving the drilled hole. The drilling operation may be suspended for a short period (i.e., overnight) to allow the fractured zone to become sealed with the higher viscosity drilling fluid.
3. If increasing the drilling fluid viscosity is ineffective, lost circulation materials (LCM) may be introduced into the hole by incorporating them in the drilling fluid and pumping the material down-hole. The drilling operation may again be suspended for a short period (i.e., overnight) to allow the fractured zone to become sealed with the LCMs.
4. Depending on the location of the fractured zone, a steel casing may be installed that is of sufficient size to receive the largest expected down-hole tools for the crossing. This casing installation provides a temporary conduit for drilling fluids to flow while opening the remaining section of the hole to a diameter acceptable for receiving the proposed pipe sections. To alleviate future concerns with the steel casing after the HDD installation is completed, the casing is generally extracted from the hole prior to or just after completing the HDD installation. However, there have been instances when attempts at extracting the steel casing were unsuccessful.
5. In the event drilling fluid flow is not regained through the annulus of the drilled hole and a steel casing installation is not utilized, the HDD contractor may elect to install a grout mixture into the drilled hole in an attempt to seal the fractured zone. The down-hole drilling assembly is generally extracted and existing hole is re-drilled to the point at which it had previously been drilled prior to having encountered the loss of drilling fluid.

In some instances, it may be determined that the existing hole encountered a zone of unsatisfactory soil material and the hole may have to be abandoned. If the hole is abandoned, it would be filled with cuttings and drilling fluid.

The HDD location on the Coos Estuary and Coos River has a large volume of water and swift flows, where the drilling mud would be diluted. If an inadvertent release of drilling mud from an HDD occurred on the Coos River, it would have minor short-term adverse effects to aquatic resources including green sturgeon. Likewise, inadvertent release of drilling mud from one or both HDDs beneath Coos Bay would be expected to have minor short-term consequences to water quality and substrate composition and characteristics in the estuary.

Dispersion of drilling fluids from a release site (inadvertent return) is a function of the energy, salinity, and sediment transportation characteristics of the watercourse and the amount of fluid released. In low-flow areas such as tidal mudflats, releases would exhibit limited horizontal transport. If drilling fluid is released into Coos Bay, the drilling fluid would not likely mobilize as it would in a rapidly moving river (Reid and Anderson 1998). Coos Bay is relatively shallow throughout much of the HDD alignment. The mudline becomes exposed during low tides across much of the alignment except within the dredged shipping channel. In the event of a drilling fluid release into Coos Bay, the drilling fluid would likely settle onto the bay floor, where it could be contained and removed (see *Drilling Fluid Contingency Plan for Horizontal Directional Drilling Operations*; appendix D). Since marine bioassays suggest bentonite to be non-toxic (Reid and Anderson 1998), a coating of bentonite on mudflats would most likely create a temporary physical barrier to benthos burrows and interfere with species' feeding mechanisms, similar to existing depositional phenomena in the estuary. If drilling fluid is released into Coos Bay, it would be addressed in accordance with the provisions of the *Drilling Fluid Contingency Plan for Horizontal Directional Drilling Operations* (see appendix D). Therefore, it is unlikely that any drilling fluid released would remain on the bay floor and not be captured and cleaned up.

Turbidity Effects – LNG Carriers in the Waterway

Propwash from LNG carriers and tug boat propellers associated with the Project, as well as ship wakes (waves) breaking on shore, could cause increased erosion along the shoreline, re-suspend the eroded material within the water column, and displace bottom organisms due to bottom scour. This may affect the diversity and health of the benthic community regarding food availability and feeding conditions for foraging and migrating fish species. At high concentrations, suspended sediments can affect oxygen exchange over the gills, resulting in weakened individuals or mortality. Waves from vessels breaking on the shoreline can also cause fish stranding. The possible magnitude and effects of the proposed Project including approximately 120 inbound and 120 outbound LNG carrier trips per year on shoreline erosion were approximated by Jordan Cove through model studies, the results of which are discussed below. Overall effects on bank and bottom erosion and elevated suspended sediment effects are expected to be unsubstantial.

Model Parameters

To estimate the effects of waves and propwash from LNG carriers in Coos Bay, Jordan Cove developed two separate model approaches. One was developed by Moffatt & Nichol (2008b) and another by Coast and Harbor Engineering (CHE; 2011). Both used similar baseline information but different approaches to determine likely effects on shoreline erosion. These models assumed that upon entering Coos Bay, LNG carriers would travel at approximately 8 to 10 knots (9.2 to 11.5 mph) within the first mile of the Coos Bay entrance. For the remainder of the route to the LNG Project, LNG carrier speed would be approximately 6 knots (6.9 mph) or less. Vessels would be assisted by tugboats during transit and docking. Both models assumed that the maximum speed of the LNG carriers would be 6 knots (6.9 mph) and made comparisons to natural waves' effects in the bay. The Moffatt & Nichol model (2008b) assumed about 200 vessel transits per year (combined inbound and outbound; about 180 combined vessel transits are proposed) of a 934-foot-long vessel traveling at about 6 knots (6.9 mph), which is the upper range of speed that may occur during transport within the Federal Navigation Channel for LNG carriers. Note that these values are based on transit numbers related to the Project as proposed in 2008.

The CHE (2011) model, however, used the wake generated by the tugboat providing transport in the bay as it would be traveling at the same speed as the LNG carrier and would actually generate larger waves. CHE (2011) also compared the energy, size and effects of waves produced by proposed LNG carriers to those generated by existing large vessel traffic in the Coos Bay route as well as natural wind waves. Both models considered the effect of waves at varied locations from near the mouth of Coos Bay to near the docking facility of the LNG carrier (seven to nine locations along the proposed LNG route for the two models). In consultation with state agencies (ODEQ and ODFW), CHE selected model points that were considered “sensitive” areas. Their model assumed 113 round trips (i.e., 226 vessel channel transits) of LNG carriers annually traveling at about 6 knots (6.9 mph) along most of the route but 4 knots (4.6 mph) near the airport. Note that these values are based on transit numbers related to the Project as proposed in 2011.

Jordan Cove has conducted a more recent vessel wake analysis recently (Moffatt & Nichol 2017c). This study compared two modeling scenarios: “without project” and “with project.” The “with project” scenario included the latest anticipated dredged depths for the Federal Navigation Channel, access channel, and marine slip. This study also incorporated the latest anticipated vessel characteristics for the new facility, which included 240 vessel transits, bulk carriers and tugs. For the “with project” scenario, all LNG carriers were assumed to travel no faster than 5 knots, with tugs traveling up to 10 knots outbound. Note that these values are based on transit numbers related to the Project as currently proposed. Results of the 2017 wake analysis are summarized below.

Wave Model Results

The Moffatt & Nichol (2008b) model found that the maximum wave height generated would be about 1.1 feet. Although waves of this size occur throughout much of the bay, they only occur about 2 percent or less of the time annually based on the locations modeled. Among the seven locations chosen by Moffatt & Nichol, the model predicted that the waves generated would equal from 0.0 to 3.1 percent of the annual wave energy at these locations above the current wave energy level.

The CHE (2011) model compared the two measures of potential changes of shoreline waves from LNG carrier activity. The first was a comparison of single event (one vessel passage) shoreline wave energy (as measure by wave velocity) to that of existing large Coos Bay vessels that already occurs. The other comparison was overall cumulative yearly effect of LNG passage to that of existing vessels and that generated by natural wind waves. Their model results showed that the single passage events of LNG carriers would have slightly less shoreline wave impact (as measured by average wave velocity at the shore) per event than that of large existing vessel passage. Existing large vessel velocity was assumed to be 10 knots (11.5 mph), which is greater than the lower velocity of 6 knots (6.9 mph) typical of LNG carriers and likely affected this result. This model estimated example direct shore wave height to be less than about 0.6 foot for the assumed mean higher high water tidal conditions for LNG carrier passage.

The CHE model simulated varied natural wind and tidal conditions (1,080 total combination conditions) to estimate wave effects on the shore sediment transport. One example of data results for high wind conditions indicated a maximum wave height near 0.9 foot high at some shore locations (assuming a 22 knot [25.3 mph] west wind). The model results indicated that nearly all of the annual shoreline wave-generated sediment transport would be generated by natural wind waves (greater than about 90 percent at all locations modeled). Overall, the model estimated that additional waves generated by the new LNG carrier traffic could increase shoreline sediment transport at the modeled point by 5 to 8 percent over existing conditions (wind-generated waves plus existing large vessel–generated waves).

Overall, while both of the CHE models indicated some additional shore sediment movement could occur from the waves generated by the passage of LNG carriers through Coos Bay, the effects would be small because increased waves would occur infrequently, contribute a very small portion of total annual wave energy and sediment transport, and be within the normal magnitude of waves that naturally occur within the bay. Therefore, the total effect is likely to be within the range of natural annual variability of wave conditions.

Additionally, the analysis indicates that the outer mile of the entrance, where LNG carriers would be traveling at 8 to 10 knots (9.2 to 11.5 mph), may have higher vessel-generated waves because of the greater speed. However, this area is already less protected from naturally occurring ocean-generated waves (this region directly faces the ocean entrance) and likely has higher background naturally generated waves than the regions farther in the bay. Overall, increased sedimentation and disruption of aquatic nearshore habitat from additional tugboat and LNG carriers generated waves would be unlikely because of the factors noted above.

The results of the more recent vessel wake analysis indicates the drawdown generated by LNG carriers' departure and arrival under the proposed Project would be lower than existing conditions (0.4 to 0.5 feet for bulk carriers compared to 0.1 to 0.2 feet for LNG carriers at the shoreline). The tug vessel trips leaving to meet LNG carriers would be at these higher speeds, as high as 10 knots, and occur about 120 times per year, but tug trips may not all be made at these higher speeds. The predicted tug-generated wave heights at the shoreline are higher (0.6 to 0.8 feet) than with the bulk carriers under the proposed project. Each vessel passage would generate some form of wave for about 15 minutes (CHE 2011), with the peak wave period much less in duration. This compares to a natural wave frequency that would last much longer (e.g., hours or days). The induced waves from these additional vessels, with the possible exception of outgoing tugs, would have an unsubstantial effect on shoreline erosion as they are well within the naturally occurring, wind-generated wave heights ranging from about 0.5 to 3 feet (CHE 2011; Moffatt & Nichol 2017d). The wave effect on the shoreline from increased vessel transits can be managed by reducing vessel speed (Moffatt & Nichol 2017d). FERC does not have authority over the LNG carriers; however, the independent carrier operators would be required to follow all Coast Guard requirements regarding the operation of LNG carriers, including vessel speeds.

Propeller Wash Model Results

Effects of propwash on bank and bed erosion were estimated by the CHE (2011) and Moffatt & Nichol (2008b) reports noted above. The two models estimated the likely bottom velocity and effects to sediment along the entire route. An additional model was developed specifically addressing propwash effect at the access channel, MOF, and slip (Moffatt & Nichol 2017d). These models considered boat and bottom sediment characteristics in the area of interest and tidal levels when transport and docking would occur. The effects of propwash from LNG carriers and related tugboat vessels on bottom erosion and turbidity likewise would not reach levels to cause substantial disruption to benthic or pelagic resources other than in the immediate access channel and slip area. However, as noted below, there are some areas near the entrance to the access channel that would experience bottom erosion and likely benthic disruption as the LNG carrier and tug boat leave after loading.

The Moffatt & Nichol (2008b) report indicated that along most of the route (approximately from CM 1 to the new access channel for the LNG Project) bottom disturbance would be slight within the Federal Navigation Channel. The bottom velocity caused by the propeller would be similar to the maximum velocity of peak tides (about 4 feet per second [ft/sec]). However, near the docking location, they estimated bottom velocity would be roughly double, or about 7 to 8 ft/sec. The report noted that along most of this route the main channel bottom is considered coarse (sand and sandstone). This type of substrate is hard to suspend and rapidly settles. Generally, no marked bottom disturbance or sediment suspension would occur along most of the route, as the increased velocity would be similar to maximum tidal currents. Within about the last half- to quarter-mile before reaching the slip (based on the point selected for modeling) is where bottom velocity is increased. Some increased bottom scour and locally elevated turbidity may occur in this area, but the effects would be limited in dimension. Disturbance would be limited, partly due to the coarse (mostly sand) bottom substrate that is relatively resistant to resuspension and rapidly settles.

The CHE (2011) report found slightly different results using a different model. It reported that maximum bottom velocity in a narrow band along the route would be 13 ft/sec, higher than the previous report. This report also noted that maximum velocity diminished rapidly from directly below the propeller to 0.6 ft/sec along the edge of the Federal Navigation Channel (150 feet from mid-channel), which is below levels that would suspend fine sediment. Based on model results, bottom velocity greater than about 4 ft/sec would occur only in an approximate 80-foot-wide band. Therefore, velocity generated by the propeller in excess of tidal flow velocity would be limited to a narrow band in the mid-channel, limiting the area where sediment may be suspended from propeller actions of the LNG carriers. Additionally, as noted by Moffatt & Nichol (2008b), this region is generally of coarser sediment that is less prone to suspension.

The CHE (2011) report also modeled likely bottom disturbance from existing large vessel transit (assumed 106 trips annually) in the bay and found that bottom velocity from these would be slightly greater than that of the LNG carriers (projected 113 trips annually). The current estimated number of LNG carrier trips has only changed slightly (120 trips), so the comparisons noted are still valid. Therefore, during LNG carrier transit, where these high bottom velocities occur, some sediment would be moved during arrival and departure. This would occur below the intertidal area. Turbidity would likely be slight due to the coarse characteristics of the Federal Navigation Channel sediment that is resistant to current-induced suspension and resulting in turbidity having unsubstantial direct effects from elevated suspended sediment to green sturgeon.

The CHE (2011) report also modeled velocities and likely effects on sediment scour at the access channel and marine slip from a tugboat pushing an LNG carrier into the dock. Assuming very high power use by the tug to dock the LNG carrier, the model estimated maximum velocity on the far bank (about 275 feet from the propeller) would be mostly less than 2.0 ft/sec, which would be unlikely to erode the bank. Furthermore, this area would be armored so no erosion would occur. Near the bottom, maximum velocity in the docking channel would be about 2.16 ft/sec. Sediment analysis suggests that over 95 percent of the bottom material (mostly silt/clay size) in the access channel would be susceptible to suspension at this velocity. The report also estimated that bottom scour would be limited to about 2 inches over a limited bottom area (approximately 100 by 50 feet) in the access channel. Some bottom disturbance would likely occur during docking. In most cases, this disturbance is likely to be much less than estimated because of the conservative assumptions used for this model. Again elevated suspended sediment levels during LNG carrier docking are expected to be brief and have only short-term local effects to any green sturgeon in the docking area.

An updated 2017 propwash memo (Moffatt & Nichol 2017d) included modeling the use of ship engines and tug assist for berthing and unberthing in the marine slip area. The model assumed the LNG carrier engines and propellers would be used in addition to that of tugs for this action. While berthing had low potential for scour, unberthing with the use of LNG carrier propeller engagement could cause high potential for scour in the access channel and slip area. Results indicated high propwash velocities along the east side of the slip during unberthing. The largest bottom velocities (13.6 ft/sec) were estimated to occur on the eastern side of the access channel and slip near the MOF. During berthing, the largest bottom velocities (5.4 ft/sec) are expected to be near the western slope within the access channel and slip.

Scour depths were estimated to be nearly 0.5 foot due to propwash near the eastern side of the access channel and slip if there is no slope protection installed. Overall, about 12 acres of bottom could be scoured to a depth over 0.2 foot. However, slope protection is planned for each side of the slip, and for the east and west sides of the access channel. Turbidity plumes could likely occur briefly in the vicinity of the slip and access channel primarily near the bottom during the period of unberthing. The turbidity increase would be local and settle once the propellers stop. These results do not change the earlier conclusion that suspended sediment levels during carrier docking are expected to only have short-term localized effects to individual green sturgeon that may occur in the docking area.

Erosion and Runoff from Jordan Cove Upland Facilities

Impacts on marine resources could occur from the clearing of vegetation at the terminal, erosion and sediment runoff, and potential hazardous substance spills during construction. While no streams are present in the upland portion of the terminal, the removal of vegetation could modify the character and amount of water runoff that makes it to the bay.

Nearshore vegetation clearing could indirectly affect aquatic resources in the bay. However, the amount of nearshore vegetation that would be removed for this Project is small compared to the extent of shoreline associated with the affected parcels. Also, the existing disturbed shoreline near the South Dunes site would be used as a temporary laydown area, thereby minimizing the extent of vegetative clearing necessary.

During construction, uncontrolled increases in sediment runoff to Coos Bay could impact local aquatic resources. Jordan Cove would prevent uncontrolled releases of sediment runoff during construction by implementing erosion control and revegetation measures from its *Plan* and *Procedures*. Additionally, accidental spills of hazardous materials (e.g., equipment fuel, oils, and paints) during construction could have effects on aquatic resources in the bay. Jordan Cove prepared a draft site-specific SPCCP to minimize the potential for accidental releases of hazardous materials. BMPs for erosion and pollution control are outlined in appendix N – Conservation Measures.

Stormwater Discharge

Stormwater discharge has the potential to contain chemicals toxic to green sturgeon. However, the NPDES permit that the applicants would obtain requires discharges to not modify state water quality standards of the receiving water. The stormwater permit application states, “The permit registrant must not cause a violation of in-stream water quality standards.” Because the water quality standards are designed to protect aquatic resources, including green sturgeon, the applicants are to ensure the standards are not exceeded, and therefore not cause adverse harm to the aquatic resources. Thus, issuance of the permit by the state should ensure that aquatic resources are protected. However, it is known that stormwater runoff often does result in chemical concentration values at the point of discharge in excess of EPA water quality criteria (WDOE 2009). The general characteristics of the stormwater system and levels of some discharge items are presented below.

The proposed stormwater management system is designed to direct any flow that does not come into contact with any equipment containing potential contaminants (e.g., grease or lubrication oil) to designated areas for treatment. Treatment of runoff from areas that have low potential for oil or grease contamination would generally consist of on-site infiltration to treat for suspended solids. Cartridge filter vaults may also be used in some locations. Stormwater collected in areas that are potentially contaminated with oil or grease would be pumped or would flow to the oily water system. Primarily, these localized drains are located around equipment to contain grease and/or lubrication oil. The oily water from the collection sump overflows to the oily waste separator package, which is equipped with plate type separation devices to remove any oil and grease washed down from the facility equipment. Recovered oil and grease is held in the sump and periodically pumped directly to storage drums for disposal. The oily water system would flow to the oily water separator package(s) before being treated and discharged to the IWWP. The facility would be designed to provide drainage of surface water to designated areas for disposal in accordance with 49 CFR § 193.2159. Stormwater collection and treatment facilities would be designed to meet regulatory requirements from the NMFS and ODEQ.

The proposed oil and grease treatment system is designed to limit discharges of oil and grease. This system design would ultimately need approval from the State to obtain the NPDES permit. The treatment system function is an additional level of protection for inadvertent spills that come into contact with stormwater. The facility is not designed to intentionally mix oil and grease with stormwater, and there are no continuous discharges of oil and grease from the LNG terminal. Discharges from the LNG terminal that could contain oil and grease would be directed to the oily water treatment system. This system would reduce the risk of stormwater affecting aquatic resources including listed fish.

LNG Terminal Site

The LNG facility and marine LNG loading area would include various drainage elements to manage segregated networks for contaminated and uncontaminated water from designated areas. Liquid effluent from the LNG facility and marine LNG loading area consists mainly of water from rainfall, protection of equipment with fire water, processing areas, storage areas, domestic areas, and utilities units. Water from all oil-filled equipment in LNG spill impounding basins would be pumped by submersible pumps to the oily water treatment system. Stormwater from areas other than LNG spill impounding basins would be collected in a system of stormwater swales, a buried storm water system, infiltration basins, and other treatment facilities. Stormwater facility overflow outfalls would ultimately connect to Coos Bay.

Jordan Cove prepared a stormwater management plan[33] to address stormwater system design, which would require approval from ODEQ. Impervious surfaces associated with the LNG Terminal site include concrete at operational laydown areas, vehicle offloading areas, secondary containment areas, and working areas for operational maintenance. General surfacing in other areas where operational maintenance access would potentially be required would be dense-graded

[33] Included as Appendix J.2 to Jordan Cove's Resource Report 2 as part of their September 2017 application to the FERC.

aggregate. In the areas of the Administration building and the SORSC building, finished surfacing would be asphalt for the parking lots and concrete for the helipad. The gas metering station would be surfaced with dense-graded aggregate. Runoff would be separated into either the stormwater system or the oily waste system. Stormwater with a high potential to encounter oil and grease pollution would be contained via curbs or other means and routed to an oil/water separator prior to disposal through the IWWP according to the applicable the NPDES permit requirements. For areas of the site where stormwater has a low potential to encounter oil and grease pollution, the first flush of stormwater would be treated onsite by either infiltration facilities, flow-through type cartridge filter devices, or vegetated side slopes. Infiltration facilities would provide treatment for the majority of the stormwater falling on the site. The facilities would be designed to capture and infiltrate all stormwater for 100 percent of the 2-year, 24-hour storm. Overflows from the infiltration facilities would be routed to pipe outfalls in the slip and Coos Bay. For locations that are not feasible to infiltrate, stormwater would be routed to cartridge filter devices, where the treated effluent would be discharged to Coos Bay. Stormwater from access roads to the site would flow through vegetated side slopes or ditches for treatment prior to being discharged to natural grade.

Industrial wastewater would be conveyed to the Port's existing ocean outfall, pursuant to the NPDES permit issued by the ODEQ. Stormwater collection and treatment facilities would be designed in consultation with NMFS and the ODEQ.

During construction, spills or leaks of hazardous liquids such as fuel or oil associated with construction equipment have the potential to reach surface waters including Coos Bay. Potential effects from a fuel spill would likely be short-term but could be detrimental to aquatic species within localized spill areas within the estuarine analysis area. Petroleum-based contaminants such as fuel, oil, and some hydraulic fluids contain PAHs, which can be acutely toxic to the aquatic environment for fishes and can also cause lethal and chronic sublethal effects to aquatic organisms (Breteler et al. 1985). Potential impacts from these spills would be avoided or greatly reduced by regulating storage and refueling activities, and by requiring immediate cleanup should a spill or leak occur. In order to avoid the contamination of surface water, the preliminary SPCCP, prepared for the construction phase; describes the measures that would minimize the potential for accidental releases of hazardous materials and to establish protocols concerning minimization, containment, remediation and reporting of any releases that occur. The SPCCP would be included as part of the NPDES permit.

The operation of the LNG Project would not require or produce large quantities of hazardous materials. Solvents and paints would be used during normal maintenance activities and would be kept in specialized containers with secondary containment to prevent spills. Within the LNG Terminal would be a system of curbs, drains, and basins that would contain and collect accidental spills or leaks, thus preventing releases into Coos Bay that may impact water quality and reduce feeding opportunities for aquatic species within the estuarine analysis area. For the operational phase of the LNG Project, the preliminary SPCCP, to be included as part of the NPDES permit, would minimize the potential for accidental releases of hazardous materials and to establish proper protocol concerning minimization, containment, remediation, and reporting of any releases that occur. This SPCCP would meet the requirements of 40 CFR Part 112.

If a spill were to occur, the hazardous material from the concrete basins would be collected and trucked offsite to appropriate disposal areas. In the unlikely event that an accidental spill of LNG were to occur, no effects on marine life are anticipated. LNG is not toxic and, if spilled on water, would vaporize when exposed to the warmer atmosphere, and this vapor, being lighter than air, would rise. LNG is not soluble, does not mix with water, and would not result in effects to marine life.

During the operation of the LNG Project, LNG carriers calling on the LNG terminal could have accidental releases of fuels or other contaminants found on all ships. Since there is no planned bunkering (i.e., loading of fuel oils) for the LNG carriers, these spills would be limited to small inadvertent spills of petroleum-based fuels and lubricants from equipment onboard that would be managed according to the carrier's oil spill response plan. These products are kept in relatively small quantities on ships and therefore would not result in the types of volumes associated with a spill from an oil tanker. Depending on the timing, weather conditions, and the efficiency of the response and cleanup, localized adverse impacts may still occur depending on the proximity to aquatic habitat.

Trans-Pacific Parkway/US-101 Intersection Widening

Stormwater generated as a result of new impervious area at the Trans-Pacific Parkway/US-101 Intersection Widening would be collected and conveyed to treatment facilities to provide treatment for 100 percent of the two-year storm event. Drainage curbs would be installed near the edge of pavement along the northwest side of the roadway. These drainage curbs would collect and convey flow from the road crown to water quality treatment facilities. The water quality facilities would provide treatment for the design flow volume and bypass higher flows before discharging the runoff into Coos Bay.

Kentuck Project Site

Roadway improvements associated with the Kentuck project, which include elevating and re-paving East Bay Drive and Golf Course Lane, would result in the addition of new impervious area. The stormwater facilities at the Kentuck project site would be designed to provide treatment for 100 percent of the 2-year storm event wherever feasible.

East Bay Drive would sheet flow stormwater runoff to roadside drainage curbs. Once along the curb, water would flow toward cartridge filters which would treat water before discharging the runoff onto rip-rap road base adjacent to the receiving waters in Kentuck Inlet.

Along most of Golf Course Lane, surface water ditches and flow-through bio-infiltration conveyance systems are proposed. In these areas, collected flow that does not fully infiltrate into the underlying well-draining soils would be conveyed to an outfall into the Kentuck Slough. At the north end of Golf Course Road, runoff would be collected in drainage curbs and conveyed to cartridge filters before discharging to Kentuck Slough.

Temporary Construction Facilities

Construction laydown areas would be surfaced to a large extent with larger, open-graded aggregate that would allow infiltration; therefore, stormwater from these areas would be self-contained and would infiltrate without the need for outfalls. Impervious surface would not be added at the Myrtlewood Off-site Park & Ride for the Jordan Cove LNG Project area. Stormwater treatment for temporary facilities is described further in the ESCP (see appendix F) and Jordan Cove's *Storm Water Management Plan.*

APCO Sites

APCO Site 1 (East) would be surfaced with dense-graded gravel and existing drainage patterns would be preserved to the maximum extent practical. Stormwater would be treated primarily by vegetated swales and filter strips. Fill placed on APCO Site 2 (West) would be surfaced with native vegetation. Additional stormwater controls would be added if necessary. The bridge connecting APCO Site 1 and 2 is in preliminary design. The stormwater runoff from the bridge would be treated prior to discharge to Coos Bay.

Pacific Connector Contractor Yards

Pacific Connector has proposed contractor yards that border Coos Bay at the shore and Isthmus Slough at the shoreline, all designated critical habitat for green sturgeon. Although the yards are previously disturbed industrial sites, stored materials and surface runoff could enter green sturgeon critical habitat. Any potential risks due to surface runoff would be mitigated through implementation of an approved stormwater management plan.

Stranding from Ship Wake

Fish stranding can occur when fish become caught in a vessel's wake and are deposited on shore by the wave generated by the vessel's passing. Stranding typically results in mortality unless another wave carries the fish back into the water. Pearson et al. (2006), in a study of fish stranding, noted that a series of interlinked factors act together to produce stranding during vessel traffic. These factors may include water surface elevations, with low tides more likely to result in strandings than high tide; beach slope, with strandings more likely on low gradients than high; wake characteristics influenced by vessel size, hull form, depth underwater (draft), and speed with faster speed producing large wakes; and biological factors, such as numbers of small fish present near the shoreline and whether or not fish are strong swimmers. All of these factors can vary simultaneously, making it difficult to predict the location and to what degree strandings may occur. A few areas may have the potential to strand fish in Coos Bay. One is the mud flats on the west side of the Federal Navigation Channel along the Coos Bay and Empire Range that have beach morphology that has been shown to have potential for stranding, especially at low tide. Size of juvenile green sturgeons that have been reported caught in the Coos Bay estuary in the 1950s through the 1990s have varied from 40 cm to over 100 cm (15.7 to over 39.4 inches) fork length or total length (Farr and Kern 2005). Because the Coos Bay system is not a known spawning area, small juveniles would be absent; the sizes of green sturgeon expected in the estuary are thus considerably larger than sizes of juvenile Chinook salmon (less than 9 cm) stranded by ship wakes in the Columbia River (Pearson et al. 2006) and may not be susceptible to stranding by comparable ship wakes.

Ship wakes produced by deep-draft vessels traveling at speeds greater than the estimates for LNG carrier speeds along most of the route have been observed to cause occasional stranding of juvenile salmon, with no observed strandings occurring from vessels traveling under 9 knots (10.4 mph) (Pearson et al. 2006). The hull geometry of the LNG carriers is such that bow wakes are minimized, especially at the slower speeds of 4 to 6 knots that would occur during most of the transit route through Coos Bay. The exceptions are near the Coos Bay entrance (first mile), when LNG carriers may be traveling 8 to 10 knots in this portion of the waterway, and possibly along the whole navigation channel when LNG carrier tugs could be traveling at 10 knots during outgoing trips. While waves generated near the entrance may be larger than those generated farther in the bay, this is an area likely already receiving larger ocean-generated waves, so the vessel-generated waves would be little different than current conditions in this region. Therefore, the LNG carriers would be traveling along most of the route at speeds less than that observed (Pearson et al. 2006) to cause stranding. In models and research conducted by Jordan Cove, wave heights produced by LNG carrier traffic would not exceed those of normal conditions in Coos Bay and overall waves would contribute to a small portion of the total waves that occur in the bay. While tug vessel travel would increase wave height along the Federal Navigation Channel during outgoing trips along the shore of the channel, green sturgeon are unlikely to be affected due to their size and distribution. In addition, the LNG carriers would be arriving and leaving at high tide, which is a period when gently sloping beaches are mostly covered and less likely dewatered from waves. Considering that LNG marine traffic (about 120 round trips per year) would enter and leave at high slack tide, have mostly low vessel speeds, and wave height would be mostly in the normal range, and that green sturgeon would be of larger size than those found to be stranded, it appears unlikely that the Project would strand green sturgeon within Coos Bay.

Exotic, Invasive Species

Invasive species have the potential to modify the food base and induce other ecological modifications in the estuarine area of Coos Bay. NAS are aquatic species that degrade aquatic ecosystem function and benefits, in some cases completely altering aquatic systems by displacing native species, degrading water quality, altering trophic dynamics, and restricting beneficial uses (Hanson and Sytsma 2001). Within the Coos Bay estuary, over 67 NAS have been identified (ANSTF 2006).

NMFS (2005b) identified effects by exotic species as a risk to green sturgeons in the Southern DPS. For example, exotic species are concerns because of replacement of food items; the exotic clam *Potamocorbula amurensis* was introduced to the Sacramento-San Joaquin River and Delta systems (California) in ship ballast water from Asia in 1988 and has become the most common food of white sturgeon. The clam was also found in the only green sturgeon so far examined and is known to bioaccumulate selenium (Linville et al. 2002), a toxic metal potentially causing teratogenesis or abnormal embryonic developmental (Lemly 1996). Further, rapid expansion of the exotic clam caused changes in the primary productivity and benthic community dynamics of portions of San Francisco Bay (Werner and Hollibaugh 1993; Nichols et al. 1990).

LNG carriers can carry a diverse assemblage of marine organisms in ballast water that may be foreign and exotic to the ship's port of destination, as these vessels are loaded with water from the surrounding ports and coastal waters throughout the world. Invasive species threaten to outcompete and exclude native species and the overall health of an ecosystem, causing algal blooms and hypoxic conditions and affecting all trophic levels resulting in a decline in biodiversity. EPA developed specific requirements for ballast water treatment under the Vessel General Permit requirement under the CWA NPDES program to reduce the chance of releasing invasive organisms in U.S. waters in April 2013 (78 *Federal Register* 121938). This regulation requires that beginning December 19, 2013, all newly built large vessels would be required to treat ballast water to kill potential invasive organisms, with older vessels of the size that would be used for the Project having some delay in implementation of this requirement (first scheduled dry dock date after January 1, 2016). The current ballast water exchange (BWE) process is mandatory under the National Ballast Water Management Program. Most LNG carriers would have implemented these new anti-nuisance species protective measures by this date; however, for the few outstanding vessels that would have not yet implemented this standard, they would discharge ballast water within 200 miles of the U.S. coast and would be required to exchange ballast water outside of this 200-mile area. This process was originally established by the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 and further amended by National Invasive Species Act of 1996 and National Aquatic Invasive Species Act of 2003, amended in 2005 and again in 2007 (NEMW 2007).

The required treatment of water would ultimately be an improvement over the requirement to just exchange ballast water to "flush" potential invasive organisms outside of the 200-mile territorial waters of the U.S., which was reported to reduce organisms by 88 to 99 percent (NRC 2011). The new requirement for treatment level is to reduce most organism types to less than 10 living organisms per cubic meter of ballast water. While this requirement may not eliminate all risk of invasive species entering waters, it is a substantial measure that would reduce the risk of project actions introducing invasive organisms. Several other regulations (as discussed below) also apply to ballast water management and discharge that would be followed by all LNG carriers; these regulations would also aid in both ensuring reduction of discharge of potentially invasive species and, through vessel inspections, that procedures are followed as noted above.

All ships utilizing the Port of Coos Bay are subject to the 2012 Coast Guard Final Rule on Ballast Water Discharges. Pursuant to this Final Rule, in order to discharge ballast water into the slip area while concurrently loading LNG cargo, all LNG carriers are required to carry out an exchange of ballast water in waters beyond the EEZ, from an area more than 200 nmi from any shore, and in waters more than 2,000 meters deep, or utilize one of several Coast Guard–approved Ballast Water Management methods. It is expected that LNG carriers calling at the LNG terminal would be required to exchange ballast water at sea, more than 200 miles offshore; therefore, the discharge of ballast water would comply with the 2012 Ballast Water Discharge Standards and the potential impact for ballast water to introduce invasive species of interest in Coos Bay would be negligible.

ODEQ recently revised the Oregon ballast water regulations to make the Oregon regulations more stringent for vessels arriving from "low salinity ports" by requiring ballast exchange in addition to the current federal ballast water treatment requirements. This applies to vessels that represent a "high-risk" for the transport and release of aquatic invasive species arriving from "low salinity ports" (like those in Oregon). A "low salinity port" is defined as a port where ballast water salinity is less than or equal to 18 parts per thousand (or when the vessel operator is unable to verify ballast salinity). A "High Risk Voyage" is defined as voyages originating in the "low salinity ports" that represents a "high-risk" for the transport and release of aquatic invasive species arriving from such "low salinity ports." The new rules retain ballast water exchange requirements, in addition to meeting federal ballast water treatment requirements, for what are termed "high-risk voyages." This is a measure to protect Oregon's low-salinity ports during a period when the reliability of new "first generation" ballast water technologies are proven to be effective for low salinity ballast.

LNG carriers would discharge ballast concurrently with the LNG cargo loading at the LNG terminal. Jordan Cove expects its terminal to be visited by 120 LNG carriers per year. Each LNG carrier would discharge approximately 9.2 million gallons of ballast water during the loading cycle to compensate for 50 percent of the mass of LNG cargo loaded.[34] The LNG loading rate is designed to be 10,000 m^3/hr (with a peak capacity of 12,000 m^3/hr), or 4,600 metric tons per hour (5,520 metric tons per hour peak); consequently, the ballast water discharge rate would be approximately 20,250 gallons per minute [gpm]. Typical LNG carriers have three ballast water pumps, each capable of 3,000 m^3/hr (13,210 gpm) rated capacity. Jordan Cove estimates it would take approximately 24 hours at the terminal to load a vessel with LNG cargo.

The ballast water discharged at the terminal would be that from 200 miles out in the open sea. Therefore, it is expected, based on the existing and future procedures to eliminate discharge of invasive species, that LNG carriers would not likely cause exotic nuisance species to be introduced into Coos Bay. The release of ballast water from LNG carriers at the LNG terminal would not have adverse effects on green sturgeon.

Another potential source of invasive species, other than LNG carrier ballast water, is transfer between waterbodies by construction equipment used in water, or other water transfer actions. USGS (2017) identified two NAS that may occur within the Coos Bay estuary: New Zealand mud snails (*Potamopyrgus antipodarum)* and brackish water snail *(Assiminea parasitologica)*. Pacific Connector would not obtain hydrostatic test water from either Coos Bay or the Coos River, to prevent the spread of NAS from the estuary to inland watersheds. Pacific Connector currently has procedures in their *Hydrostatic Test Plan* (see appendix U), which include measures such as inspection and cleaning of all dredge and similar equipment prior to use intended to reduce or eliminate the chance of spreading invasive species.

Entrainment from Dredging

After a review of dredging studies done through 1998, Reine et al. (1998) concluded that "much of the available evidence suggests that entrainment is not a significant problem for many species of fish and shellfish in many bodies of water that require periodic dredging." Because the Coos River is not a known spawning area for this DPS of green sturgeon, smaller individuals that would be more susceptible to entrainment because of slower swimming ability would not be present. In addition, green sturgeon have been found to often leave estuaries in the winter months, when dredging would occur. Considering these factors, their low likelihood of being susceptible to entrainment during dredging, and their likely low abundance, it is not anticipated that construction or maintenance dredging would result in entrainment of green sturgeon.

Entrainment and Impingement through Vessel Cooling Water Intake at the Terminal Dock

During operation of the LNG terminal, vessels at the export terminal slip may entrain marine organisms through cooling water intake needed for vessel power plant operations. The quantity of cooling water used depends primarily on size and type of vessel, time at the terminal, power source used while at the dock, and the amount of recirculation. LNG carriers would need to recirculate water while loading LNG at the berth. The amount of cooling water to be recirculated is a function of the ships' propulsion systems.

[34] One cubic meter of LNG is 0.46 metric tons, which for the maximum size of LNG carrier authorized to call on the LNG Terminal (148,000 m^3) would be 68,080 metric tons of LNG per ship. Assuming 1 metric ton of seawater is 1.027 m^3, the amount of seawater ballast discharged (50 percent of the weight of the LNG loaded) would be approximately 34,959 m^3 (approximately 9.2 million gallons).

A steam propulsion LNG carrier's typical cooling water flow rate while at the berth is expected to be approximately 11,000 cubic meters per hour (m^3/hr) (2.9 million gallons per hour or 48,430 gpm). For a 148,000 m^3 vessel, this flow rate would result in a total of approximately 69.7 million gallons of water being recirculated during the 24-hour loading cycle of LNG cargo. If a DFDE propulsion system (160,000 – 170,000 m^3 ship) were used, the typical cooling water flow rates are expected to be approximately 3,200 m^3/hr (845,376 gallons per hour or approximately 14,000 gpm). This would result in a total of approximately 20.3 million gallons of cooling water being recirculated to the slip over a 24-hour loading cycle of LNG cargo.

Initial estimates are that 40 percent of the LNG carriers loading at the terminal would be steam propulsion and 60 percent would be DFDE propulsion. Over time, the trend is anticipated to shift to a greater number of DFDE propulsion LNG carriers, thereby reducing the total cooling water intake per vessel call in the future. Generally, the total water intake would occur over a 24-hour period during each loading period, about 110 to 120 times per year.

Water to cool engines would be taken in through the sea chests located on the bottom of the vessel hull. An LNG carrier usually has sea chests on each side of the hull. The lower unit is just above the keel of the ship, approximately 15 to 20 feet above the channel bottom. The typical sea chest is approximately 3.5 to 4.2 square meters covered by a screen with 4.5 millimeter (mm) bars, spaced every 24 mm. Currently, no additional screening system other than that already employed on the LNG carriers is proposed for water intakes. Additional finer mesh screens are located internally on the vessels to prevent larger items from entering the system. These screens would not meet NMFS (1997c) screening criteria for juvenile salmonids.

As presented in detail below under Oregon Coast coho salmon (section 3.5.3.3), zooplankton entrainment loss would occur from water intake. Some organisms small enough to pass through the screens covering the vessel's sea chests would be drawn in with the cooling water and would be lost from the population in the slip area. The loss of planktonic species through entrainment is likely to be insignificant relative to current population in the bay as loss rate would be well below estimated natural mortality in the bay (Shanks et al. 2011, and analysis below).

Additionally, because green sturgeon primarily feed on benthic organisms, losses of plankton in the water column would have very limited influence on their available prey source in Coos Bay. Thus, mortality of some plankton from water intake through the vessel sea chests, while docked, would have no detectable adverse effect to green sturgeon.

The estimated velocity at the opening of the cooling water intake for a steam propulsion system ranges from 3.4 to 4.3 ft/sec (1.32 to 1.04 meters/second), depending on the intake area dimensions. The estimated velocity at the opening of the cooling water intake for a dual propulsion system is approximately 1.0 to 1.3 ft/sec (0.30 to 0.38 meters/second), depending on the intake area dimensions. NMFS recommends an approach velocity of 0.33 ft/sec (0.10 meter/second) for screening systems for salmonids of less than 60 mm, and 0.8 ft/sec (0.24 meter/second) for larger juvenile salmonids (NMFS 1997c). These guidelines also include other requirements such as sweeping velocity and type and size of openings that are not present on these screens. The result is likely to be that fish at least up to fry and possibly larger juvenile size fish near the intakes may be entrained or impinged during cooling water intake. The intake velocities for cooling water are low enough that it is not anticipated that any larger organisms (larger fish, marine mammals, or invertebrates) would be impinged on the intake screen. This includes likely exclusion of juvenile green sturgeon due to their larger size from being entrained or impinged. Green sturgeon also primarily remain near the sea bottom, which would be away from the vessel water intake. Therefore, it is unlikely that entrainment or impingement during engine water intakes by a vessel at the terminal would occur or have adverse effects on green sturgeon.

Temperature Effects in the Marine Slip from Vessels at the LNG Project

The LNG carriers would increase water temperature within the slip slightly while at the terminal through the discharge of water after its use for engine cooling. The engines would be running to provide power for standard hotelling activities as well as running the ballast water pumps. The activities that would require LNG carrier power and the assumptions used to develop the cooling water flow requirements are described in Moffatt & Nichol (2017e). For purposes of this analysis, typical cooling water flow rates were used. Cooling water flows while at the berth for a steam turbine LNG carrier are approximately 11,000 m^3/hr (2.91 million gallons per hour) and for a dual-fuel diesel version about 3,200 m^3/hr (0.84 million gallons per hour). Analysis and numerical modeling were performed to identify potential impacts of LNG carrier cooling water discharge on water quality in the slip and adjacent area of Coos Bay (CHE 2011; Moffatt & Nichol 2017e).

Results of the earlier modeling by CHE (2011) showed that for typical ambient flow conditions at a distance of 50 feet from the discharge point (LNG carrier sea chest), temperatures from DFDE LNG carriers would not exceed 0.3°C (0.54°F) above the ambient temperature. This difference would decrease with further distance. Based on estimated slip volume, this total heat could result in an average water increase for the total slip volume during one day when the carrier is loading from 0.03 to 0.06°F. No temperature effects would extend beyond the slip due to the much larger water volume of Coos Bay. However, the slight increase in water temperature in the slip due to the release of engine cooling water while the vessel is at dock would be ameliorated by cooling of the slip water during cargo load, due to the fact that LNG is at a temperature of -260°F. There would be a heat exchange between the cold hull of the vessel and the surrounding slip water, as discussed below.

The Moffatt & Nichol (2017f) analysis used the numerical thermal plume dispersal model from the EPA (2003) "Visual Plume Model" in combination with the Coos Bay hydrodynamic model (Moffatt & Nichol 2017g) to study possible slip temperature changes resulting from the discharge of engine cooling water by an LNG carrier at the Jordan Cove berth. The models simulate hydrodynamic mixing processes of submerged discharges and predict temperature fields and dispersion of non-conserved substances in ambient waterbodies. The thermal plume modeling by Moffatt & Nichol (2017e) investigated the extent of the regulatory mixing zone (RMZ) where cooling water discharge would be greater than 0.3°C above ambient. The RMZ used in the temperature plume modeling is defined as the three-dimensional extent where water quality standards may be exceeded as long as acutely toxic conditions are prevented and fish habitat and other uses are protected. This modeling analyzed both steam turbine and DFDE LNG carriers with capacity of 148,000 m^3 and 170,000 m^3. It also modeled cooling water discharges of 10 to nearly 21°C into various ambient temperatures ranging from 8 to 18°C and under constant and stratified salinity conditions.

Results of the modeling showed that for typical ambient flow conditions the estimated water temperature of the discharged water would be up to about 2 to 3°C (3.6 to 5.4°F) warmer at the discharge port than ambient water temperature. The results indicated the maximum distance of the RMZ zone (0.3ºC [0.54ºF]) above the ambient temperature from the port discharge point where the plume would reach this temperature was 80 and 37 feet for the steam turbine vessel and DFDE vessel, respectively (Moffatt & Nichol 2017f). Distance to achieve this temperature would be less under many environmental conditions. We expect the actual average increase in water temperature in the slip would be less than the higher value estimated due to tidal exchange and the vessel uptake of heat from its surroundings due to the transfer of liquid gas into the vessel at -260°F (-162°C). It is unlikely that the water temperature of the slip would be greatly increased from the release of engine cooling water; therefore, no substantial adverse impacts on aquatic species in the bay are anticipated.

Fish and invertebrates are adapted to function over the normal range of conditions encountered in their environment. Moderate to large temperature increases have the potential to reduce fish and invertebrate growth and reproductive success, and, if high enough, cause direct mortality. Fish of the north Pacific, including those found in Coos Bay, are adapted to cool water conditions and could be adversely affected by sharp, large increases in water temperature. Temperatures over about 24 to 26°C (75 to 79°F) would be considered lethal in the short term (a few days) for salmonids (WDOE 2002). These temperatures would likely be similarly lethal to green sturgeon, which have demonstrated significantly reduced growth for larvae at 24°C (Cech et al. 2000). Lower temperatures, however, can still have some adverse effects to various fish species and other organisms (see section 3.5.4.3). The temperature of the water in Coos Bay undergoes both seasonal and diurnal fluctuations. In December and March, the ocean and fresh water entering the estuary had similar temperatures, around 50°F. In summer, low stream flows results in a rise of temperatures in the bay, to above 60°F in September at CM 8 (Roye 1979).

It is expected that water temperature in the terminal slip influenced by engine water releases from an LNG carrier at dock is not likely to cause any adverse impacts on green sturgeon. First, engine cooling water released into the slip would only slightly increase water temperature for a limited distance away from the vessel. Second, the slight increase in water temperatures from engine cooling water releases would be offset by cooling from contact with the hull of a vessel loading LNG. Third, the volume of water in the slip, and exchanges during tidal cycles would further minimize temperature variations.

Effects of Lighting

Localized changes in light regime have been shown to affect fish species behavior in a variety of ways (Valdimarsson et al. 1997; Tabor et al. 2004; Nightingale and Simenstad 2001). Disorientation may cause delays in migration, while avoidance responses may cause diversion of migratory routes into deeper, less protected waters. In some cases, increased light may attract both predators and potential prey species (Simenstad et al. 1999; Valdimarsson et al. 1997; Tabor et al. 2004). Green sturgeon are bottom oriented and would likely be less affected by shore lights than near surface and pelagic species like salmonids.

Nighttime construction is likely to occur in the estuarine analysis area for in-water work activities such as dredging or placing revetment, as well as on-water activities such as receiving deliveries at the TMBB or MOF. Construction lighting would be designed, installed, and operated at a level that allows construction work to be completed safely and effectively while minimizing glare to surrounding areas. Construction lighting would be directed only to the surface waters of Coos Bay when necessary, in order to minimize impacts to aquatic organisms. Lighting for in-water work would be limited to the area around each vessel and the area of the in-water work. For example, during dredging, the area under the crane boom for clamshell dredging or derrick arm for cutter suction dredging would be lit. Lighting is anticipated to be a mix of fluorescent and sodium fixtures around the vessels (dredge, barges, tugs, and support vessels) with larger sodium or halogen lights shining on the work area (i.e., the water) under the crane boom or derrick of the suction dredge. Lighting for on-water work, such as barge or ship unloading, would be limited to the vessels and adjacent landing areas. Final marine construction lighting requirements would be subject to review and approval by the Coast Guard as part of the Construction Security Plan.

The lighting levels would be based on American Petroleum Institute standards. Lighting around equipment and facilities where routine maintenance activities could occur on a 24-hour basis would range from 1 to 20 foot-candles, and there would be 20 foot-candle lighting levels within the compressor enclosures. General process area lighting would be kept to a minimum, on the order of 2 foot-candles. As a point of reference, 20 foot-candles is close to the indoor lighting in a typical home, 2 foot-candles is typical of that found in a store parking lot, and 0.4 foot-candle is typical of residential street lighting. The lighting design would use high-pressure sodium light fixtures during construction and for the final LNG terminal facility.

Lighting at the LNG terminal and onshore facilities would likely include a mixture of low-power fluorescent lighting and higher intensity security lighting that would primarily be located on shore, in and adjacent to the slip. No high-intensity lighting would be present near the water except possibly during vessel docking. When an LNG carrier is not in the berth, the lighting would be reduced to that required for security. It would be focused upon the structures and not be in proximity to the water so as to serve as an attractant or deterrent to fish species. When an LNG carrier is at the berth, it would physically block the lighting on the berth from the slip waters and, due to its proximity to the slip wall, would block the fish from getting too close to the lighting on the berth. Lighting used at the LNG terminal would be similar to that already in place at other Coos Bay facilities.

Lighting on the tug dock would be low-intensity lighting for safety, providing sufficient light for personnel movements on the trestle out to the tug berth and for movement on the berth itself. There is no intention to provide lighting near the water line or high-intensity lighting that would be associated with activities other than the simple berthing of the tugs at this location. The reduced lighting levels near the water would reduce or eliminate any behavioral effects to fish in the Project vicinity. Jordan Cove plans to develop the details of its final lighting plan in consultations with the FWS, NMFS, and ODFW to minimize potential impacts on aquatic resources. The limited use of high-intensity lighting, the large habitat area available for fish to avoid lighted regions, and plans to develop a final lighting plan that would be approved by managing resource agencies before construction are anticipated to reduce the potential for adverse effect to fish resources. In conclusion, effects of lighting from facility operations to the Southern DPS of green sturgeon are expected to be discountable.

<u>Acoustic Effects from Construction and Operation</u>

Underwater noise may affect green sturgeon. State agencies in Washington, Oregon, and California along with federal agencies have developed interim noise exposure threshold criteria for pile driving effects on fish (WSDOT 2019; Fisheries Hydroacoustic Working Group 2008; Popper et al. 2006). Interim noise exposure threshold criteria for pile driving effects on fish include: 1) a SEL_{cum} of 187 dB re 1 μPa^2 s for fishes more than two grams, 2) a SEL_{cum} of 183 dB re 1 μPa^2 s for fishes less than two grams, and 3) an SPL_{peak} of 206 dB re 1 μPa for all sizes of fishes (WSDOT 2019). SEL_{cum} is the cumulative sound pressure squared, integrated over time, and normalized to one second. SEL_{cum} is calculated as SEL (single strike at 10 meters from the pile) + 10 Log (number of strikes).

Noise would be generated during excavation and dredging of the slip and access channel. Noise would also be generated when an impact hammer is used to install the piles to support the LNG berth and tugboat dock, the temporary mooring piles at the TMBB, temporary dredge transport pipelines at the APCO Site, temporary piles at the Kentuck project and Eelgrass Mitigation site, temporary mooring piles for booster and off load barges used for marine waterway modification dredging, APCO and Trans-Pacific Parkway/US-101 Intersection Widening temporary work bridge piles, and the MOF fender piles. However, the sheet pile walls and LNG terminal berth and tugboat dock piling installation would occur while the marine berth is still isolated from the bay by the berm with the exception of 28 east mooring piles that will be installed after the berm is removed.

Construction noise levels for the LNG Terminal are expected to be similar to typical commercial structure construction programs, which average from 47 to 57 dBA at 2,000 feet (H&K 1994). Noise levels 50 feet air distance from typical construction equipment (not including pile driving, or sheet wall installation) to be used at the site would typically range from about 70 to 90 dB (see table 3.3.2-1). Typical noise generated from operations would be less. Considering that noise levels would be attenuated from this equipment into water, based on the interim NMFS criteria, levels of noise that could cause direct adverse effects to fish would be unlikely from typical equipment and future operations.

Some dredging activities may generate underwater noise levels that may be harmful to very small fish in close proximity to the activity. Fischer (2004) noted dredging source decibel levels of 172 and 185 at one meter (three feet) from the dredge. The upper range of these values exceeds the interim noise criteria for small fish (those less than two grams). Thus, small fish very near (within about a meter of) the dredging, may be harmed if they remained in the area for a period of time. Initial slip dredging would have some sediment removal from shallow water but maintenance dredging would occur in the deepest channel areas. Small green sturgeon of the size to be affected by these noise levels would not be present in the bay because this system does not include a spawning population that would supply small sturgeon to this area. Since no very small green sturgeon would be present in the bay and the fact that harmful levels of noise would occur only at the site of dredging, it is expected that green sturgeon would not be in a zone considered directly hazardous from noise levels.

Potential underwater acoustic effects of in-water and land-based pile driving are addressed separately in the sections below.

Land-based Pile

Underwater noise may be generated by driving piles on land (dry piles) because some noise propagates through ground and sediments (especially through harder substrates such as rock and clay) and may transfer to the water column somewhere else (known as sound flanking). Table 3.5.1-1a below summarizes locations and quantities of land-based piles for the LNG Project.

TABLE 3.5.1-1a **Land-based Pile and Structures Summary**								
Project Component	**Description**	**Year Installed**	**Pile Size or Type**	**Total Pile Quantity**	**Estimated Pile # Installed After Berm Breach**	**Avg Piles per Day**	**Total Days a/**	**Distance from Shore Without Berm (feet)**
Material Off-loading Facility (MOF)	Mooring Bollards	2	36"	8	NA	1	14	12
	Sheet Piles	1 and 2	Sheet	1,869	NA	13	145	20
LNG Berth (East)	Mooring Structures (6 ea. x 14 pile)	3	30"	84	28	4	8	20
	Breasting Structures (4 ea. x 14 pile)	3	36"	56	0	1	72	NA

a/ Pile driving after berm breached, when applicable

Sound in the water column would be at a lower level than at the source (WSDOT 2019) because most sound energy does not travel through water but through the sediment. The propagation of underwater construction noise from the "dry" impact pile driving associated with the MOF was modeled in several reports prepared by JASCO Applied Sciences (O'Neill and MacGillivray 2017; Wladichuk et al. 2017; Wladichuk et al. 2018). Wladichuk et al. (2018) modeled potential impacts of land-based pipe pile impact driving on fish using both current guidelines (Fisheries Hydroacoustic Working Group 2008) and new proposed guidelines (Popper et al. 2014).

Previous noise studies investigated radii to marine mammal and fish threshold criteria from a pipe pile with the same diameter (36 inches [0.9 meter]) but a shorter length (60 feet [18.3 meters]), as well as different number of strikes in a 24-hour period and at four setback locations behind the MOF (O'Neill and MacGillivray 2017; Wladichuk et al. 2017; Wladichuk and MacGillivray 2018). After receiving additional construction details, the most recent study examined the threshold radii from driving a 104.8-foot (31.9-meter) pile at the MOF and at a 98.4-foot (30-meter) setback distance behind the MOF using a reduced impact hammer energy of 65 percent. This study found that injury to fish from peak sound pressure levels (206 dB in current guidelines) would occur up to 37 meters from the face of the MOF. Also, this study predicted that injury to both small (less than two grams) and large (greater than or equal to two grams) fish from cumulative sound exposure levels (183 and 187 dB respectively under current guidelines) would occur up to 1,723 meters from the shoreline. This distance was the same for both 10,000 and 20,000 total impact strikes because in both cases this was the distance when the noise attenuated to the sound level considered effectively quiet (150 dB).

Under proposed guidelines (Popper et al. 2014), modeled distances to injury were considerably less, although the distance to temporary threshold shift (TTS) was the same (i.e., 1,723 meters). Figure 3.5.1-2 shows the modeled extent of this potential zone of injury in the project area from land-based pipe pile driving at the MOF face for 206 dB peak and 187 dB SEL. Based on the results of Wladichuk et al. (2018), installation of land-based piles at the MOF face would increase potential exposure of listed green sturgeon to underwater noise in an area encompassing the

Federal Navigation Channel from the MOF across the bay to the airport and southwest to the vicinity of Southport Lumber yard. These noise thresholds could be reached during pile driving of the eight mooring bollards at the MOF that would take approximately 14 days to install and the 28 east mooring piles at the LNG berth that would be installed after the berm is breached. These 28 piles would take approximately 8 days to install. Individual fish occurring in this area during pile driving could experience physiological effects sufficient to cause injury. Sheetpile installation away from the water edge using vibratory hammer would not reach noise levels in the range of those noted above to cause harm to fish other than possibly at worst a few meters (~2 meters) from shore (data from Deveau and MacGillvray 2017 using the NMFS [2009f] model).

Land-based pile driving at the MOF shown to generate injury-level in-water noise would be limited to the approved in-water work window, which is October 1 through February 15. This window would minimize potential interaction with green sturgeon, which are most likely to be in the bay during summer. Also, small green sturgeon that would be most susceptible to barotrauma from increased sound pressures would not occur in the bay due to the lack of a spawning population in the area.

In-water Pile

In addition to the large number of piles that would be driven on land, a smaller number of piles would be driven in the water column using primarily a vibratory hammer in various locations throughout the estuarine analysis area, mostly for temporary mooring of vessels and structures during construction. These piles are summarized in table 3.5.1-1b.

TABLE 3.5.1-1b

In-water Pile and Structures Summary

Project Component	Description	Pile Type	Installation Method	# of Piles	Pile Size (inches)
Temporary Material Barge Berth (TMBB)	Temporary – breasting/mooring	Steel Pipe	Vibratory/proof with impact	6	<24
Material Off-loading Facility (MOF)	Permanent – fender pile	Steel H-pile	Vibratory/proof with impact	12	18
Temporary Dredge Transfer Line	Temporary – mooring piles or spuds	Steel pipe	Vibratory only	TBD	<24
APCO Temporary Dredge Transfer Line Support Cradle	Temporary	Steel pipe	Vibratory only	5	24
APCO Temporary Work Bridge	Temporary – 3 piles per bent	Steel pipe	Vibratory/proof with impact	12	24
Dredge Off-loading Area at Kentuck	Temporary – piles or spuds	Steel pipe	Vibratory/proof with impact	16	24
Dredge Off-Loading Area at Eelgrass Mitigation Site	Temporary – piles or spuds	Steel pipe	Vibratory/proof with impact	16	24
Dredge Off-Loading at APCO	Temporary – piles or spuds	Steel pipe	Vibratory/proof with impact	16	24
Trans-Pacific Parkway/U.S. 101 Intersection Temporary Work Bridge	Temporary	Steel pile	Vibratory/proof with impact	36	24
Trans-Pacific Parkway/U.S. 101 Intersection	Temporary – sheet pile	Sheet pile	Vibratory only	TBD	TBD
Trans-Pacific Parkway/U.S. 101 Intersection	Permanent	Untreated timber pile	Vibratory/proof with impact	1,150	14
Total Steel Piles				Approx. 119	
Total Wood Piles				1,150	

Installation of both land-based and underwater piles would increase potential exposure of listed green sturgeon to underwater noise. If individual fish are close enough to a pile while it is being driven, injury or behavioral changes could occur. Most of the in-water piles would be driven with vibratory hammer only, which would reduce the potential distance for injury. However, if an impact hammer is required for proofing of the piles, for instance, in the case of some of the longer term temporary piles (e.g., dredge booster barges), then fish would be exposed to disturbance and potential injury for some distance surrounding each pile driving location.

The NMFS pile driving effects calculator was used to determine the threshold distances where injury and disturbance are likely to be encountered by fish of different sizes for vibratory and impact pile driving (see tables 3.5.1-2 and 3.5.1-3). Peak, SEL, and RMS noise values were obtained from documented noise levels for vibratory and impact pile driving of 24-inch piles (the largest piles proposed for the project as described in table 3.5.1-1). These noise levels have been summarized in WSDOT (2018) but have other sources such as Laughlin (2005) and CalTrans (2015). All values were measured at 10 meters. The rationale for using 3,000 strikes was that all in-water piles would first be driven with vibratory pile driver, and an impact driver would only be used for proofing.

Based on these calculators (see tables 3.5.1-2 and 3.5.1-3), which assumes no sound attenuation (e.g. bubble curtain, cushion blocks, etc.) are used, the following effect distances have been determined:

- For vibratory pile driving, fish would not experience injury from peak sound pressures. Physical injury from cumulative sound exposure levels would occur within 233 feet (71 meters) for larger fish (greater than or equal to two grams) and within 328 feet (100 meters) for smaller fish (less than two grams).

- For impact pile driving, fish would experience physical injury within 40 feet (12 meters) from peak sound pressures. Physical injury from cumulative sound exposure levels would occur within 1,712 feet (522 meters) for larger fish (greater than or equal to two grams) and within 2,415 feet (736 meters) for smaller fish (less than two grams). Disturbance could occur anywhere within 28,133 feet (8,577 meters) of impact pile driving. Disturbance is where individual fish could experience behavioral effects such as decreased foraging efficiency, changes in daily movements, and movement of prey species, etc. due to impact pile driving.

TABLE 3.5.1-2

Distance Thresholds for Disturbance and Injury to Fish from In water Vibratory Pile Driving

Fill in green cells: estimated sound levels and distances at which they were measured, estimated number of pile strikes per day, and transmision loss constant.				
	Acoustic Metric			
	Peak	SEL	RMS	Effective Quiet
Measured single strike level (dB)	182	165	165	150
Distance (m)	10	10	10	
Estimated number of strikes	3000			
Cumulative SEL at measured distance				
200				
	Distance (m) to threshold			
	Onset of Physical Injury			Behavior
	Peak	Cumulative SEL dB**		RMS
	dB	Fish ≥ 2 g	Fish < 2 g	dB
Transmission loss constant (15 if unknown)	206	187	183	150
15	0	71	100	100
** This calculation assumes that single strike SELs < 150 dB do not accumulate to cause injury (Effective Quiet)				

TABLE 3.5.1-3

Distance Thresholds for Disturbance and Injury to Fish from In water Impact Pile Driving

Fill in green cells: estimated sound levels and distances at which they were measured, estimated number of pile strikes per day, and transmision loss constant.				
	Acoustic Metric			
	Peak	SEL	RMS	Effective Quiet
Measured single strike level (dB)	207	178	194	150
Distance (m)	10	10	10	
Estimated number of strikes	3000			
Cumulative SEL at measured distance				
213				
	Distance (m) to threshold			
	Onset of Physical Injury			Behavior
	Peak	Cumulative SEL dB**		RMS
	dB	Fish ≥ 2 g	Fish < 2 g	dB
Transmission loss constant (15 if unknown)	206	187	183	150
15	12	522	736	8577
** This calculation assumes that single strike SELs < 150 dB do not accumulate to cause injury (Effective Quiet)				

It was assumed that temporary pilings could be driven anywhere along the Federal Navigation Channel to support the marine waterway modifications pump stations. The location and number of these pump stations is currently unknown, so it was conservatively assumed that they could be located anywhere along the navigation channel. Therefore, potential noise impacts from pile driving are shown along the entire channel. The extent of these distances would be limited in some cases by the physical interruption of land masses and sharp turns in the landscape. Figures 3.5.1-2 and 3.5.1-3 show the physical extent of underwater noise disturbance and injury thresholds measured above, with the area of general disturbance shown in figure 3.5.1-4.

There would also be 1,150 wood piles and sheetpiles constructed at the Trans-Pacific Parkway/US-101 intersection widening. These may be installed above or below water level depending on tide level. The methods for wood pile installation are unknown, but sheetpile would be installed by vibratory hammer with an impact hammer being used if necessary. One report measured peak values of 180 dB 10 meters from wood piling when using an impact hammer (Illinworth and Rodking 2007). Data are not available on noise levels from a vibratory hammer on wood, but vibratory hammer noise levels are generally much lower at peak noise production compared to an impact hammer. With the number of pilings to be installed, the frequency of piling contacts would be high. There is some risk of cumulative noise levels associated with wood piling being an issue if peak noise values were near 180 dB. Jordan Cove has indicated that an impact hammer would not be used on sheet piles if they were inundated by high tides; implementation of this commitment would reduce the effects of cumulative and peak noise levels on fish.

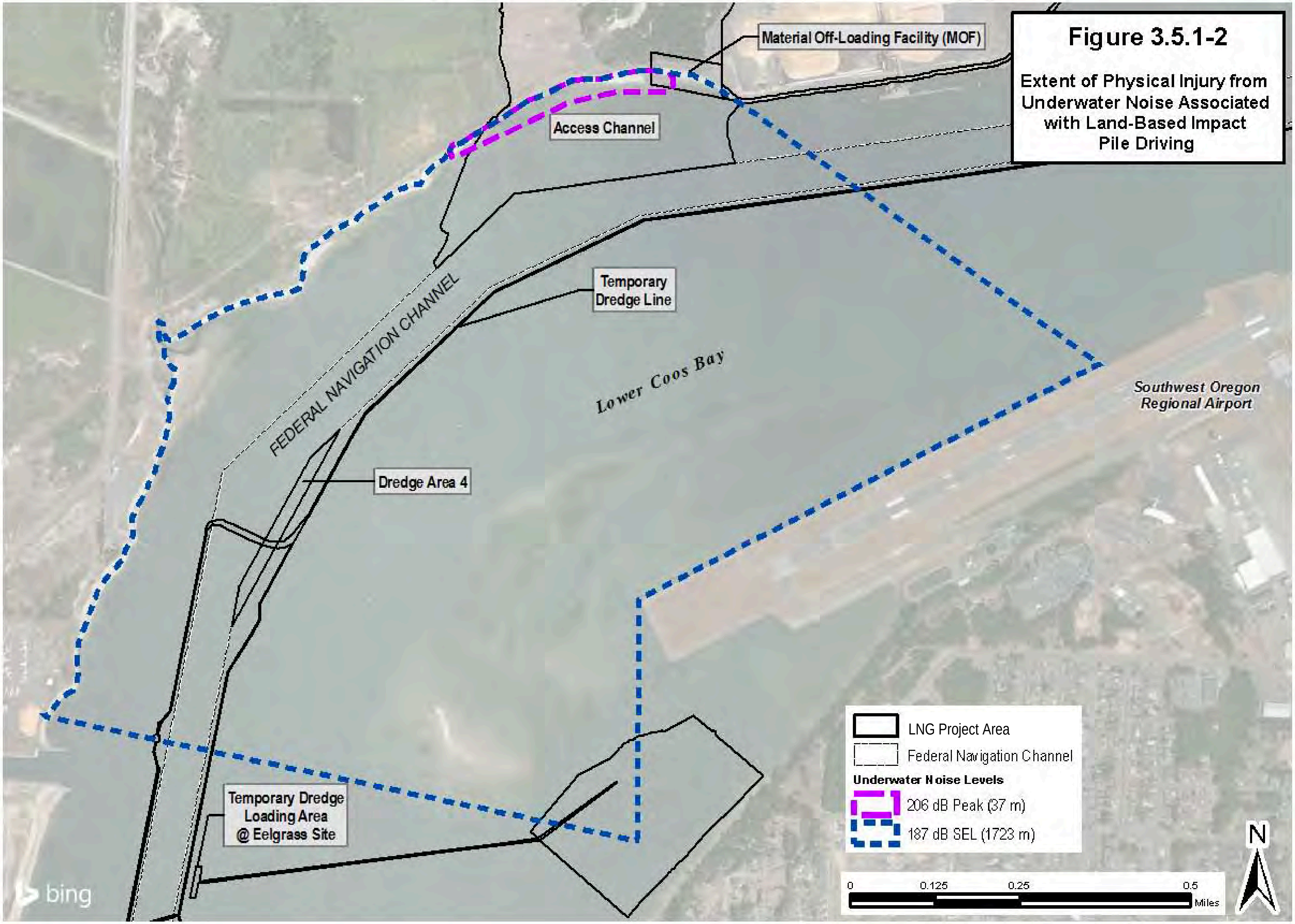


Figure 3.5.1-2
Extent of Physical Injury from Underwater Noise Associated with Land-Based Impact Pile Driving
Material Off-Loading Facility (MOF)
Access Channel
Temporary Dredge Line
FEDERAL NAVIGATION CHANNEL
Lower Coos Bay
Southwest Oregon Regional Airport
Dredge Area 4
Temporary Dredge Loading Area @ Eelgrass Site
LNG Project Area
Federal Navigation Channel
Underwater Noise Levels
206 dB Peak (37 m)
187 dB SEL (1723 m)
0
0.125
0.25
0.5
Miles
N
bing

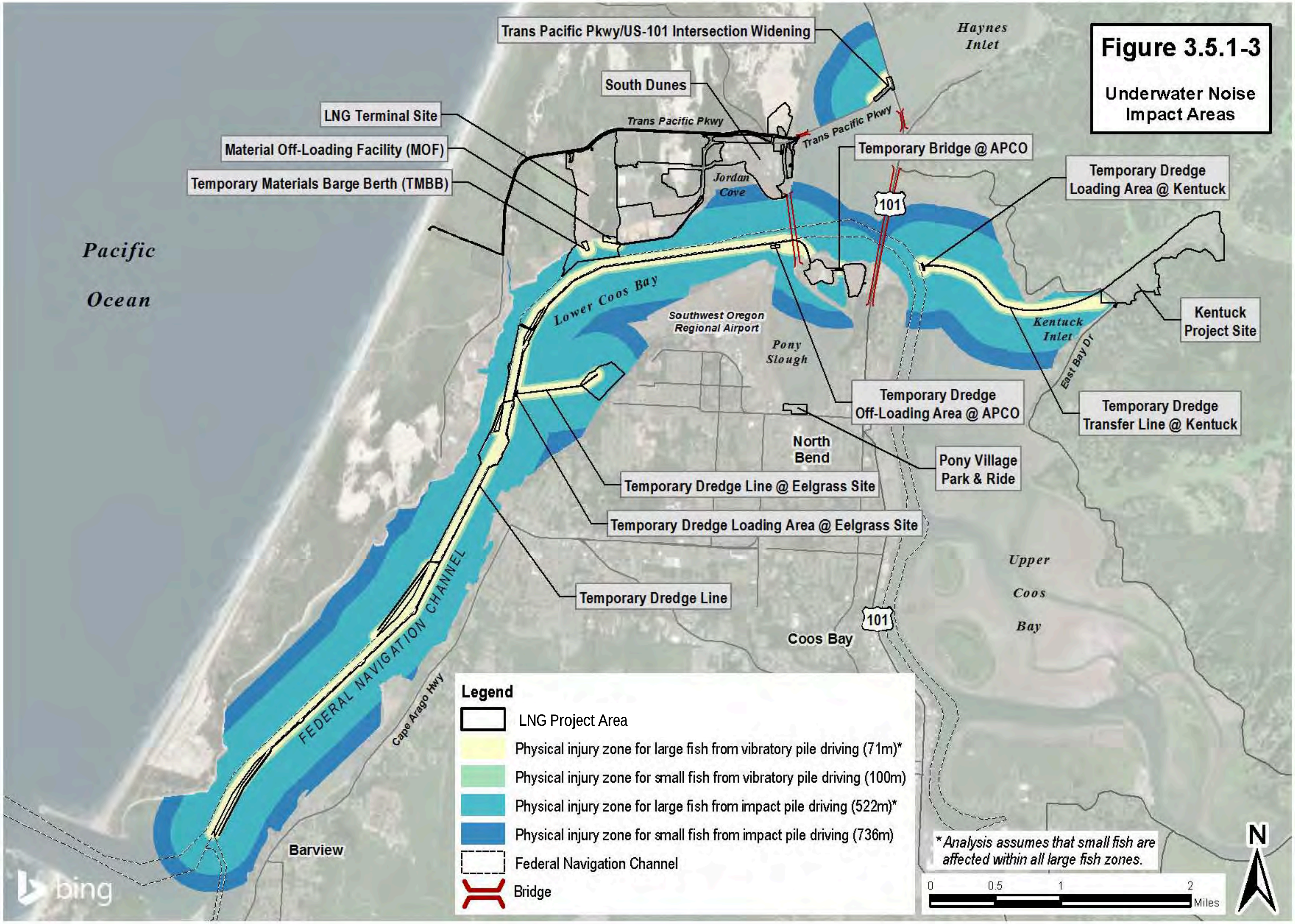


Figure 3.5.1-3
Underwater Noise Impact Areas
Trans Pacific Pkwy/US-101 Intersection Widening
South Dunes
LNG Terminal Site
Material Off-Loading Facility (MOF)
Temporary Materials Barge Berth (TMBB)
Temporary Bridge @ APCO
Temporary Dredge Loading Area @ Kentuck
Kentuck Project Site
Temporary Dredge Transfer Line @ Kentuck
Temporary Dredge Off-Loading Area @ APCO
Pony Village Park & Ride
Temporary Dredge Line @ Eelgrass Site
Temporary Dredge Loading Area @ Eelgrass Site
Temporary Dredge Line
Haynes Inlet
Trans Pacific Pkwy
Jordan Cove
101
Pacific Ocean
Lower Coos Bay
Southwest Oregon Regional Airport
Pony Slough
Kentuck Inlet
East Bay Dr
North Bend
Upper Coos Bay
Coos Bay
FEDERAL NAVIGATION CHANNEL
Cape Arago Hwy
Barview
bing
Legend
LNG Project Area
Physical injury zone for large fish from vibratory pile driving (71m)*
Physical injury zone for small fish from vibratory pile driving (100m)
Physical injury zone for large fish from impact pile driving (522m)*
Physical injury zone for small fish from impact pile driving (736m)
Federal Navigation Channel
Bridge
* Analysis assumes that small fish are affected within all large fish zones.
0 0.5 1 2 Miles
N

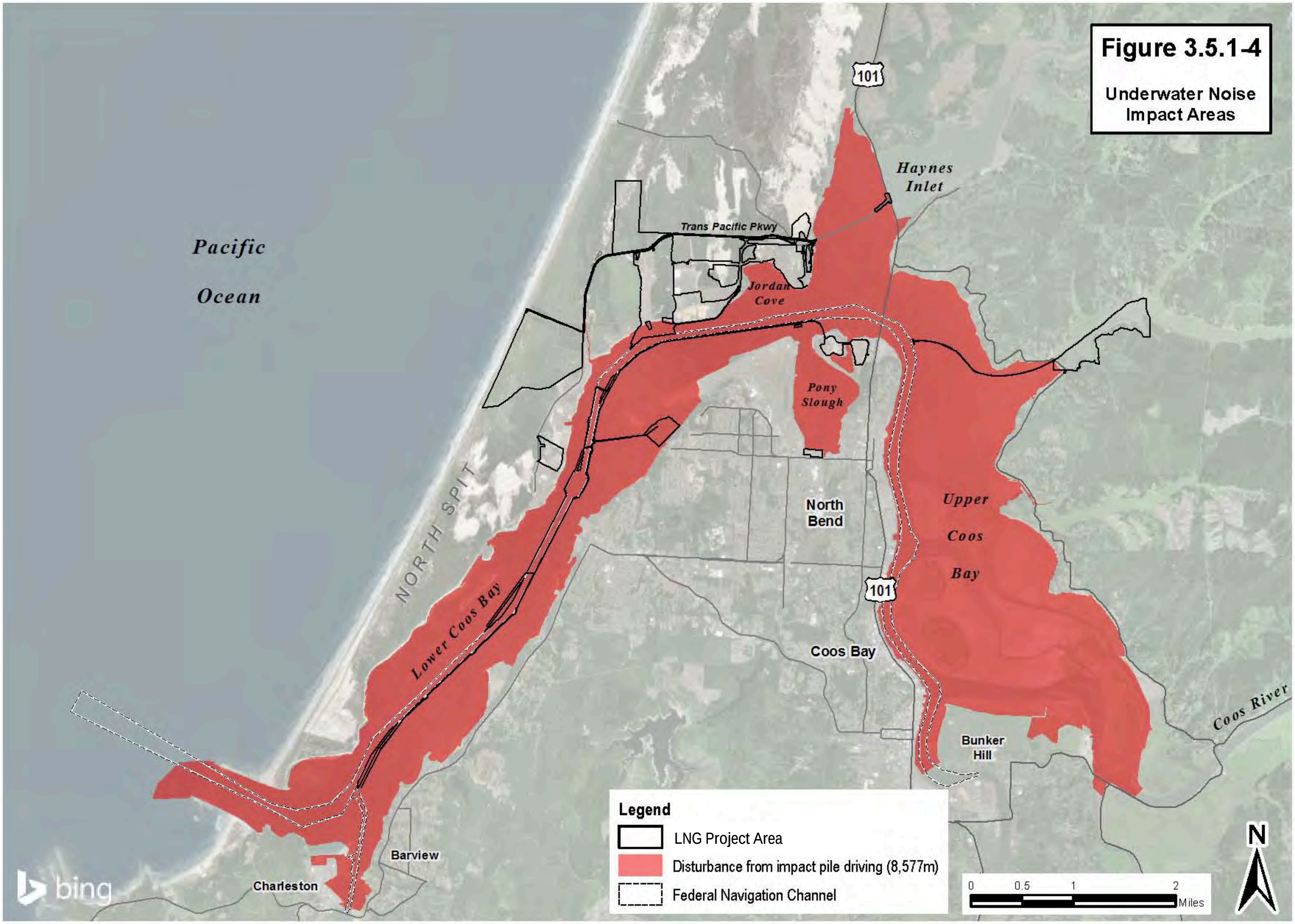


Figure 3.5.1-4
Underwater Noise Impact Areas
Pacific Ocean
NORTH SPIT
Trans Pacific Pkwy
Haynes Inlet
101
Jordan Cove
Pony Slough
North Bend
Upper Coos Bay
101
Lower Coos Bay
Coos Bay
Coos River
Bunker Hill
Barview
Charleston
Legend
LNG Project Area
Disturbance from impact pile driving (8,577m)
Federal Navigation Channel
0 0.5 1 2
Miles
N
bing

In-water pile driving would be limited to the approved in-water work window for the Project, which is October 1 through February 15. This window would minimize potential interaction with green sturgeon, which are most likely to be in the bay during summer. Also, small green sturgeon that would be most susceptible to barotrauma from increased sound pressures would not occur in the bay due to the lack of a spawning population in the area.

Operation

The addition of approximately 120 LNG carriers to the existing average commercial traffic of 50 ships per year is predicted to increase the in-water sound level by 4.5 dB in the Federal Navigation Channel. The intensity of the sound pressure levels from vessel traffic can vary considerably. However, sound pressure levels are generally in the range of 112 to 160 dB, intensities that may influence organism behaviors or perceptions but are not great enough to cause physiological damage (Richardson 1995; Hastings and Popper 2005; Fisheries Hydroacoustic Working Group 2008).

It is expected that LNG carrier noise in Coos Bay would be less than in the marine analysis area as vessel speed and engine output would be greatly reduced, which affects the magnitude of sound levels. In the Hatch et al. (2008) study, an LNG carrier during travel produced sound levels (with 1 standard error) of 182 ± 2 dB re: 1 µPa at 1 meter that attenuated to 160 dB at 35 ± 11 meters and to 120 dB at 16,185 ± 5,359 meters (Hatch et al. 2008). Other than possibly within 1 meter of the vessel hull, these are all values less than the current interim noise levels for fish noted above.

Generally, response to noise impacts would be behavioral and perceptual, and not physiological in nature, as fish would tend to avoid the area during periods of high noise output. It is expected that operational noise would not have adverse effects on aquatic resources including green sturgeon.

Habitat and Food Source Effects – Slip, Access Channel, Pile Dike Rock Apron, and Marine Waterway Modification Sites

Construction of the LNG Project facilities would impact about 83 acres of existing estuarine habitat, of which 37.3 acres would be from construction of the slip and access channel, the associated MOF, and TMBB (table 3.5.1-4). About 14.5 acres of intertidal to shallow subtidal habitat, plus 1.9 acres of eelgrass habitat, and 0.1 acre of salt marsh would be modified to primarily deep subtidal habitat as a result of the dredging for the slip and access channel. The dredging operation would change physical conditions of the bottom, locally altering the bathymetry and potentially altering the morphology and water currents. About 36.7 acres of upland habitat would be converted to open water, primarily deep subtidal habitat.

TABLE 3.5.1-4

Estuarine Habitat Impacted from Construction of the Jordan Cove LNG Project

		Acres of Impact											
Estuarine Habitat Type	**Type of Impact** [a/]	**Slip, Access Channel, MOF, and TMBB**	**Pile Dike Rock Apron**	**Wetland APCO Site**	**Hydraulic Dredge Pipeline**	**Marine Waterway Modifica-tion Dredge Areas 1 through 4**	**Marine Waterway Modifica-tion Temp. Dredge Line**	**APCO Temp. Dredge Transfer Line**	**Eelgrass Temp. Dredge Line**	**Kentuck Temp. Dredge Line**	**Trans Pacific Parkway/ Hwy 101**	**South Dunes**	**Total**
Shallow Subtidal	Permanent	3.71	0.38	–	–	–		–	–	–	–	–	4.09
	Temporary	0.11	0.18	–	0.05	–	0.03	–	–	0.64	–	–	1.01
	Construction	3.82	0.56	–	0.05	–	0.03	–	–	0.64	–	–	5.10
Salt Marsh	Permanent	0.06	–	–	–	–	–	–	–	–	–	–	0.06
	Temporary	0.00	–	–	–	–	–	–	–	–	–	–	0.00
	Construction	0.06	–	–	–	–	–	–	–	–	–	–	0.06
Intertidal	Permanent	10.81	1.27	–	–	–	–	–	–	–	0.51	0.07	12.66
	Temporary	0.10	0.57	<0.01	0.08	–	0.05	–	0.41	0.01		–	1.22
	Construction	10.91	1.84	<0.01	0.08	–	0.05	–	0.41	0.01	0.51	0.07	13.88
Eelgrass	Permanent	1.90	0.18	–	–	–	–	–			–	–	2.08
	Temporary	0.00	0.11	–	–	–	0.03	–	0.11	0.02	–	–	0.27
	Construction	1.90	0.29	–	–	–	0.03	–	0.11	0.02	–	–	2.35
Deep Subtidal	Permanent		0.49	–	–	–	–	–			–	–	0.49
	Temporary	17.31	0.63	–	–	26.98	12.95	0.91	0.53	1.54	–	–	60.85
	Construction	16.82	1.12	–	–	26.98	12.95	0.91	0.53	1.54	–	–	60.85
Total	**Permanent**	**16.48**	**2.32**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.51**	**0.07**	**19.38**
	Temporary	**17.52**	**1.49**	**<0.01**	**0.13**	**26.98**	**13.06**	**0.91**	**1.05**	**2.21**	**0.00**	**0.00**	**63.35**
	Construction	**34.00**	**3.81**	**<0.01**	**0.13**	**26.98**	**13.06**	**0.91**	**1.05**	**2.21**	**0.51**	**0.07**	**82.73**

Note:

a/ Construction acres are total acres affected during construction, permanent acres are areas that became a different habitat type after construction, while temporary acres are those that remain the same type of habitat after construction disturbance.

TMBB = temporary material barge berth

MOF = material offloading facility

The construction of the proposed marine slip, pile dike rock apron, and access channel would impact local aquatic resources by removal or conversion of some habitats. The pile dike rock apron would permanently convert approximately 2.3 acres of former estuarine soft bottom habitat (eelgrass, intertidal, subtidal, etc.) into angular rock. This change in habitat would create a variety of effects to listed fish species, including providing new substrate for seaweeds that can provide cover, providing potential habitat for predators (particularly in subtidal areas), and interrupt normal shoreline drift processes by acting like a groin. Use of riprap in the proposed marine slip would reduce the suitability of some green sturgeon habitat in the bay but would have no significant impacts to listed fish. There would also be short-term turbidity from dredging in the bay, and additional erosion of the shoreline during construction activities could result in sedimentation. To control soil erosion and potential sedimentation, Jordan Cove would follow the measures outlined in its ESCP.

There is also the potential for an accidental oil or fuel leak from dredging equipment to affect aquatic resources in the bay. To avoid or reduce impacts from oil or fuel leaks, Jordan Cove developed Preliminary Draft SPCCPs for both construction and operation.

Prey species that are important for local fish species, likely including those for green sturgeon, rely on many of the same habitat conditions. Eelgrass habitat supplies a diverse habitat for fish (Murphy et al. 2000). Eelgrass is an important ecological component in Coos Bay affecting many species. For example, submerged aquatic grasses are important habitat for small prey species of adult lingcod (in Appendix B-2 of PFMC 2008). Submerged grass meadows provide cover and food for a large number of organisms including burrowing, bottom-dwelling invertebrates; diatoms and algae; herring that deposit eggs clusters on leaves; tiny crustaceans and fish that hide and feed among the blades; and, larger fish, crabs and wading birds that forage in the meadows at various tides. Eelgrass provides shelter for a variety of fish and may lower predation, allowing more opportunity for foraging. The protective structure attribute of eelgrass is primarily for smaller organisms and juvenile life history stages of fishes. Previous studies (Akins and Jefferson 1973) have reported that Coos Bay has 1,400 acres of lower intertidal and shallow subtidal flats covered by eelgrass meadows. Therefore, changes in eelgrass abundance may have food chain effects to green sturgeon.

Permanent eelgrass impacts at the access channel would affect less than 1 percent of the estimated total area where eelgrass was detected in lower Coos Bay (EPA 2005; DEA 2007 and 2010; Ellis Ecological Services 2007 and 2013). This impact would result in an unnoticeable and extremely localized, short-term loss in forage food available for green sturgeon. Located south of the impact site, the mitigation site would be created within an existing eelgrass bed to replace the narrow band of eelgrass habitat lost at the impact site. The mitigation site would take several years to develop, but it would result in a long-term benefit to eelgrass, listed fish, critical habitat, and EFH.

Benthic and epibenthic invertebrates that presently inhabit shallow intertidal and subtidal regions within the boundaries of the proposed access channel dredging area would be removed with the dredged material. Ghost shrimp and sand shrimp (adults, juveniles and larvae), amphipods, clams, Dungeness crab, and various fish species are important prey for green sturgeon. Therefore, the loss of invertebrates and vertebrates at the access channel would result in a reduction in fish food available to green sturgeon in those areas affected by the Project.

Dredging at the four marine waterway modifications sites would take place in deep subtidal habitat used by benthic organisms, macroinvertebrates, and demersal fishes (e.g., worms, clams, crustaceans, mollusks, flatfish, and Pacific sand lance [*Ammodytes personatus*]), some of which serve as prey to green sturgeon. Entrainment from dredging could injure or kill these and other bottom-dwelling species that have limited mobility and move, rest, find shelter, and feed within the dredge prisms for these areas.

The marine waterway modifications sites are located entirely within deep subtidal habitats along the Federal Navigation Channel. Such habitat is less productive than shallow subtidal and intertidal habitats. Furthermore, the Federal Navigation Channel is subject to periodic dredging and propeller scour, which can disturb the associated benthic community. Benthic communities associated with mud substrates like those within Coos Bay, however, have been shown to recolonize to pre-dredging conditions within four weeks following dredging (Newell et al. 1998), while recovery in estuarine channel muds has been reported in a review paper of dredging to be typically six to eight months (Newell et al. 1998). In the lower Columbia River, McCabe et al. (1997, 1998) noted benthic organism recovery in three months. Studies of a dredged sandy substrate area in Yaquina Bay (Oregon) found recovery of benthos took one year (Swartz et al. 1980, as cited in Wilber and Clarke 2007). Because of the large quantity being dredged and type of substrate, the recovery may take longer than a four-week period relative to typical dredging and thus the benthic communities in the areas to be dredged may take a correspondingly longer time to recover. The similarity of sandy substrate like that of Yaquina Bay to substrate in the Federal Navigation Channel suggests it is likely that recovery would be closer to a year for benthic resources, particularly in the area of the Marine Waterway Modifications.

Impacts to bottom-dwelling marine life where dredging is planned at the marine waterway modifications sites, LNG terminal slip, and access channel, therefore, are expected to occur over a short-term duration. While it is anticipated that affected areas would partly recolonize by similar species within a month or two following dredging, complete recovery could be closer to a year and with the relative composition among species likely altered over the near term.

Direct mortality or injury from dredging is not expected for most pelagic fishes due to their swimming ability and behavioral tendency to avoid disturbance. Dredging could affect other bottom-dwelling fishes, however, such as Pacific sand lance, which frequently inhabit sands and fine-grain sediments for rest and predator avoidance. Sand lance are an important prey species for many marine mammals, birds (including marbled murrelet), and fishes (including Pacific salmon and green sturgeon). While sand lance could be subject to mortality or injury from proposed dredging, the timing and extent of their presence in the lower bay at the marine waterway modifications sites has not been confirmed.

As noted above, the CHE (2011) modeling indicated that, during LNG carrier transit, bottom disturbance from high bottom velocities would occur. An updated 2017 propwash memo (Moffatt & Nichol 2017d) included modeling the use of ship engines and tug assist for berthing and unberthing in the marine slip area. Scour depths were estimated to be nearly 0.5 foot due to propwash near the eastern side of the access channel and slip if there is no slope protection installed. Overall, about 12 acres of bottom could be scoured to a depth over 0.2 foot. This could result in some benthic organisms (potential green sturgeon prey) being disrupted and some sediment being moved during arrival and departure. Mobile organisms (e.g., crabs, shrimp) would be able to return to the region, while some benthic organisms may be permanently displaced.

Turbidity would likely be slight due to the coarse characteristics of the Federal Navigation Channel sediment that is resistant to current induced suspension. Overall, some loss of benthic organisms may occur from LNG carrier propwash during each transport trip near the slip approach, but the magnitude would be small and likely less than currently occurs under each existing large vessel trip.

Although the substrate proposed for maintenance dredging in the access channel and berth would largely be sand and silt, it is anticipated that recovery times would be similar to local estimates, although possibly longer, but still resulting in likely only short-term effects to the benthic community and potential food resources for green sturgeon.

Shading Effects

Shading from over-water structures reduces the amount of light available to phytoplankton and aquatic macrophytes. However, the area where shading from LNG terminal facilities would occur is intended for industrial uses and not the creation of new habitat. The general habitat within the excavated slip would not be conducive for many marine resources because of depth and steep armored banks, so relatively few resources would likely utilize this newly created area. The slip would be created from an area that is currently upland, and therefore no shading of currently unshaded water habitat and no net loss in productivity due to shading would occur. Project components that could potentially shade the new open water created by the construction of the slip include those listed below.

- the tug dock, which would be built over an open water portion of the newly developed slip and would be about 470 feet long by 18 feet wide, connected from shore by a pile-founded trestle; and
- floats for mooring and accessing the security vessels, which would be 360 feet long and 8 feet wide.

Most fish have developed countershading as an adaptation to avoid predation (Moyle and Cech 2000) from above (dark dorsal surface blends with bottom substrate) and from below (light ventral surface blends with light from the surface). Fish within a shaded area would be more easily detected by a predator, especially from below because light colored ventral surfaces would stand out against a shaded water surface. Predation is potentially a concern for juvenile fish including juvenile salmonids, based on some observed fish behavior (Nightingale and Simenstad 2001). However, actual increased occurrence in predator numbers from even substantial overwater structures has rarely been documented. Additionally, a review of many marina and pier studies has not documented actual increased predation at these facilities (Nightingale and Simenstad 2001). For example, marine marina studies have found no documentation of increased concentrations of juvenile salmonid predators and some predators such as birds may be of lower abundance than under natural shoreline conditions (Cardwell et al. 1980, and Heiser and Finn 1970, as cited in NMFS 2005c). The extent to which any of these predators affect juvenile green sturgeon in shaded areas created by the proposed action is unknown; however, the probability of this occurring is low because the facilities would shade less than one percent of the slip surface area and the dock is located at the north side of the slip.

Direct and Indirect Effects – Riverine Analysis Area

Two waterbodies, Coos River and Stock Slough, are within the green sturgeon riverine analysis area. Potential effects of the Project's crossing of the Coos River were addressed above in the estuarine analysis area section because the crossing location is within a tidally influenced river reach, and the Coos River would be crossed by HDD along with two crossings of Coos Bay.

The Pipeline would cross Stock Slough at MP 15.11 approximately 220 feet upstream from the head of tide endpoint and designated critical habitat for Southern DPS green sturgeon. At that location, Stock Slough is classified as a minor stream, less than 10 feet wide with intermittent flow. Pacific Connector would use dry open-cut construction, either with a flume or using dam-and-pump. Although these methods would have limited impacts on streams and aquatic species, they could result in some erosion and turbidity, as discussed below. At the point of crossing, green sturgeons would not require salvaging during dry open-cut construction because adults or subadults would not be expected upstream from the head of tide in intermittent streams.

Flume. The flume method typically is used to cross small to intermediate flowing waterbodies that are either fish-bearing or non-fish-bearing streams. The flume technique involves diversion of stream flow into a carefully positioned steel pipe of suitable diameter to convey the maximum flow of the stream across the work area, and ensures that stream flow rate is not interrupted.

Dam-and-Pump. With the dam-and-pump method, stream flow is diverted around the work area by pumping water through hoses over or around the construction work area. The goal of this technique is to create a relatively "dry" work area to avoid or minimize the transportation of heavy sediment loads and turbidity downstream of the crossing. This crossing method may be used on all waterbodies where stream flow can be diverted by pumping around the work area.

Turbidity and sedimentation impacts associated with dry open cut methods are generally minor and temporary, lasting typically for only a few hours, and are associated with 1) installation and removal of the upstream and downstream dams used to isolate the construction area; 2) water leaking through the upstream dam and collecting sediments as it flows across the work area and continues through the downstream dam; 3) movement of in-stream rocks and boulders to allow proper alignment and installation of the flume and dams; and 4) when streamflow is returned to the construction work area after the crossing is complete and the dams and flume are removed.

Estimates of suspended sediment concentrations are presented in detail in section 3.5.3 (SONCC coho) and section 3.5.4 (Oregon Coast ESU coho) and are not repeated here. Stock Slough is within the Coos Bay Frontal-Pacific Ocean fifth-field watershed. Characteristics of channel conditions for streams within the watershed were derived from the ODFW (n.d.) Aquatic Inventory Project; average conditions of bankfull widths, bankfull channel depths, channel gradients and percent sand, silt, and organics in streambed substrates in the watershed are assumed to apply to Stock Slough for analysis purposes.

Using the available data, including stream flow estimates during in-stream crossing periods designated by ODFW (2008) which extends from July 1 to September 15 for Stock Slough (which could be dry at the time of construction), modeled dry open-cut construction could generate suspended sediment concentrations from 11.1 mg/l at 637 meters downstream to 0.26 mg/l at 1,323 meters downstream if a flumed crossing is used and concentrations of 11.1 mg/l at 51 meters to 0.26 mg/l at 1,247 meters downstream if dam-and-pump construction is used to cross Stock

Slough. In general, the duration for exposure to those concentrations would be approximately 2 hours for crossing a stream less than 10 feet wide. Use of severity-of-ill effects (SEV) models developed by Newcombe and Jensen (1996) for adult estuarine nonsalmonids (Model 5 in Newcombe and Jensen), the maximum concentration of 11.1 mg/l lasting for 2 hours would produce a SEV score of 6, equating to moderate physiological stress but effects to green sturgeon in Stock Slough would be sublethal according to the model for adult estuarine nonsalmonids.

In their review of TSS effects and SEV scores in relation to estuarine fish and shellfish, Wilber and Clarke (2001) determined that the Newcombe and Jensen (1996) Model 5 for estuarine nonsalmonids yielded erroneous results, predicting lethal effects at very low concentrations of suspended sediment. Wilber and Clarke (2001) revised Model 5 so that SEV scores would be reduced by one. With this revision, the SEV score of 6, derived from a concentration of 11.1 mg/l lasting for 2 hours , above, would be corrected to SEV =5, equating to minor physiological stress (increase in rate of coughing, increased respiration rate). No records of sturgeons' (Acipenseridae) response to dose and exposure to suspended sediments were used in the development of Newcombe and Jensen (1996) Model 5 or in the corrected model described by Wilber and Clarke (2001) so the adjusted SEV model may not be applicable. Nevertheless, sediment generated by dry open-cut construction across Stock Slough would not cause lethal effects to green sturgeons if present in habitat downstream.

Habitat Effects – Pacific Connector Pipeline

The same approach utilizing suspended sediment concentration and exposure to evaluate levels of risk to fish (Newcombe and Jensen 1996) was applied to quantifying effects of sediment on fish habitat, termed harmful alteration, disturbance or destruction (HADD) of habitat by Anderson et al. (1996). HADD risk includes concentration and exposure to sediment along with sensitivity of the habitat affected. As described above, a SEV of 7 would equate to moderate habitat degradation. Based on the modeling similar to that conducted for SONCC coho and Oregon Coast ESU coho, there would be no risk of suspended sediment generated during Pipeline construction reaching concentrations that would cause moderate habitat degradation in Stock Slough and from the pipeline construction site.

Critical Habitat

Coos Bay has been included in the estuarine critical habitat for the species. The Coos Bay estuary provides several PCEs including food resources, migratory corridors (passage) between estuarine and marine habitats, and sediment quality and water quality (NMFS 2009c), all of which are necessary to support various green sturgeon life stages. Similarly, coastal marine waters 110 meters (60 fathoms) deep or less, between Coos Bay and San Francisco Bay, provide food, passage, and water quality as PCEs. Within Coos Bay, NMFS (2009c) noted that in-water construction or alterations, point and non-point source pollution, and LNG projects could affect the estuary portion of designated critical habitat. Project-related effects to Southern DPS green sturgeon within the Coos Bay estuary are likely to be similar to those discussed above including the following: 1) turbidity effects to forage/prey species and habitat by dredging, 2) shading effects on marine plants, 3) introduction of exotic species, 4) ship wake, and 5) pile driving.

Overall, adverse short-term effects would occur to the critical habitat of Southern DPS of green sturgeon from modification of nearshore and bottom habitat from slip construction, modification of bottom habitat from the marine waterway modifications and maintenance dredging which would disrupt food supply.

Similar to the modeling conducted for SONCC coho (section 3.5.3) and Oregon Coast ESU coho (section 3.5.4), there would be no risk of suspended sediment generated during Pipeline construction reaching concentrations that would cause moderate habitat degradation in Stock Slough and designated green sturgeon critical habitat 220 feet downstream from the pipeline construction site.

3.5.1.4 Conservation Measures

The Project would implement multiple BMPs to minimize potential impacts to marine, estuarine, and riverine habitats. These BMPs are detailed in many different Project documents, including the DMMP (Moffatt & Nichol 2017a), *Storm Water Management Plan*, and the COE Section 404 permit application, and are summarized in appendix N and the *Compensatory Wetland Mitigation Plan* in appendix O.1. Several specific conservation measures are called out below for additional discussion.

Effects within the estuarine analysis area would be offset by wetland restoration mitigation at a the Kentuck project (see appendix O.1, *Compensatory Wetland Mitigation Plan*). The permanent loss of the 2.08 acres of eelgrass by construction and operation of the LNG Project would be mitigated at an off-site proposed eelgrass mitigation location south of the west end of the Southwest Oregon Regional Airport; at this site approximately 9.3 acres would be created with the objective of establishing about 5.7 acres of new eelgrass habitat to produce a functional equivalent of the 1.90 acres of eelgrass habitat lost during Project construction and operation (see appendix O.1).

The interim loss of unvegetated mud flat (intertidal and shallow subtidal habitats) would be restored at a 3:1 ratio. Restoration would occur at the Kentuck Slough golf course, east of North Bend, where a portion of the golf course would be converted to intertidal and mudflat habitat to offset the estuarine impacts. Conversion would require removing existing levees and removing tide gates, actions that would reestablish tidal connections between former intertidal habitat within the golf course and Kentuck Slough. Jordan Cove also proposes wetland mitigation to offset the effects on freshwater wetlands associated with the development of the LNG terminal site, South Dunes site, and utility corridor and access road between the LNG terminal and South Dunes (see appendix O.1, *Compensatory Wetland Mitigation Plan*). Overall, approximately 90 acres of estuarine habitat would be recreated and/or enhanced at the Kentuck project site with the goal of re-establishing a minimum of 67 acres of historical tidal lands.

Potential acoustic impacts to aquatic organisms identified in the analysis above are based on worst-case use of impact pile driving without any sound attenuations measures. There are a number of measures (listed below) that could reduce the peak and cumulative sound pressures, which in turn could significantly reduce the range of sound waves that could injure or disturb listed fish species. Installation of piles during various phases of the Project would use the following measures to minimize risk of physical injury to fish:

- use vibratory pile driver whenever possible to minimize impulsive noise;
- use sound attenuation measures whenever driving in-water piles with an impact hammer;

- limit pile driving in the bay to the in water work window;
- limit pile driving in the bay and the land-based 8 MOF bollard piles and 28 east mooring piles to the in-water work window;
- limit number of land-based piles driven prior to breaching the berm (currently analyzed as 28 piles); and
- limit total impact hammer strikes on in-water piles per day to less than 3,000 or another amount determined in consultation with NMFS.

3.5.1.5 Determination of Effects

Species

The Project **may affect** green sturgeon (Southern DPS) because:

- adult and/or subadult green sturgeons may occur within the estuarine analysis area during construction and operation of the proposed action;
- adult and/or subadult green sturgeons may occur within the marine analysis area during operation of the proposed action; and
- adult green sturgeon may occur in Stock Slough which is included in the riverine analysis area during construction of the proposed action.

The Project is **likely to adversely affect** green sturgeon (Southern DPS) because of the following:

- Short-term increase in noise generated from MOF land-based pile driving and in-water pile driving at various temporary construction sites throughout the bay may cause disturbance and physical injury to green sturgeon if individuals are in proximity to the noise during construction.
- On a localized basis, the proposed action may affect migratory and feeding behavior, potential food resources, and water quality (TSS) during the short-term construction period and periodic maintenance dredging within the estuarine analysis area.
- Localized bottom disturbance from Project construction and periodic maintenance dredging may reduce the abundance and diversity of benthic food sources in discrete areas of Coos Bay and cause direct impact to individual green sturgeon.

Critical Habitat

The Project **may affect** critical habitat for the green sturgeon (Southern DPS) because:

- the riverine analysis area includes Stock Slough, which is included in designated critical habitat;
- the estuarine analysis area includes the Coos Bay estuary, which is included in designated critical habitat; and
- the marine analysis area includes coastal marine waters up to 110 meters (60 fathoms) deep, which have been included as coastal marine critical habitat.

The Project is **likely to adversely affect** critical habitat for green sturgeon (Southern DPS) because:

- bottom disturbance from construction and periodic maintenance dredging would locally affect the abundance and diversity of food sources within discrete areas of Coos Bay; and

- suspended sediment produced during dry open-cut crossing of Stock Slough, 220 feet upstream from designated critical habitat in Stock Slough, could affect water quality (PCE 4) in freshwater riverine critical habitat.

3.5.2 Pacific Eulachon (Southern Distinct Population Segment)

3.5.2.1 Species Account and Critical Habitat

Status

NMFS was petitioned on July 16, 1999, to list and designate critical habitat under the ESA for Columbia River populations of Pacific eulachon (Columbia River smelt) in 1999. NMFS (1999a) found that although eulachon catches within the Columbia River basin had recently declined, substantial scientific information was lacking to support the petition (NMFS 1999a). In 2007, the Cowlitz Indian Tribe petitioned NMFS to list the eulachon population south of the U.S./Washington-Canada Border as threatened or endangered under the ESA (Cowlitz Indian Tribe 2007). NMFS found that the 2007 petition did provide sufficient information to warrant delineation of a DPS for the eulachon south of the U.S./Washington-Canada border and that this population had substantially declined in abundance (NMFS 2009c).

NMFS listed the eulachon (Columbia River smelt), Southern DPS, as threatened in 2010 (NMFS 2010c). The Southern DPS includes eulachon spawning in rivers from California into British Columbia (NMFS 2008c).

Threats

The five primary threats to the eulachon generally, in order of severity, include: 1) climate change impacts on ocean conditions, 2) climate change impacts on freshwater habitat, 3) eulachon by-catch in offshore shrimp fisheries, 4) dams and water diversions in the Klamath and Columbia Rivers, and 5) predation in the Fraser and British Columbia coastal rivers (NMFS 2008c).

Species Recovery

NMFS published a recovery plan for the Southern DPS of eulachon in September of 2017 (NMFS 2017i). The recovery strategy includes research and monitoring actions that include but are not limited to the following: 1) estimating long-term spawner abundance, 2) survival of larval eulachon, 3) evaluating importance of the tidal freshwater, estuary, plume, and nearshore ocean environments to the viability and recovery of eulachon in the Klamath, Columbia, and Fraser Rivers, 4) determining the significance of plume and ocean conditions that affect eulachon survival, 5) developing a marine abundance survey for eulachon and correlation with riverine abundance estimates, 6) determining the significance of climate-related impacts on ocean conditions that affect eulachon survival, and 7) determining the significance of water quality degradation by potential contaminants on eulachon recovery potential. Priority management recovery actions identified in NMFS (2017i) include:

1. establish a eulachon technical recovery and implementation team to develop an overall framework for funding, prioritization, implementation, and reporting of recovery actions;
2. develop outreach and education strategies regarding the ecological, economic, and cultural values of eulachon;
3. continue to work with the ocean shrimp trawl fisheries and the states of California, Oregon, and Washington to implement actions (e.g., fleet-wide implementation of light emitting

diode lights, rigid grate bycatch reduction devices, and additional gear-type or operational modifications, to further reduce bycatch of eulachon in the ocean shrimp trawl fisheries);

4. continue to work with the states to implement a limited-opportunity eulachon fishery to:
   a) provide essential context for interpreting historical harvest data to better understand trends and variability in eulachon abundance;
   b) fill critical information gaps such as the length and age structure of spawning eulachon, as well as the temporal and spatial distribution of the run;
   c) support the cultural traditions of Northwest tribes who rely on eulachon as a seasonally important food source; and
   d) provide a limited public and commercial opportunity for eulachon harvest to maintain a connection between people and the eulachon resource.
5. continue to work with federal and non-federal entities that maintain and operate dams and channel-spanning water control structures to develop and implement actions to reduce the ecological effects caused by water management operations on riverine and estuarine habitats to support the full-range of biological requirements for eulachon;
6. continue to work with the COE to develop and implement actions to reduce impacts from dredging (e.g., entrainment, on eulachon);
7. continue to work with the states of California, Oregon, and Washington to implement programs that improve water quality for temperature; and
8. continue to work with federal agencies and the states of California, Oregon, and Washington to implement programs (e.g., revetment breaching and removal, to reduce the impacts of shoreline construction on eulachon and their habitats).

Life History, Habitat Requirements, and Distribution

Pacific eulachon are an anadromous smelt endemic to the northeastern Pacific Ocean. They range from northern California to southwest and south-central Alaska and into the southeastern Bering Sea (NMFS 2013f). Adult eulachon usually spend three to five years in saltwater before returning to fresh water to spawn from late winter though early summer (NMFS 2009e). Eulachon generally spawn at night in rivers that are glacier-fed and/or have peak spring freshets, and it has been suggested that imprinting is confined to an estuary not a specific individual spawning river (Hay and McCarter 2000). The typical spawning temperature is from 4° to 10°C in the Columbia River and tributaries and from 0° to 2°C in the Nass River (NMFS 2009e).

Spawning time is mostly likely dependent on geographic location, with those individuals in the southern part of the range spawning earlier than their northern counterparts. Eulachon spawn earlier in southern portions of their range than in rivers to the north. River-entry and spawning begins as early as December and January in the Columbia River system (NMFS 2008c). Reports have indicated spawning beginning in January in rivers of the Copper River Delta of Alaska and in May in North California. Within coastal British Columbia, the typical pattern is reversed, with spawning occurring as early as February in the Nass River and the latest spawning occurring in April and May in the Fraser River. Data also support the evidence of waves or runs of eulachon spawning in some basins (Hay and McCarter 2000). Most eulachon adults die after spawning.

Eulachon sexes must synchronize their activities closely because eulachon sperm remain viable for only a short time, estimated to be minutes (Hay and McCarter 2000). Eggs are fertilized in the water column, sink, and adhere to the river bottom typically in areas of gravel and coarse sand.

Eulachon eggs hatch in 20 to 40 days, with incubation time dependent on water temperature. Shortly after hatching, the larvae are carried downstream and dispersed by estuarine and ocean currents (NMFS 2009e). After leaving estuarine rearing areas, juvenile eulachon move from shallow near shore areas to deeper areas over the continental shelf. Larvae and young juveniles become widely distributed in coastal waters, with fish found mostly at depths up to 15 meters (50 feet) but sometimes as deep as 182 meters (600 feet) (Hay and McCarter 2000). Eulachon larvae and post-larvae eat phytoplankton, copepods and their eggs, mysids, barnacle larvae, worm larvae, and other eulachon larvae (NMFS 2009e). Adults and juveniles commonly forage at moderate depths (15 to 182 meters) in inshore waters, feeding on zooplankton, primarily eating crustaceans (Hay and McCarter 2000). Other common adult eulachon food sources include euphausiids, copepods, and cumaceans (Gustafson 2016).

With their high lipid content and massing in estuaries and rivers during spawning migrations, eulachon are an important part of the Pacific coastal food web. Eulachon are prey to numerous fish, avian species, marine mammals, and terrestrial mammals (NMFS 2009e). Historically, eulachon distribution corresponds closely with the EPA's Coastal Range Ecoregion, which extends from the Olympic Peninsula through the Coast Range and down to the Klamath Mountains and the San Francisco Bay area. Streams within this region exhibit two distinct annual flow patterns: 1) streams draining coastal watersheds commonly experience winter rain events with periods of high flow; and 2) streams draining more interior areas, such as the Columbia and Cowlitz Rivers, have a distinct spring freshet period coinciding with snow melt. Eulachon production is highest in these latter interior systems (NMFS 2009e).

Population Status

The Columbia River has historically shown the largest returns of spawning population throughout the eulachon's range. A review of records has shown that eulachon spawning runs from California to southeastern Alaska have declined in the past 20 years, with a significant trend observed since the mid-1990s (Hay and McCarter 2000). From 1938 to 1992, the median commercial catch of eulachon in the Columbia River was approximately 1.9 million pounds. From 1993 to 2006, the median catch had declined to approximately 43,000 pounds, representing a 97.7 percent reduction in catch from the prior period. Despite a short increasing trend noted for the Columbia River from 2001 to 2003, recent catches remain lower than the historical median (Cowlitz Indian Tribe 2007).

Similar trends were noted by the Cowlitz Indian Tribe for tributaries of the Columbia River in Oregon and Washington, as well as Fraser River: a rapid decline in the mid-1990s, increasing returns during 2001-2003, and a recent decline to low levels (NMFS 2008c). The 2007 petition noted that the eulachon is most likely extirpated or nearly so in the Klamath River, Mad River, Redwood Creek, and Sacramento River (Cowlitz Indian Tribe 2007; NMFS 2008c).

Analysis of eulachon bycatch in ocean shrimp fisheries between 2007 and 2012 observed a greater than 40 percent annual increase in eulachon density, which was attributed to increasing population size (Ward et al. 2015). This same study also observed that coastal areas just south of Coos Bay are consistent hotspots for eulachon bycatch. This trend is supported by recent observations of increased eulachon population abundance (James et al. 2014).

Critical Habitat

Critical habitat for Pacific eulachon was designated in 2011 (NMFS 2011f). Critical habitat for eulachon includes freshwater creeks and rivers and their associated estuaries comprising approximately 335 miles of habitat within in 16 specific estuarine and freshwater areas in California, Oregon, and Washington. Essential to the conservation of the species are the following physical and biological features (or PCEs) of freshwater spawning and incubation sites: water flow, water quality, water temperatures, suitable substrate for spawning and incubation, and migratory access for adults and juveniles. The physical and biological features of freshwater migration corridors include water flow, water quality and water temperatures to support larval and adult mobility; abundant prey items to support larval feeding (NMFS 2011f).

Activities that may affect the physical and biological features essential to the Southern DPS of eulachon include: 1) dams and water diversions; 2) dredging and disposal of dredged material; 3) in-water construction or alterations; 4) pollution and runoff from point and non-point sources; 5) tidal, wind, or wave energy projects; 6) port and shipping terminals; and 7) habitat restoration projects (NMFS 2011f). These activities may have an effect on one or more of the essential physical and biological features by altering alteration of one or more of the following: 1) stream hydrology, 2) water level and flow, 3) water temperature, 4) dissolved oxygen, 5) erosion and sediment input/transport, 6) physical habitat structure, 7) vegetation, 8) soils, 9) nutrients and chemicals, 10) fish passage, and 11) estuarine/marine prey resources (NMFS 2011f).

3.5.2.2 Environmental Baseline

Analysis Area

Two analysis areas are applicable to effects determinations for eulachon in the Southern DPS – the estuarine analysis area and the marine analysis area. Effects in the estuarine analysis area are associated with 1) operational activities by LNG carriers entering and exiting Coos Bay, 2) in-water construction activities including dredging and pile installation, and 3) the crossing of Coos Bay by the Pipeline. Eulachon occur within marine waters offshore and within the marine analysis area where they could be affected by 1) underwater noise from LNG carriers, and 2) oil and fuel spills.

Species Presence

Although Coos Bay is within the historical range of the eulachon, south of the Columbia River mouth, eulachon have been identified in very few coastal streams (Cowlitz Indian Tribe 2007). Adults are found rarely in Coos Bay (NMFS 1999a) and spawning runs have not been documented for the Coos River. The Biological Review Team review of eulachon status also concluded that their presence in Coos Bay was "rare" (NMFS 2008c). Observations of adult eulachon have been reported from the Umpqua and Rogue Rivers, Oregon (Emmett et al. 1991). Pelagic Tucker trawl samples over a 17-month period found larvae and small juveniles of a close relative, surf smelt, but no eulachon in the vicinity of the proposed LNG terminal in Coos Bay (Shanks et al. 2011). Storch et al. (2014) reported that opportunistic sampling for eggs and larvae of eulachon was conducted in January and February 2011 in the Coos River, but nothing was found. However, given the limited survey effort and highly variable presence of eggs and larvae, eulachon occurrence in Coos Bay could not be ruled out (Storch and Van Dyke 2014). While no recent spawning runs have been documented for the Coos River, some may have occurred historically.

Recently, a confirmed capture occurred in Winchester Creek, a major tributary to South Slough that enters Coos Bay near the ocean (Willson et al. 2006; Wagoner et al. 1990; NMFS 2018d).

Coos Bay is known to occasionally support adult populations of eulachon (NMFS 1999a). When present, eulachon may utilize both shallow and deep water habitats within the estuary. Based on current information, this analysis assumes that although adult eulachon may be infrequently present in Coos Bay, larvae are likely not present based on the lack of documented larvae or spawning in Coos Bay tributaries.

Critical Habitat

Critical habitat has been designated within the Lower Umpqua River. No critical habitat has been designated within the Coos Bay estuary or marine analysis area.

3.5.2.3 Effects of the Proposed Action

The Project effects to the Southern DPS of Pacific eulachon would be similar to those described above in section 3.5.1.3 for North American green sturgeon.

Direct and Indirect Effects – Marine Analysis Area

Project-related effects to the Southern DPS of Pacific eulachon within the marine analysis area could result from LNG carrier–generated acoustic effects and inadvertent fuel spills and equipment fluid releases at sea.

Acoustic Effects

The criteria for noise levels considered harmful to fish are presented above in the green sturgeon discussion (section 3.5.1.3), but generally values less than 183 dB are not considered harmful to fish. As a result, only fish within about one meter (three feet) of the carrier would be in danger of direct noise harm. Eulachon, which tend to reside at midwater depths, would be highly unlikely to be within three feet of these carriers, and thus adverse effects to eulachon from LNG carrier noise are not expected.

Fuel or Oil Spills at Sea

The LNG carriers use either a steam or DFDE propulsion system that is primarily fueled by natural boil-off gas. Fuel (e.g., diesel) used for back-up generation for LNG carrier propulsion and oil or hydraulic fluids used for mechanical equipment could possibly leak or be spilled during waterway transits. The low volume of petroleum oils and fuel on LNG carriers greatly reduces chance of impacts in the marine environment from petroleum spills. The Federal Water Pollution Control Act, as amended by the CWA (33 U.S.C. 1251–1387), prohibits the discharge of oil upon the navigable waters of the U.S., Contiguous Zones (nine miles seaward of the three-mile limit of Territorial Waters), and, where it can be determined that the natural resources of the U.S. are impacted, out to the EEZ (200 miles). Also, LNG carriers calling on the LNG Project would be required by the Coast Guard to have a carrier response plan in order to be adequately prepared for accidental spills. Therefore, neither fuel nor oil leaks from LNG carriers transiting in the waterway to and from the LNG Project are likely to have adverse effects on aquatic resources including eulachon.

Direct and Indirect Effects – Estuarine Analysis Area

Potential Project-related effects to the Southern DPS of Pacific eulachon within the estuarine analysis area are associated with the following:

1. interference with key life history functions;
2. turbidity from dredging and from LNG carrier propwash and ship wake;
3. habitat modification and food source effects from the slip, access channel, and pile dike rock apron construction and marine waterway modifications;
4. entrainment during dredging activities;
5. contamination from dredging;
6. suspended sediment potentially released during HDD construction across the Coos Bay Estuary and Coos River;
7. acoustic effects from construction and operation; and
8. other effects including stranding, invasive species, temperature, shading, and lighting.

Details on these potential effects would be similar to those discussed for green sturgeon in section 3.5.1.3.

Timing to Life History Functions

In-water construction of the LNG Project within the Coos Bay estuary is planned from October 1 through February 15 following ODFW's recommendation. The two HDD installations may occur between March and December. Although recently a eulachon was captured in a Coos Bay tributary, eulachon spawning has not been documented in freshwater tributaries to Coos Bay, and the estuary most likely only provides infrequently occupied habitats for eulachon. Seasonal presence of eulachon in the estuary has not been definitively documented but fish have been reported captured in the estuary from June through September (NMFS 2008c). If those reports are indicative of the seasonal presence of eulachon in Coos Bay, the timing of in-water construction would avoid such presence. The timing of HDD installation, however, may coincide with eulachon presence.

Turbidity Effects from Construction and Maintenance Dredging in Coos Bay and Vessel Traffic

Turbidity would be generated at the LNG terminal slip and access channel, marine waterway modification sites, and Eelgrass Mitigation site; while performing construction and maintenance dredging; and from the propwash of LNG carriers, tugs, and escort boats in the waterway during operation of the terminal (see discussion of direct impacts to green sturgeon within the estuarine analysis area in section 3.5.1.3, above). As discussed for green sturgeon above, turbidity in Coos Bay during dredging would be temporary, and there would be only limited areas and times where suspended sediment concentrations would be above ambient levels. Turbidity in Coos Bay caused by the Project is not likely to have significant adverse effects on eulachon. While dredging has been shown to have damaging effects on out-migrating eulachon larvae (NMFS 2017i), larvae are not expected to be present in Coos Bay based on the absence of documented spawning in Coos Bay tributaries. Similarly, no eggs are anticipated to be present in tributaries that could be smothered, entrained or damaged by proposed dredging activities. Should adult eulachon be present coincidental with LNG carrier traffic in the waterway, they would be expected to avoid the LNG carriers. Given the deep and shallow water habitats available, there is likelihood that temporary elevated levels of turbidity would result in minor significant impacts on adult eulachon in Coos Bay. It is also possible that individual adult eulachon could become entrained by hydraulic suction or clamshell dredging if they are present during the winter and early spring, but this is unlikely given the rare occurrence of the species in Coos Bay.

Similarly, individual adult eulachon could experience negative physiological and behavioral effects from incremental increases of propwash turbidity at the new access channel and marine slip. These areas are expected to experience up to 0.5 foot of bed scour from propwash (Moffatt & Nichol 2017d).

At the Eelgrass Mitigation site, a total of 40,000 cy of dredge material would be removed, most likely with a small hydraulic dredge. Modeled turbidity values were determined to be about 1,700 mg/l (about 270 to 290 NTUs) in the active dredging area from the excavator dredging. A turbidity plume having values above background values (20 mg/l [10 NTU]) would generally be limited to between 340 and 360 feet in all directions from the active dredge site (Moffatt & Nichol 2017b). If a mechanical excavator were used for the eelgrass site construction, a confined area of elevated TSS would extend less than 0.1 mile from point of dredging (Moffatt & Nichol 2017b). Because the site is a more confined and shallow area with somewhat limited circulation, the turbidity plume would be maintained within the local area of excavation. The duration of suspended sediment settling, therefore, is expected to be very short with turbidity dissipating to background levels within an hour after dredge operations cease, depending on the tidal cycle.

<u>Habitat and Food Source Effects – Slip, Access Channel, Pile Dike Rock Apron and Marine Waterway Modifications</u>

As discussed under section 3.5.1, the construction of the proposed marine slip, pile dike rock apron, and access channel would impact local aquatic resources by removal or conversion of some habitats. These resources supply food and some habitat for eulachon and some local short term reduction in food sources would occur; these effects would be slight to eulachon because of the limited areas affected and rare occurrence of eulachon in these areas but not completely discountable.

Dredging at the four marine waterway modifications sites would take place in deep subtidal habitat used by benthic organisms, macroinvertebrates, and demersal fishes (e.g., worms, clams, crustaceans, mollusks, flatfish, and Pacific sand lance). Few if any of these would serve as prey to eulachon because they are primary a plankton feeder including, copepods, cumaceans, and euphausiid crustaceans. Entrainment from dredging could injure or kill these and other bottom-dwelling species that have limited mobility and move, rest, find shelter, and feed within the dredge prisms for these areas.

The marine waterway modifications sites are located entirely within deep subtidal habitats along the Federal Navigation Channel. Such habitat is less productive than shallow subtidal and intertidal habitats. Furthermore, the Federal Navigation Channel is subject to periodic dredging and propeller scour which can disturb the associated benthic community. Benthic communities associated with mud substrates like those within Coos Bay, however, have been shown to recolonize to pre-dredging conditions within four weeks following dredging (Newell et al. 1998). However, recovery in estuarine channel muds has been reported in a review paper of dredging to be typically six to eight months (Newell et al. 1998). In the lower Columbia River, McCabe et al. (1997, 1998) noted benthic organism recovery in three months. Studies of a dredged sandy substrate area in Yaquina Bay (Oregon) found recovery of benthos took one year (Swartz et al.

1980, as cited in Wilber and Clarke 2007). Because of the large quantity being dredged and type of substrate, the recovery may take longer than a four-week period relative to typical dredging, and thus the benthic communities in the areas to be dredged may take a correspondingly longer time period to recover. The similarity of sandy substrate like that of Yaquina Bay to substrate in the Federal Navigation Channel suggests it is likely that recovery would be closer to a year for benthic resources, particularly in the area of the marine waterway modifications.

Based on the preceding, impacts to bottom-dwelling marine life where dredging is planned at the marine waterway modifications sites, LNG terminal slip, and access channel are expected only to occur over the short term. While it is anticipated that affected areas would partly be recolonized by similar species within a month or two following dredging, complete recovery could be closer to a year and with the relative composition of species likely altered over the near term.

There is some potential for habitat effects from the LNG Project, including potential effects of installation of riprap (such as at the pile dike rock apron, and slip), conversion of shallow water areas to deep water areas, and short-term loss of eelgrass areas (see section 3.5.1.3 for description of habitat changes). However, the changes in habitat would be discountable for eulachon, given the rarity of this species in the bay and its reliance on primarily pelagic areas.

Entrainment from Dredging

Direct mortality or injury from dredging is not expected for most pelagic fishes including eulachon due to their swimming ability and behavioral tendency to avoid disturbance. Entrainment of eulachon from dredging activities is also likely to be rare due to the relatively large size and swimming ability of adult life stage, their likely low abundance, and mostly pelagic distribution in the bay.

Contamination Effects from Dredging

Dredging is not anticipated to suspend or activate contaminants in the substrate that could have negative physiological effects on eulachon. A comprehensive sediment sampling and analysis plan was completed in October 2006 in order to evaluate the grain size distribution and total volatile solids composition of sediments in the proposed dredge prism for the terminal access channel (SHN 2007). The testing that was conducted to determine whether the sediments meet DMEF guidelines, relative to Lower Columbia River Management Area, for in-water disposal. Because results of the study revealed that all samples were primarily composed of medium to fine grain sand and had a very low percentage of total volatile solids, no further chemical testing was required, and the sediments were considered suitable for in-water disposal per DMEF guidelines. Furthermore, the results indicate the sediment character should not result in significant increases in bioavailability of contaminants to fish and fish food organisms within the analysis area. Based on the results of the sediment sampling, there is little to no risk of contamination as a result of dredging the access channel.

Sediment evaluations conducted by the COE in 2004 for the Coos Bay channel maintenance and improvement dredging along the Federal Navigation Channel revealed only low levels of sediment contaminants, all below their respective DMEF screening levels. In 2011 and 2016, Jordan Cove conducted geotechnical investigations at the marine waterway modifications sites to support Jordan Cove's DMMP. Analysis of the physical character of sediments at the marine waterway modifications sites determined that sediment composition consisted of sand, silty sand, sandstone, and siltstone. This is similar to sediments collected from the adjacent Federal Navigation Channel and from within the footprint of the proposed LNG Project access channel. These sediments were generally described as coarse-grained with high sand content, which the Portland Sediment Evaluation Team (PSET) previously determined suitable for unconfined aquatic disposal. Due to their proximity to previous sampling locations in the Federal Navigation Channel and access channel, sediments to be dredged from the marine waterway modifications sites would have a similar chemical character which would be confirmed in future consultations with the PSET. Therefore, dredge materials from the marine waterway modifications sites would also have a low likelihood of potential contaminants and be suitable for unconfined aquatic disposal.

Turbidity Effects – Pipeline Construction with HDD

HDD effects, locations, and processes to remedy issues were presented above in section 3.5.1 (North American Green Sturgeon) and would be the same for eulachon.

Due to the procedures in place to reduce the chance of frac out, methods to repair effects, large dilution effects in the estuary, and the low likelihood of eulachon being present in the crossing areas, any potential adverse effects from releases would be discountable.

Acoustic Effects from Construction and Operation

Increased underwater noise from pile driving and other construction-related activities would have similar effects on adult eulachon as described for North American green sturgeon in section 3.5.1.3. In-water pile driving would be limited to the approved in-water work window for the Project, which is October 1 through February 15. This window would minimize potential interaction with eulachon which, if present, would most likely be in the bay during spring and summer.

As discussed in section 3.5.1.3, underwater noise can be generated by driving piles on land (dry piles). The propagation of underwater construction noise from the "dry" impact pile driving associated with the MOF was modeled for fish in several reports prepared by JASCO Applied Sciences (Wladichuk and MacGillivray 2018; Wladichuk et al. 2018). Wladichuk et al. (2018) modeled potential impacts of land-based pipe pile driving on fish using both current guidelines (Fisheries Hydroacoustic Working Group 2008) and new proposed guidelines (Popper et al. 2014). Previous noise studies investigated radii to marine mammal and fish threshold criteria from a pipe pile with the same diameter (36 inches [0.9 meter]) but a shorter length (60 feet [18.3 meters]), as well as different number of strikes in a 24-hr period and at 4 set-back locations behind the MOF (O'Neill and MacGillivray 2017; Wladichuk et al. 2017, Wladichuk and MacGillivray 2018). After receiving additional construction details, the most recent study examined the threshold radii from driving a 104.8 feet (31.9 meters) pile at the MOF and at 98.4 feet (30 meters) setback distance behind the MOF using a reduced impact hammer energy of 65 percent. This study found that injury to fish from peak sound pressure levels (206 dB in current guidelines) would occur up to 37 meters from the face of the MOF. Also, this study predicted that injury to both small (less than 2 grams) and large (greater than or equal to 2 grams) fish from cumulative sound exposure levels (183 and 187 dB respectively under current guidelines) would occur up to 1,723 meters from the shoreline. This distance was the same for both 10,000 and 20,000 total impact strikes because in both cases this was the distance when the noise attenuated to the sound level considered effective quiet (150 dB). Under proposed guidelines (Popper et al. 2014), modeled distances to injury were considerably less, although the distance to TTS was the same – 1,723 meters. Figure

3.5.1-2 (in section 3.5.1) shows the modeled extent of this potential zone of injury in the Project area from land-based pipe pile driving at the MOF face for 206 dB peak and 187 dB SEL.

Based on the results of Wladichuk et al. (2018), installation of land-based piles at the MOF face would increase potential exposure of individual eulachon to underwater noise in an area encompassing the navigation channel from the MOF across the bay to the airport and southwest to the vicinity of Southport Lumber yard. Individual fish occurring in this area during pile driving could experience physiological effects sufficient to cause injury or mortality.

Sheetpile installation away from the water edge using vibratory hammer would not reach noise levels in the range of those noted above to cause harm to fish other than possibly at worst a few meters (~2 meters) from shore (data from Deveau and MacGillvray 2017 using NMFS [2009f] model).

Also, there would be 1,150 wood piles and sheetpiles constructed at the Trans-Pacific Parkway/US-101 intersection widening. These may be installed above or below water level depending on tide level. The methods for wood pile installation are unknown, but sheetpile would be installed by vibratory hammer with an impact hammer being used if necessary. One report measured peak values of 180 dB 10 meters from wood piling when using an impact hammer (Illinworth and Rodking 2007). Data are not available on noise levels from a vibratory hammer on wood, but vibratory hammer noise levels are generally much lower at peak noise production compared to those from an impact hammer. With the number of pilings to be installed, the frequency of piling contacts would be high. There is some risk of cumulative noise levels associated with wood piling being an issue if peak noise values were near 180 dB. Jordan Cove has indicated that an impact hammer would not be used on sheet piles if they were inundated by high tides; implementation of this commitment would reduce the effects of cumulative and peak noise levels on fish.

As discussed in section 3.5.1, other noise source such as LNG carrier traffic and dredging would only have potential to affect fish within a few feet (less than four feet) of either activity if present in those areas for extended periods. It is highly unlikely that eulachon would be in that close proximity because few, if any, are likely to be present, and individuals could avoid these areas; as a result, adverse noise effects from these activities would be unlikely to occur.

Conservation actions may include sound attenuation measures to minimize risk of disturbance that may occur in the Project vicinity during construction as well as limiting land-based pile driving close to the MOF face to the in-water work window, which would minimize the risk of exposure of adult and migrating eulachon to increased noise. The larval life stage of eulachon, which would be most susceptible to barotrauma from increased sound pressures, is not expected to occur in the bay due to the lack of documented spawning populations in Coos Bay tributaries.

Other Effects within the Estuarine Analysis Area

Other impacts on eulachon within the estuarine analysis area are not expected to be adverse, similar to the discussions for North American green sturgeon. Stranding of adult eulachon by ship wake is possible but unlikely given the low vessel speed of 4 to 6 knots that would occur during most of the transit route through Coos Bay. The size of adult eulachon that may infrequently enter the estuary is 20 to 30 cm (Moyle 2002), considerably larger than juvenile Chinook salmon (less than 9 cm) that were subject to stranding by ship wakes in the Columbia River (Pearson et al. 2006).

As a result, eulachon that may be present in the estuary should not be susceptible to ship wake stranding.

The release of ballast water by LNG carriers during loading at the LNG terminal should not introduce exotic, invasive species into Coos Bay. While it is unlikely that eulachon would be entrained or impinged during an LNG carrier's intake of engine cooling water at dock as their larger size (no larvae would be present) would allow them to swim away from the velocity of the intake, the possibility cannot be completely ruled out. Some loss of estuarine food organisms would occur from vessel water intake, as discussed in the green sturgeon section. The release of engine cooling water by LNG carriers at the LNG terminal would not significantly elevate water temperature in the slip, nor would eulachon be affected by operational lighting or shading at the LNG slip.

Critical Habitat

Critical habitat has been designated for this species but none occurs within either the marine or the estuarine analysis areas. No critical habitat would be affected by the proposed action.

3.5.2.4 Conservation Measures

Measures developed for application within the estuarine analysis area to conserve green sturgeon would also benefit the eulachon Southern DPS if they are present within the estuarine analysis area during construction and operation of the Project.

3.5.2.5 Determination of Effects

Species

The Project **may affect** Pacific eulachon (Southern DPS) because:

- adult eulachon may be present within the estuarine analysis area during construction and operation of the Project; and
- eulachon may occur within the marine analysis area during operation of the proposed action.

The Project is **likely to adversely affect** Pacific eulachon (Southern DPS) because:

- even though eulachon are rare in Coos Bay and their large size would allow most individuals to avoid the LNG carrier cooling water intake, some limited number could be entrained during vessel loading in Coos Bay;
- the proposed action including navigation channel widening and maintenance dredging within the estuarine analysis area would result in bottom disturbance and habitat modification, and may affect water quality, suspended sediment, and the abundance and diversity of potential food resources over the short-term durations of Project construction; and
- short-term increase in noise generated from the MOF land-based pile driving and in-water pile driving in the estuarine analysis area may cause physical injury to individual eulachon at a limited distance during construction.

Critical Habitat

The Project would have **no effect** on critical habitat for the Pacific eulachon (Southern DPS) because no designated critical habitat is present within the estuarine analysis area.

3.5.3 Coho Salmon (Southern Oregon Northern California Coast ESU)

3.5.3.1 Species Account and Critical Habitat

Status

The SONCC ESU coho salmon was listed as a threatened species in 1997 (NMFS 1997b). At the time of listing, NMFS estimated that there were less than 10,000 naturally reproducing SONCC coho (NMFS 1997b). The SONCC coho ESU includes all coastal tributaries to the Pacific Ocean between Punta Gorda, California and Cape Blanco, Oregon. It includes all naturally spawning populations as well as three artificial propagation programs, of which one, the Cole Rivers Hatchery (ODFW stock #52) located on the Rogue River, is within the Pipeline Project area.

Threats

At the time the SONCC coho salmon ESU was proposed for listing, various factors were included as threats to West Coast salmon populations in general but were not specific to this ESU. Logging, agricultural practices, urbanization, stream channelization, dams, wetland loss, water withdrawals with unscreened diversions for irrigation, and mining were listed as development actions that threatened the survival of this ESU and two others (NMFS 1995). The result of these development practices caused increased soil erosion and stream sedimentation, degradation of riparian zones, increased water temperatures, decreased recruitment of LW in streams, decreased habitat complexity, and damage to riparian vegetation. Overharvest by commercial and recreational fisheries, disease, drought, warming ocean temperatures, and artificial propagation with associated impact of hatchery populations on wild stock have been contributory threats to all West Coast salmon (NMFS 1995).

Prior to listing the species, NMFS published a status review in 1995 that included the SONCC coho salmon ESU (Weitkamp et al. 1995). In that document, all coho salmon populations in the ESU were described as depressed. In the Rogue River, wild coho salmon were heavily affected by hatchery production with little natural production in the mainstem. The declining trend of coho salmon was indicative that natural populations in the Rogue River and others within the ESU were not self-sustaining (Weitkamp et al. 1995).

NMFS's most recent status review was published in 2016 (NMFS 2016d). The updated status review indicates that there has been no improvement in the status of SONCC coho in the last five years, and the ESU is at a heightened risk of extinction since the former status review conducted in 2011 (NMFS 2011g). A total of 24 out of 31 independent populations are at high risk and six are at moderate risk of extinction (NMFS 2016d). Coho salmon populations continue to be depressed within the ESU as a whole, and the Rogue River stock has demonstrated a declining trend, though insignificant, since the last formal status reviews when an average increase in numbers of spawners had been observed (Good et al. 2005; Ly and Ruddy 2011). While the Rogue River run includes hatchery fish releases from the Cole Rivers hatchery, these hatchery fish are of Rogue River stock origin and are considered by NMFS as part of this ESU. Consequently, there is reduced genetic risk to wild stocks in the Rogue River. Ocean harvest of the Rogue-Klamath stock by commercial and recreational fishers has been controlled since 1999 (not to exceed 13 percent), and river harvest within the ESU has not been allowed since 1994 (with tribal harvests excepted).

NMFS (2016b) concluded that data collected at Huntley Park provide the best estimates of coho spawner abundance in the Rogue Basin. Long-term (35 years) analysis indicates that SONCC coho have had a significant increasing trend, but from 2001 to 2014 (12 years), the population showed a non-significant declining trend (NMFS 2016b). The current risk of extinction of SONCC coho in the Upper Rogue River is “Moderate,” as opposed to “High” for other populations in the Interior Rogue Stratum (NMFS 2016b). Other populations in the SONCC ESU appear to be decreasing, with negative trends have been thought to also be related to low marine survival (NMFS 2016d). Multiple projects conducted in the Oregon portion of the ESU have improved riparian habitats, decommissioned roads, treated stream crossings, improved fish passage by dam removal, and installed fish screens on diversions (NMFS 2016b).

Insufficient in-stream flow, limiting adequate habitat for juveniles rearing during summer, has become a greater risk factor as groundwater and surface water withdrawal have increased due to crop irrigation and residential use. Water temperatures throughout the ESU have likely increased in summer during the ongoing drought; higher temperatures can limit migration, reduce growth, stress fish, reduce reproductive success, inhibit smoltification, contribute to susceptibility to disease, and alter competitive dominance (NMFS 2016b). Absence of large wood has contributed to lack of floodplain and channel structure and, along with declines in beaver abundance, has reduced pool habitats utilized by juvenile coho for shelter and thermal refugia throughout the SONCC ESU.

NMFS (2014d) released a final recovery plan for SONCC coho salmon that identified 10 stresses, or limiting factors, and 13 threats to various life-stages for coho in the Upper Rogue River population. Limiting factors or stresses that were determined to be very high to all life stages (see table 32-1 in NMFS 2014d) included 1) altered hydrologic function primarily due to reservoirs constructed to support irrigated cropland and ground water depletions for a variety of uses, and 2) impaired water quality, especially high water temperatures (from lower water flows and removal of riparian trees) with lower dissolved oxygen. Other stresses with high or very high severity effects to multiple life stages (from fry to adults) include 3) degraded riparian forest conditions caused by removal of large conifers, channelization, wetland drainage, and other alterations, 4) lack of floodplain and channel structure (channelization and reduction of slow, cool edgewater habitats where coho fry and juveniles thrive), and to a lesser extent, 5) altered sediment supply from roads, timber harvest, and bank erosion following removal of riparian vegetation causing elevated fine sediment input (NMFS 2014d). In addition, barriers to upstream migrations by small temporary agricultural dams, large diversion dams, and seasonal loss of stream flow in tributaries such as Trail Creek are a key limiting factor for the population.

Threats to all life stages having very high or high severity rankings contribute to the limiting factors discussed above. Severe threats to the Upper Rogue River population include 1) agricultural practices that include water withdrawals causing insufficient in-stream flows along with effects due to grazing, wetland filling, riparian removal, channel simplification, and chemical application; 2) roads and high road densities that cause chronic fine sediment and increase probabilities of landslides; 3) urban-residential-industrial developments that have led to channelization, increased non-point source storm water pollution, and resulted in loss of aquatic system function; 4) channelization-diking that has impaired floodplain functions, constricted channels, and reduced surface-groundwater connections, all of which adversely affect water temperatures and salmon carrying capacities; 5) timber harvest that has caused early seral stage forests and high road densities in riparian zones; 6) dams and diversions that impede upstream adult salmon passage or strand downstream-migrating juveniles, if fish screens are not in place; 7) channelization and confinement of mainstem and tributaries to the Upper Rogue River that diminish summer and winter habitat carrying capacity for coho; and 8) climate change that is projected to cause increased regional average temperatures over the next 50 years and is currently leading to ocean acidification, affecting numerous marine habitat conditions including prey availability (NMFS 2014d).

The BLM and Forest Service evaluated habitat conditions in the four fifth-field watersheds crossed by the Pipeline where SONCC ESU coho salmon inhabit waterbodies (see table 3.5.3-1). Summaries for three of these watershed analyses are provided in tables AA-8, AA-9, and AA-10 in appendix AA). In these three watersheds, streams lacked in-stream LW, fish access was limited, sedimentation was excessive, and high flows degraded in-stream habitats. More recently, the Little Butte Creek Watershed Council conducted an assessment in 2003, and the Upper Rogue Watershed Association conducted an assessment in 2006 (table 3.5.3-1). Both assessments relied, in part, on ODFW stream habitat data that are also analyzed below in section 3.5.3.2 (see table 3.5.3-8). Findings in the more recent assessments were consistent with the earlier BLM and Forest Service watershed assessments: there was an overall lack of complex pools and LW in lower reach channels. However, NMFS (2016d) noted improvements for fish access to upstream habitats in the Upper Rogue sub-basin, including the removal of three diversion dams on the main-stream Rogue River – the Gold Hill Dam removed in 2008, the Savage Rapids Dam in 2009, and the Gold Ray Dam in 2010.

TABLE 3.5.3-1

Watershed Assessments Conducted by Federal and State Agencies for Fifth-Field Watersheds Crossed by the Pipeline within the Upper Rogue Subbasin

Sub-basins and Fifth-Field Watersheds	Watershed Analysis, BLM and/or Forest Service	Watershed Assessment, Oregon Watershed Enhancement Board
Trail Creek	• Trail Creek Watershed Analysis (Western Watershed Analysts and Maxim Technologies, Inc. 1999)	• Upper Rogue Watershed Assessment (Upper Rogue Watershed Association 2006)
Shady Cove-Rogue River	• Shady Cove-Rogue River Watershed Water Quality Restoration Plan (BLM 2011)	
Big Butte Creek	• Lower Big Butte Watershed Analysis (BLM 1999d)	
Little Butte Creek	• Little Butte Creek Watershed Analysis (BLM and Forest Service 1997).	• Little Butte Creek Watershed Assessment (Little Butte Creek Watershed Council 2003)

Historically, the SONCC coho salmon ESU inhabited the Upper Klamath Basin, upstream from Iron Gate Dam to Spencer Creek, but various impediments to passage, principally hydroelectric projects, have occurred due to basin development activities, reducing access to these areas. Currently, the Upper Klamath River coho salmon population is not viable and is at high risk of extinction according to the population viability criteria. Summer and winter rearing habitat is in poor condition in many areas and is limited in its extent and connectivity. Mainstem conditions during the summer are prohibitive for migration and rearing, and hatchery influences on the population are very high. The removal of the four mainstem Klamath River dams—Iron Gate, Copco 1, Copco 2, and J.C. Boyle dams, up to Keno Dam—would be the most significant action that can be taken to restore the viability of the Upper Klamath population unit (NMFS 2014d). Until that occurs, the Upper Klamath River population of SONCC coho salmon persists in about 64 miles of mainstem habitat and numerous tributaries downstream from the Iron Gate Dam to Portuguese Creek in California (NMFS 2014d).

In 2008, the Oregon Fish and Wildlife Commission approved a plan to initiate efforts to re-establish anadromous fish into the Oregon portion of the Klamath River Basin. A definite plan (AECOM Technical Services et al. 2018) to remove the four dams was submitted to FERC on June 28, 2018. This plan indicates preparation to remove the dams would begin in 2020, and if all permits are received, removal would begin in 2021. This could result in the ESA-listed SONCC coho salmon being present in the Klamath River system upstream to Keno Dam after 2021. Actual introduction would be unlikely to occur prior to Pipeline construction.

Species Recovery

NMFS (2014d) released a final recovery plan that addressed limiting factors and threats to each coho population within the SONCC ESU, including those within the Upper Rogue River population (see discussion under *Threats,* above). The plan calls for immediate habitat restoration and threat reduction in areas currently occupied by coho salmon in Evans, Trail, Elk, Big Butte, and Little Butte Creeks. The greatest factor limiting the recovery of coho salmon in the Upper Rogue River is the lack of suitable rearing habitat for juveniles (NMFS 2014d). Consequently, recovery actions to create and maintain juvenile rearing habitat must be restored by restoring flow, increasing habitat complexity within the channel, restoring off-channel rearing areas, and reducing threats to in-stream habitat.

The following actions have been proposed: 1) reconnecting channels with floodplains, 2) increasing channel complexity, 3) improving flow timing and volumes, 4) improving fish access, 5) improving large wood recruitment, bank stability, shading, and food subsidies, 6) reducing predation and competition from non-native fish species, 7) improving estuarine habitat, 8) managing fisheries consistent with recovery of SONCC coho salmon, 9) managing scientific collection consistent with recovery of SONCC coho salmon, 10) tracking population abundance, spatial structure, productivity, or diversity, 11) tracking habitat condition, 12) reducing delivery of sediment to streams, and 13) reducing pollutants.

Life History, Habitat Requirements, and Distribution

Five life phases are generally recognized for the coho salmon: juvenile rearing, juvenile migration, growth and development, adult migration, and spawning. Juvenile summer and winter rearing areas and spawning areas are often located in small headwater streams. Juvenile migration corridors, adult migration corridors, and spawning areas are found in tributaries as well as main-stream reaches and estuarine zones. Growth and development to adulthood happens primarily in near- and offshore marine waters. Final maturation takes place in freshwater tributaries when the adults return to spawn (NMFS 2014d). Typically, coho salmon begin their spawning migration at three years old in late summer and fall and spawn by mid-winter. Eggs incubate for 1.5 to 4 months and then hatch. Juveniles rear for about 15 months in freshwater before migrating in spring to the ocean. They generally spend two growing seasons within the ocean before migrating back to their natal stream to spawn (NMFS 2014d).

Adult coho salmon rarely migrate farther up freshwater streams greater than 150 miles and generally return to spawn at sites where they hatched. Returning to parental spawning grounds ensures repeated use of suitable redd sites (Sandercock 1991). Straying (movements in non-natal stream systems) has been documented. In streams with deteriorated habitat such as low water flow, straying rates up to 50 percent have been documented (Sandercock 1991).

Preferred water temperatures during adult coho salmon upstream migration range between 7.2°C and 15.6°C (45°F to 60°F) with an upper lethal limit for adult coho salmon of 25.8°C or 78°F (Table 3 in Laufle et al. 1986). Preferred coho salmon spawning temperatures range from 4.4°C to 9.4°C (40°F to 49°F) while temperatures between 4.4°C to 13.3°C (40°F to 56°F) during egg incubation are preferred; the warmer the temperature, the less time before eggs hatch. The preferred range for juvenile survival systems is between 11.8°C to 14.6°C (53°F to 58°F) (Laufle et al. 1986). Elevated temperatures in streams may lead to early smoltification and ultimately premature migration towards sea during unfavorable conditions for young coho salmon (McMahon 1983).

Productive coho salmon streams are those that have a riffle-to-pool ratio of close to 1:1. Smaller streams are preferred over larger rivers due to the higher proportion of slack water to midstream area (Sandercock 1991). Substrate composition and riffles are factors, along with terrestrial vegetation, that are important for producing aquatic and terrestrial insects, which are food for coho salmon. Benthic invertebrate production is best in rubble, followed by bedrock, gravel, and sand. Coho salmon parr abundance is greatest in larger deeper pools where they can find cover near the streambank from logs, roots, debris, undercut banks, and overhanging vegetation (McMahon 1983).

Adult coho salmon require minimum water depths of 0.18 meter or 7 inches (Laufle et al. 1986) during upstream migration. Redd sites are found in waters at least 15 cm (5.9 inch) deep, though once hatched, coho salmon fry and parr prefer water at least 0.30 meter (1 foot) deep (McMahon 1983). During adult migrations upstream to spawn, water velocities less than 2.44 meters per second (m/sec; 8 feet/sec) are most desirable. At spawning grounds, coho salmon select redd sites where flows range between 5.0 and 6.8 m^3/minute (177 to 240 cubic feet per minute or from 3 to 4 cfs), and where stream width does not exceed 1 meter or 3.2 feet (Sandercock 1991). For adult migration upstream, DO concentrations exceeding 6.3 mg/l are preferred (McMahon 1983). Incubation of eggs is best near DO saturation concentrations, and weight gains by fry are maximized in water with DO concentrations between 4 and 9 mg/l (Laufle et al. 1986).

Spawning substrate is gravel size between 1.3 and 10.2 cm (0.5 to 4 inches) (Laufle et al. 1986). Gravels less than 16 cm (6.3 inches) account for 85 percent of redd sites (Sandercock 1991). Average coho salmon redd size is 2.8 m^2 (30 ft^2); the recommended area per spawning pair is 11.7 m^2 or 126 ft^2 (Laufle et al. 1986). Egg survival to fry emergence has a positive correlation with gravel sizes between 3.35 mm and 26.9 mm (0.13 to 1.06 inches). For successful fry emergence, not more than 15 percent of the substrate should be fine sediment (McMahon 1983) because higher concentrations of fines may lead to earlier fry emergence, smaller fry, and fry with more yolk (Sandercock 1991). Silt loads less than 25 mg/l are preferable for survival of eggs and juvenile coho salmon (Laufle et al. 1986).

Coho salmon diets in freshwater differ between locations and seasons, though young coho salmon feed mainly on aquatic and terrestrial insects, becoming more piscivorous as they grow (McMahon

1983). After emergence, fry feed mostly on various life stages of aquatic insects including dipterans (true flies), ephemeropterans (mayflies), plecopterans (stoneflies), and others as well as crustaceans and fish (Laufle et al. 1986). In the West Fork Smith River in Douglas County (Oregon), diets of juvenile coho salmon (from December through May) were mostly benthic invertebrates (larval dipterans, ephemeropterans, limnephilid caddisflies, and plecopterans), but also included salmon eggs, aquatic snails, salamanders, and terrestrial invertebrates (Olegario 2006).

Major rivers, estuaries, and bays known to support coho salmon within the range of the SONCC ESU include the Rogue River, Smith River, Klamath River, Mad River, Humboldt Bay, Eel River, and Mattole River (NMFS 1999b), of which the Rogue and Klamath Rivers are within the Pipeline area. Historically, SONCC coho inhabited the Upper Klamath Basin. However, construction of the Copco 1 Dam on the mainstem Klamath River in 1918, followed by construction of the Copco 2 Dam in 1925 and the Iron Gate Dam in 1962 created impassible barriers to anadromous fish. Prior to construction of the dams, anadromous fish including SONCC coho salmon potentially could utilize over 600 miles of spawning, incubation, and rearing riverine habitats upstream from Iron Gate Dam (Hamilton et al. 2005). The historical extent of coho salmon upstream from Iron Gate Dam is believed to be Spencer Creek (Hamilton et al. 2005), which would have coincided with the Pipeline if not for the downstream barriers.

Specific timings of life history phases for SONCC coho salmon within the Pipeline Project area are shown in figure 3.5.3-1. Included are the Rogue River mainstem and Upper Rogue River tributaries from Marial Creek to Lost Creek. Evident in figure 3.5.3-1 is the general synchrony in life phases within the mainstem and tributaries. Peak occurrence of juvenile out-migration lasts longer in tributaries than in the mainstem. In general, adult coho migrate upstream beginning in September and October and spawn during November through January. Fry emergence occurs about one month after spawning, and juvenile rearing continues throughout the year with juvenile out-migration extending from February through early June.

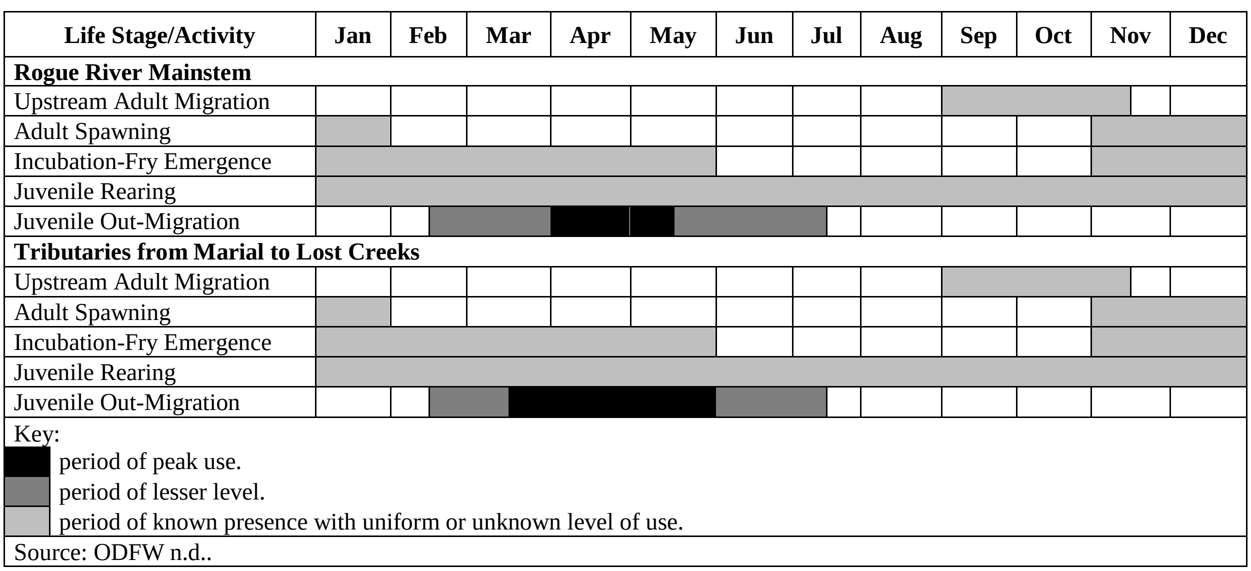


Figure 3.5.3-1 Approximate Timing of SONCC ESU Coho Salmon Use of the Rogue River Mainstem and Tributaries from Marial to Lost Creek

Coho in the SONCC ESU inhabit waterbodies in the following four fifth-field watersheds in the Upper Rogue subbasin that would be crossed by the Pipeline: Trail Creek (HUC 1710030706), Shady Cove-Rogue River (HUC 1710030707), Big Butte Creek (HUC 710030704), and Little Butte Creek (HUC 1710030708). Table 3.5.3-2 summarizes the number of waterbodies within each fifth-field watershed crossed by the Pipeline that are known or assumed to support SONCC coho. Critical habitat is designated to include all river reaches accessible to listed coho within the range of the SONCC coho ESU. Critical habitat consists of the water, substrate, and adjacent riparian zone of estuarine and riverine reaches in hydrologic units and counties identified in NMFS (1999b), including the Upper Rogue HUC 1700307. Accessible reaches are those within historical range of the ESUs that can still be occupied by any life stage of coho salmon. Consequently, waterbodies with critical habitat enumerated in table 3.5.3-2 include those in which coho juvenile-fry are assumed to occur.

TABLE 3.5.3-2

Number of Waterbodies Crossed by the Pipeline Project within the Upper Rogue Subbasin and Fifth-Field Watersheds with SONCC Coho Designated Critical Habitat and Coho Presence (Known or Assumed)

		Number of Waterbodies		
Subbasin and Fifth-Field Watersheds	**Hydrologic Unit Code**	**Critical Habitat Known a/**	**Coho Known b/**	**Coho Assumed c/**
Upper Rogue Subbasin	17100307			
Trail Creek	1710030706	3	3	0
Shady Cove-Rogue River	1710030707	1	1	1
Big Butte Creek	1710030704	2	2	0
Little Butte Creek	1710030708	2	2	2
	Total	**8**	**8**	**3**

a/ NMFS 1999b.
b/ ODFW 2017f.
c/ Assumed presence based on connectivity to occupied stream reaches (may be critical habitat but not known).

Population Status

At the time NMFS proposed this ESU for listing, population estimates for naturally reproducing coho salmon in the SONCC ESU included escapement records from Gold Ray Dam on the upper Rogue River as well as some catch estimates from all Oregon rivers and estimates of run size in the Rogue River. During the 1940s, 2,000 adult coho salmon were counted at the Gold Ray Dam per year, but that number declined to fewer than 200 adults in the early 1970s (NMFS 1995). The Gold Ray Dam on the Rogue River was removed in August 2010. Prior to dam removal, ODFW (2012b) counted adult coho and other anadromous salmonids passing the Gold Ray Dam as they utilized a fish ladder between late September and January, with last recorded counts before removal in June 2010. Abundance of coho returning to the Upper Rogue River above Gold Ray Dam increased from 1996 to 2002 but significantly declined from 2002 through 2009, the last full year counted before the dam was removed (see figure 3.5.3-2).

Similar declines were demonstrated with counts made at Huntley Park, at RM 8 on the lower Rogue River over a similar period, using daily totals of seine counts from 1997 to 2016 (ODFW 2017e). ODFW has been monitoring spawner abundance on a regular basis on the Rogue River by seine estimates conducted in the vicinity of Huntley Park. Numbers of coho counted at Huntley Park represent salmon in the Illinois, Middle, and Upper Rogue populations aggregated together.

From 1980 to 2004, the trend for adult spawner abundance on the Rogue River consistently increased (Spence et al. 2005), mostly due to decreased harvest. However, the overall trend since 2004 has been decreasing but increased returns have been observed through 2016, suggesting some improvement in run status from the lows of 2008 (see figure 3.5.3-3). A similar trend was observed for Rogue River coho adults (wild and hatchery, combined) migrating upstream past Huntley Park, downstream from the Gold Ray Dam location on the Rogue River. The data from Huntley Park indicate a severe decline from 2002 through 2008 (only 572 total coho counted) with an increasing trend (not significant) from 2008 through 2016 in figure 3.5.3-3 (ODFW 2017e).

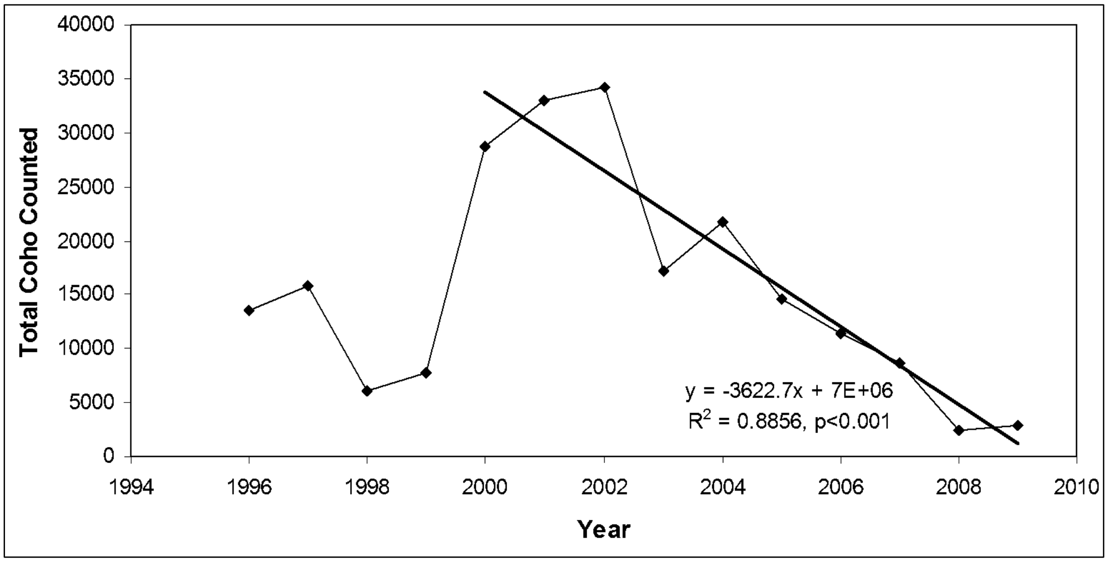


Figure 3.5.3-2 Total Number of SONCC Adult Coho Counted at the Gold Ray Dam Fish Ladder on the Middle Rogue River, from 1996 to 2009. The decreasing trend from 2001 through 2009 is significant (data from ODFW 2012b).

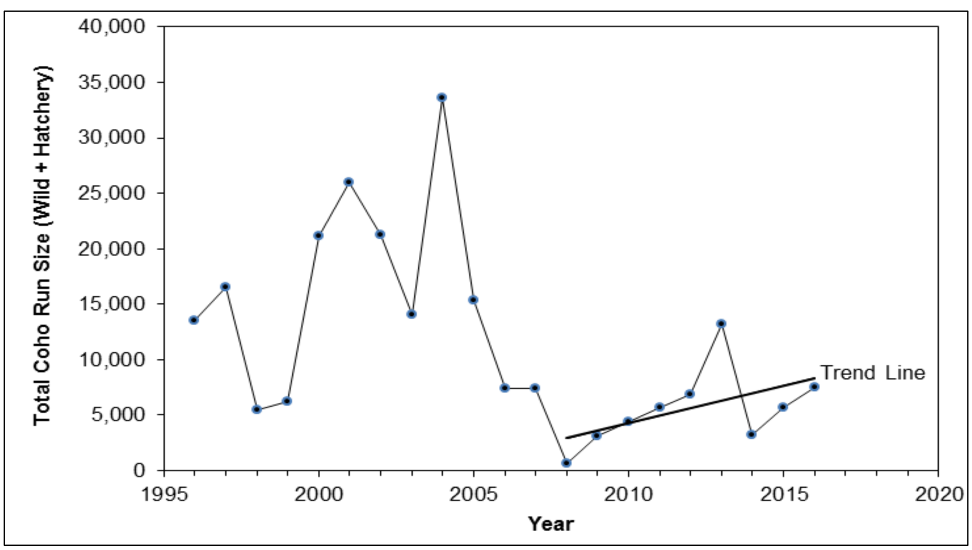


Figure 3.5.3-3 Total Number of SONCC Coho (Wild plus Hatchery-raised) Counted at Huntley Park (RM 8) on the Rogue River, from 2000 to 2016. The increasing trend from 2008 to 2016 (solid line) is not significant (data from ODFW 2017e).

Critical Habitat

NMFS designated critical habitat for coho salmon in the SONCC ESU based on the species' requirements such as space for growth and behavior, nutritional and physiological requirements, cover and/or shelter, reproduction sites, and habitats that are protected from disturbance or are representative of historically known population sites (NMFS 1999b). Other known essential physical and biological features (or PCEs) considered essential for the conservation of the species, referred to as PCEs, are crucial to species conservation and critical habitat. These features include, but are not limited to, spawning sites, food resources, water quality and quantity, and riparian vegetation (NMFS 1999b).

Generally, riparian areas form the basis of healthy watersheds and impacts on them in turn affect these PCEs (NMFS 1999b). However, the PCEs that create healthy salmonid habitat vary throughout the coho salmon's range and the extant of the adjacent riparian zone may change accordingly. A site-potential tree height is a suitable benchmark for identifying a riparian zones in some cases, but in order to better assess the features of a specific locale, site-specific analyses provide the best means to characterize the riparian zone (NMFS 1999b). Spence et al. (1996) concluded that fully protected riparian management zones of one site-potential tree would adequately maintain 90 to 100 percent of most key riparian functions of Pacific Northwest forests (NMFS 1999b). Within that distance, riparian zones provide the following functions: shade, sediment input, nutrient or chemical regulation, streambank stability, and input of LW or organic matter.

Critical habitat for coho salmon in the SONCC ESU includes the accessible reaches of all rivers (including water, substrate, and adjacent riparian zone of estuarine and riverine reaches) between the Mattole River in California and the Elk River in Oregon. Within the counties traversed by the Pipeline, critical habitat has been designated in USGS hydrologic unit Middle Rogue (HUC 17100308 – Jackson County) up to Emigrant Lake Dam/Emigrant Lake; hydrologic unit Upper Rogue (HUC 17100307 – Jackson, Klamath, and Douglas Counties) up to Agate Lake Dam/Agate Lake, Fish Lake Dam/Fish Lake, Willow Lake Dam/Willow Lake, and Lost Creek Dam/Lost Creek Reservoir; hydrologic unit Applegate (HUC 17100309 – Jackson County) up to Applegate Dam; and hydrologic unit Upper Klamath (HUC 18010206 – Jackson County) up to Irongate Dam (NMFS 1999b). The Pipeline would cross designated critical habitat within waterbodies of the Upper Rogue hydrologic unit (HUC 17100307) below the Lost Creek, Willow Creek, and Fish Lake Dams (NMFS 1999b). Eight waterbodies within the four fifth-field watersheds crossed by the Pipeline are known to support designated critical habitat for SONCC coho; three others are assumed to support SONCC ESU coho and are included as critical habitat in table 3.5.3-2.

3.5.3.2 Environmental Baseline

Analysis Area

Two analysis areas are applicable to coho salmon in the SONCC ESU: the marine analysis area and the riverine analysis area. The marine analysis area extends approximately 12 nmi offshore to the continental shelf. Within the marine analysis area, effects to coho salmon in coastal marine waters would be associated with LNG carriers entering and exiting the Port of Coos Bay from the Pacific Ocean.

The riverine analysis area includes two components: 1) the water column and substrate of all waterbodies crossed by the Pipeline within the Upper Rogue River watershed, from the point of crossing to the extent downstream where water quality is not adversely affected by suspended sediments generated during construction; and 2) riparian zones associated with waterbodies crossed by the Pipeline within the Upper Rogue River watershed affected in the short-term during construction and in the long-term by operation. Riparian zones widths are defined as the distance from each bank extending to one site-potential tree height.

The downstream extent of the riverine analysis area was determined by estimating the likely downstream extent that any stream crossing generated suspended sediment could equal ambient conditions within the Project area streams. The methods used to estimate this distance are explained below.

TSS concentrations generated during wet open-cut construction have been estimated from models developed by Reid et al. (2004). Amounts of TSS produced during dry open-cut construction (fluming, dam-and-pump) adjustments are fractions of the concentrations produced during wet-open cuts (Reid et al. 2004). Estimates of TSS produced during dry open-cut construction across waterbodies in fifth-field watersheds are presented below in section 3.5.3.3. Average sediment percentages (grain sizes including gravel, sand, silt, and organics) for streams within each fifth-field watershed (see table 3.5.3-12 below in section 3.5.3.3 under *Habitat* and section 3.5.3.3 under *Suspended Sediment by Pipeline Crossing Methods*) were assumed to be fractions of the TSS generated during construction, and concentrations of each grain class at various distances downstream were estimated using a simple sediment transport model (Ritter 1984). Distances at which concentrations near zero (settle out of suspension) differ considerably for the different grain sizes and are dependent on water depths and stream discharge rates at the time of construction (see table 3.5.3-17 and table 3.5.3-19 below in section 3.5.3.3 under *Suspended Sediment by Pipeline Crossing Methods*). Downstream settling distances would be much greater for deeper waterbodies with higher flow velocities than for shallow, slow flowing streams.

Using models noted above and data on the average sediment composition, stream depth, and average summer low flows for streams within range of SONCC coho that would be crossed by the Pipeline, the average downstream distance expected to be near assumed ambient concentrations of 2 mg/l of silt (0.0016 cm diameter, 0.023 cm/sec settling velocity) ranges from 699 meters (2,293 feet) in the Big Butte Creek Watershed to 1,235 meters (4,051 feet) in the Trail Creek Watershed. The average downstream distance expected to near assumed ambient concentrations of 2 mg/l of clay (0.0004 cm diameter, 0.0015 cm/sec settling velocity) ranges from 10,563 meters (34,647 feet) in the Big Butte Creek Watershed to 18,591 meters (60,978 feet) in the Trail Creek Watershed. These estimates are for average summer low flows likely to occur during construction within the ODFW (2008) allowed in-stream construction period. The estimated average downstream distance traveled of these very fine particles is a very conservative limit to consider for the analysis area (see figure 3.5.3-4).

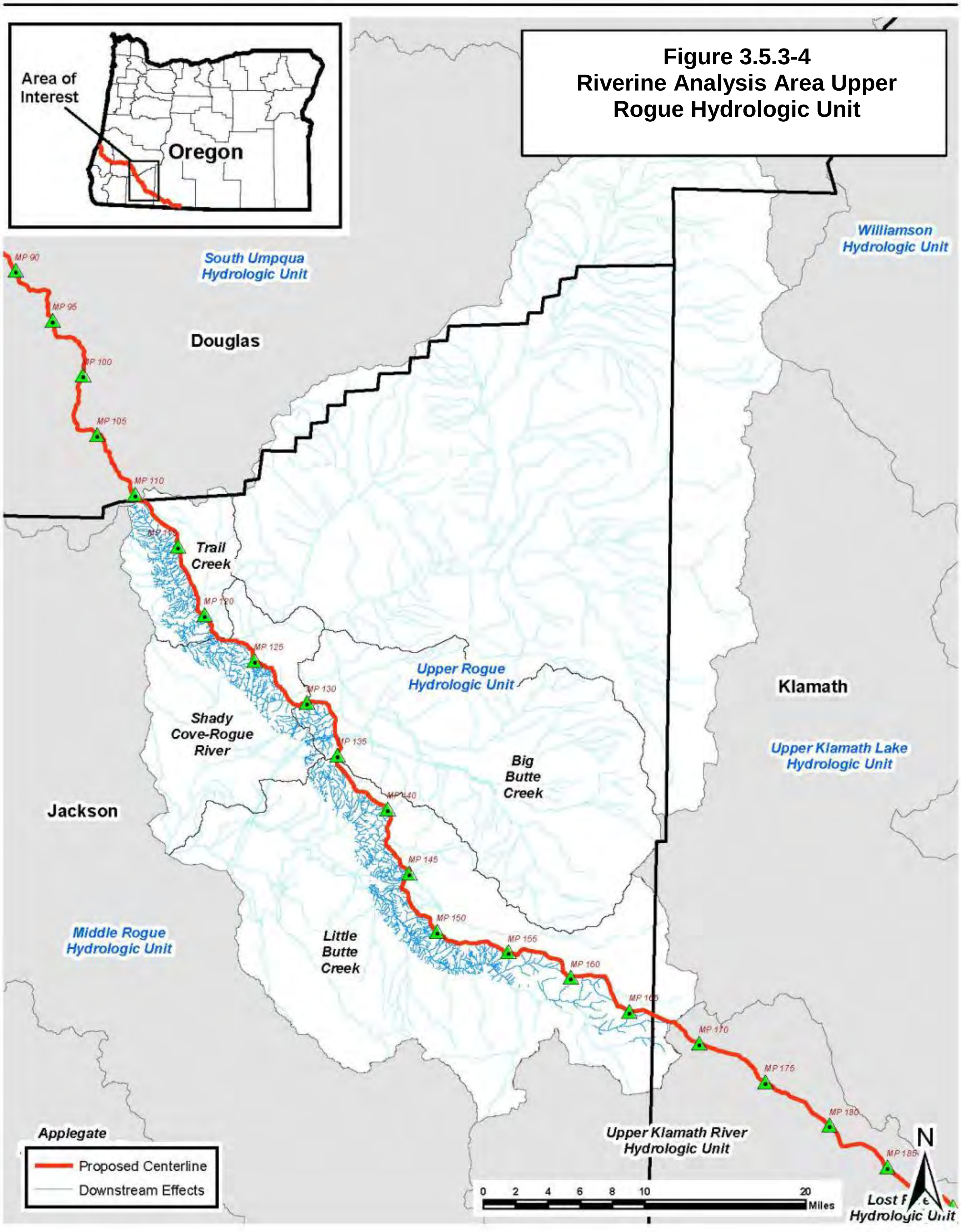


Figure 3.5.3-4
Riverine Analysis Area Upper Rogue Hydrologic Unit
Area of Interest
Oregon
South Umpqua Hydrologic Unit
Williamson Hydrologic Unit
Douglas
Trail Creek
Upper Rogue Hydrologic Unit
Klamath
Shady Cove-Rogue River
Big Butte Creek
Upper Klamath Lake Hydrologic Unit
Jackson
Middle Rogue Hydrologic Unit
Little Butte Creek
Upper Klamath River Hydrologic Unit
Applegate
Proposed Centerline
Downstream Effects
Miles
N
MP 90
MP 95
MP 105
MP 110
MP 120
MP 125
MP 130
MP 135
MP 145
MP 150
MP 155
MP 160
MP 175
MP 180

Species Presence by Project Watersheds

Coho salmon in the SONCC ESU are known or are expected to occur within the Upper Rogue River hydrologic unit (HUC 17100307) in some perennial and intermittent tributaries. The Pipeline would cross four fifth-field watersheds including Trail Creek (HUC 1710030706), Shady Cove-Rogue River (HUC 1710030707), Big Butte Creek (HUC 1710030704), and Little Butte Creek (HUC 1710030708). All affected waterbodies within the Upper Rogue subbasin and within the range of SONCC coho salmon ESU proximate to the Pipeline are included in table 3.5.3-3. There are 90 waterbodies included in the table, of which 14 are perennial, 73 are intermittent, and three are ponds. Coho salmon are known to occur in eight of the waterbodies and are assumed to be present in three others based on connectivity to perennial streams known to support coho salmon, the presence of steelhead and/or resident salmonids, and/or information provided by fisheries biologists. Data in table 3.5.3-3 were revised based on ODFW (2017f) fish habitat distribution shapefiles and Oregon Department of Forestry (ODF 2018) Forest Practices statewide hydrography shapefiles that provide field evaluations for fish presence/absence in stream segments.

TABLE 3.5.3-3

Waterbodies Crossed or Adjacent to the Pipeline within the Upper Rogue Subbasin (HUC 17100307) and in the Range of the SONCC Coho Salmon ESU (updated March 2018)

Waterbodies Crossed and Waterbody ID	NHD Waterbody Reach Code and/or Jurisdiction	Pipeline Milepost (MP)	Waterbody Type	Proposed Crossing Method a/ (potential for blasting) d/	Species Present b/	Habitat Component Present b/	Fishery Construction Window c/
Upper Rogue (HUC 17100307) Subbasin, Trail Creek (HUC 1710030706) Fifth-Field Watershed, Jackson County							
Pond Trib. to W. Fork Trail Creek (EW-69)	Forest Service – Umpqua NF	110.57	Intermittent Pond	Within Peavine Quarry TEWA 110.73	None	None	Jun 15 to Sep 15
Trib. to W. Fork Trail Creek (ESI-68)	17100307018629 Forest Service – Umpqua NF	110.57	Intermittent	Within Peavine Quarry Adjacent to centerline within TEWA 110.73	None	None	Jun 15 to Sep 15
Trib to West Fork Trail Creek (SS-100-032)	17100307015563 Private	118.80	Intermittent	Dry Open-Cut	None	None	Jun 15 to Sep 15
West Fork Trail Creek (ASP-202)	17100307000492 Private	118.89	Perennial	Dry Open-Cut (Streambed-bedrock)	Coho	Coho Spawning, Rearing	Jun 15 to Sep 15
Trib. to Trail Creek (S1-06 (DA-16 (MOD))	17100307002143 Private	119.84	Intermittent	Dry Open-Cut	None	None	Jun 15 to Sep 15
Canyon Creek (NSP-11)	17100307000501 BLM-Medford District	120.45	Perennial	Dry Open-Cut (Streambed-bedrock)	Coho	Coho Spawning, Rearing	Jun 15 to Sep 15
Trib. to Trail Creek (ASI-205)	17100307009101 Private	120.90	Intermittent	Dry Open-Cut	None	None	Jun 15 to Sep 15
Trib. to Trail Creek (ASI-206)	17100307002356 Private	121.57	Intermittent	Dry Open-Cut	Coho	Coho Spawning, Rearing	Jun 15 to Sep 15
Upper Rogue (HUC 17100307) Subbasin, Shady Cove-Rogue River (HUC 1710030707) Fifth-Field Watershed, Jackson County							
Trib. to Cricket Creek (ESI-71)	Private	121.87	Intermittent	Adjacent to centerline within ROW	None	None	Jun 15 to Sep 15
Trib. to Cricket Creek (ESI-73)	Private	121.91	Intermittent	Adjacent to centerline within ROW	None	None	Jun 15 to Sep 15

TABLE 3.5.3-3 (continued)

Waterbodies Crossed or Adjacent to the Pipeline within the Upper Rogue Subbasin (HUC 17100307) and in the Range of the SONCC Coho Salmon ESU (updated March 2018)

Waterbodies Crossed and Waterbody ID	NHD Waterbody Reach Code and/or Jurisdiction	Pipeline Milepost (MP)	Waterbody Type	Proposed Crossing Method a/ (potential for blasting) d/	Species Present b/	Habitat Component Present b/	Fishery Construction Window c/
Trib. to Cricket Creek (ESI-72)	17100307002397 Private	121.96	Intermittent	Adjacent to centerline within ROW	None	None	Jun 15 to Sep 15
Trib. to Cricket Creek (ESI-74)	17100307019333 Private	122.04	Intermittent	Adjacent to centerline within ROW	None	None	Jun 15 to Sep 15
Cricket Creek (ESI-70)	17100307002397 Private	122.07	Intermittent	Adjacent to centerline within ROW	None	None	Jun 15 to Sep 15
Rogue River (ASP-235)	17100307000156 Private	122.65	Perennial	HDD	Coho	Coho Rearing, Migration	Jun 15 to Aug 31
Trib. to Indian Creek (ASI-223)	17100307014756 Private	125.91	Intermittent	Dry Open-Cut	None	None	Jun 15 to Sep 15
Trib. to Indian Creek (ASI-222)	17100307016576 Private	125.98	Intermittent	Dry Open-Cut	None	None	Jun 15 to Sep 15
Trib. to Indian Creek (RS-4)	17100307008662 BLM-Medford District	126.53	Intermittent	Dry Open-Cut	None	None	Jun 15 to Sep 15
Trib. to Indian Creek (ASI-221)	17100307008662 BLM-Medford District	126.56	Intermittent	Dry Open-Cut	None	None	Jun 15 to Sep 15
Ditch (ADX-287)	17100307015921 Private	127.21	Intermittent	Adjacent to ROW & TEWA	None	None	Jun 15 to Sep 15
Ditch (ADX-285)	17100307015921 Private	127.33	Intermittent	Dry Open-Cut	None	None	Jun 15 to Sep 15
Deer Creek (ASP-307)	17100307006079 Private	128.49	Perennial	Dry Open-Cut (Streambed-bedrock)	None	None	Jun 15 to Sep 15
Indian Creek (AW-278)	17100307003031 Private	128.61	Perennial	Dry Open-Cut	Coho assumed	Unknown	Jun 15 to Sep 15
Trib. To Indian Creek (ASP-310)	17100307017016 Private	128.68	Perennial	Dry Open-Cut (Streambed-bedrock)	None	None	Jun 15 to Sep 15
Trib. To Indian Creek (ASI-400)	BLM-Medford District	129.13	Intermittent	Dry Open-Cut	None	None	Jun 15 to Sep 15
Trib. To Indian Creek (ASI306)	BLM-Medford District	129.21	Intermittent	Adjacent to centerline within ROW	None	None	Jun 15 to Sep 15
Trib. to Indian Creek (ASI-277)	71003070174 44Private	129.46	Intermittent	Dry Open-Cut	None	None	Jun 15 to Sep 15
Upper Rogue (HUC 17100307) Sub-basin, Big Butte Creek (HUC 1710030704) Fifth field Watershed, Jackson County							
Trib. to Neil Creek (AW-245)	17100307011767 Private	130.81	Intermittent	Adjacent to centerline within ROW	None	None	Jun 15 to Sep 15
Trib. to Neil Creek (SS-201-014a (AW-244))	17100307010117 Private	130.81	Intermittent	Adjacent to centerline within ROW	None	None	Jun 15 to Sep 15
Trib. to Neil Creek (SS-201-14b (AW-244))	17100307010117 Private	130.83	Intermittent	Dry Open-Cut (Streambed-bedrock)	None	None	Jun 15 to Sep 15
Trib. to Neil Creek (ASI246)	17100307010117 Private	130.86	Intermittent	Dry Open-Cut	None	None	Jun 15 to Sep 15

TABLE 3.5.3-3 (continued)

Waterbodies Crossed or Adjacent to the Pipeline within the Upper Rogue Subbasin (HUC 17100307) and in the Range of the SONCC Coho Salmon ESU (updated March 2018)

Waterbodies Crossed and Waterbody ID	NHD Waterbody Reach Code and/or Jurisdiction	Pipeline Milepost (MP)	Waterbody Type	Proposed Crossing Method a/ (potential for blasting) d/	Species Present b/	Habitat Component Present b/	Fishery Construction Window c/
Trib. to Neil Creek (ASI-251)	17100307018233 BLM-Medford District	131.37	Intermittent	Adjacent to within TEWA	None	None	Jun 15 to Sep 15
Irrigation Ditch (Trib. to Neil Creek) (S2-02/(ADX-253)	Private	132.03	Intermittent	Dry Open-Cut	None	None	Jun 15 to Sep 15
Neil Creek (ASP-252)	17100307006088 Private	132.12	Perennial	Dry Open-Cut (Streambed-bedrock)	Coho	Coho, Spawning, Rearing	Jun 15 to Sep 15
Ditch (EDX-75)	Private	132.26	Intermittent	Dry Open-Cut (Streambed – bedrock)	None	None	Jun 15 to Sep
Quartz Creek (ASI-265)	17100307000857 Private	132.75	Intermittent	Dry Open-Cut (Streambed-bedrock)	Coho	Coho, Spawning, Rearing	Jun 15 to Sep
Trib. to Quartz Creek (AW-264)	17100307000857 Private	132.77	Intermittent	Dry Open-Cut (Streambed-bedrock)	None	None	Jun 15 to Sep
Trib. to Quartz Creek (ASP-241)	BLM-Medford District	133.35	Perennial	Dry Open-Cut	None	None	Jun 15 to Sep 15
Medford Aqueduct - Ditch 3 (ASP-240)	17100307006008 BLM-Medford District	133.38	Perennial	Conventional Bore	None	None	N/A
Upper Rogue (HUC 17100307) Sub-basin, Little Butte Creek (HUC 1710030708) Fifth field Watershed, Jackson County							
Whiskey Creek (ASI-207)	17100307000892 Private	137.48	Intermittent	Dry Open-Cut	None	None	Jun 15 to Sep 15
Trib. to Lick Creek (ASI-208)	17100307012488 Private	138.26	Intermittent	Dry Open-Cut	None	None	Jun 15 to Sep 15
Trib. to Lick Creek (SS-GM-9)	17100307020234 Private	138.36	Intermittent	Dry Open-Cut	None	None	Jun 15 to Sep 15
Trib. to Lick Creek (SS-GM-10)	17100307003986 Private	138.44	Intermittent	Dry Open-Cut	None	None	Jun 15 to Sep 15
Trib. to Lick Creek (ASI-210)	17100307003986 Private	138.50	Intermittent	Dry Open-Cut	None	None	Jun 15 to Sep 15
Trib. to Lick Creek (SS-GM-11)	17100307000884 Private	138.55	Intermittent	Dry Open-Cut	None	None	Jun 15 to Sep 15
Trib. to Lick Creek (SS-GM-12)	Private	138.57	Intermittent	Adjacent to centerline within ROW	None	None	Jun 15 to Sep 15
Trib. to Lick Creek (ASI-211)	17100307008460 Private	138.71	Intermittent	Dry Open-Cut	None	None	Jun 15 to Sep 15
Trib. to Lick Creek (SS-GM-13)	Private	138.74	Intermittent	Dry Open-Cut	None	None	Jun 15 to Sep 15
Trib. to Lick Creek (SS-GM-14)	17100307008463 Private	139.07	Intermittent	Dry Open-Cut	None	None	Jun 15 to Sep 15
Trib. to Lick Creek (ASI-216)	17100307015395 Private	139.19	Intermittent	Adjacent to centerline within ROW	None	None	Jun 15 to Sep 15
Trib. to Lick Creek (SS-GM-15)	Private	139.21	Intermittent	Dry Open-Cut	None	None	Jun 15 to Sep 15
Trib. to Lick Creek (SS-GM-16)	Private	139.28	Intermittent	Dry Open-Cut	None	None	Jun 15 to Sep 15
Trib. to Lick Creek (ASI-217)	Private	139.42	Intermittent	Dry Open-Cut	None	None	Jun 15 to Sep 15

TABLE 3.5.3-3 (continued)

Waterbodies Crossed or Adjacent to the Pipeline within the Upper Rogue Subbasin (HUC 17100307) and in the Range of the SONCC Coho Salmon ESU (updated March 2018)

Waterbodies Crossed and Waterbody ID	NHD Waterbody Reach Code and/or Jurisdiction	Pipeline Milepost (MP)	Waterbody Type	Proposed Crossing Method a/ (potential for blasting) d/	Species Present b/	Habitat Component Present b/	Fishery Construction Window c/
Trib. to Lick Creek (ASI-226)	17100307019116 Private	139.59	Intermittent	Dry Open-Cut (Streambed-bedrock)	None	None	Jun 15 to Sep 15
Trib. to Lick Creek (ASI-227)	Private	139.63	Intermittent	Dry Open-Cut (Streambed-bedrock)	None	None	Jun 15 to Sep 15
Trib. to Lick Creek (ASI-228)	Private	139.68	Intermittent	Dry Open-Cut	None	None	Jun 15 to Sep 15
Trib. to Lick Creek SS-GM-43 (AW-230)	Private	139.75	Intermittent	Dry Open-Cut	None	None	Jun 15 to Sep 15
Trib. to Lick Creek (SS-GM-19)	Private	139.91	Intermittent	Adjacent to centerline within ROW	None	None	Jun 15 to Sep 15
Lick Creek (ASI-233)	17100307000130 BLM-Medford District	140.27	Intermittent	Dry Open-Cut	None	None	Jun 15 to Sep 15
Ditch Trib. to Lick Creek (ADX-234)	17100307001378 BLM-Medford District	140.32	Intermittent	Dry Open-Cut	None	None	Jun 15 to Sep 15
Trib. to Lick Creek (ASI-189)	17100307009921 Private	140.58	Intermittent	Dry Open-Cut (Streambed-bedrock)	None	None	Jun 15 to Sep 15
Ditch Trib. to Lick Creek (ADX-186)	17100307001383 BLM-Medford District	140.94	Intermittent	Dry Open-Cut	None	None	Jun 15 to Sep 15
Star Lake Reservoir (Edge-1)	17100307005853 Private	141.01	Perennial	Adjacent to TEWA 140.98 Water Source	None	None	Jun 15 to Sep 15
Trib. to Salt Creek (ASI-187)	17100307014303 BLM-Medford District	141.18	Intermittent	Dry Open-Cut (Streambed-bedrock)	None	None	Jun 15 to Sep 15
Trib. to Salt Creek (ASI-188)	17100307004291 BLM-Medford District	141.48	Intermittent	Dry Open-Cut (Streambed-bedrock)	None	None	Jun 15 to Sep 15
Trib. to Salt Creek (RS-17)	17100307004291 BLM-Medford District	141.49	Intermittent	Dry Open-Cut	None	None	Jun 15 to Sep 15
Trib. to Salt Creek (ESI-30)	17100307014306 Private	141.95	Intermittent	Dry Open-Cut	None	None	Jun 15 to Sep 15
Ditch (EDX-32)	Private	142.28	Intermittent	Dry Open-Cut	None	None	Jun 15 to Sep 15
Trib. to Salt Creek (ESI-31)	17100307018645 Private	142.32 142.35	Intermittent	Dry Open-Cut	None	None	Jun 15 to Sep 15
Salt Creek (ESP-34)	17100307000121 Private	142.57	Perennial	Dry Open-Cut	Coho	Coho, Spawning, Rearing	Jun 15 to Sep 15
Ditch (EDX-36)	Private	142.65	Intermittent	Dry Open-Cut	None	None	Jun 15 to Sep 15
Trib. to Salt Creek (ESI-37)	17100307014301 Private	143.12	Intermittent	Dry Open-Cut	None	None	Jun 15 to Sep 15
Trib. to Long Branch Creek (ESI-38)	17100307009770 Private	143.51	Intermittent	Dry Open-Cut	Coho Assumed	Unknown	Jun 15 to Sep 15
Trib. to Long Branch Creek (ESI-39)	17100307011758 Private	143.74	Intermittent	Dry Open-Cut	None	None	Jun 15 to Sep 15

TABLE 3.5.3-3 (continued)

Waterbodies Crossed or Adjacent to the Pipeline within the Upper Rogue Subbasin (HUC 17100307) and in the Range of the SONCC Coho Salmon ESU (updated March 2018)

Waterbodies Crossed and Waterbody ID	NHD Waterbody Reach Code and/or Jurisdiction	Pipeline Milepost (MP)	Waterbody Type	Proposed Crossing Method a/ (potential for blasting) d/	Species Present b/	Habitat Component Present b/	Fishery Construction Window c/
Stock Pond (EL-41)	Private	143.76	Stock Pond	Adjacent to centerline within ROW	None	None	Jun 15 to Sep 15
Trib. to Long Branch Creek (ESI-38)	17100307009083 Private	143.76	Intermittent	Adjacent to centerline within ROW	None	None	Jun 15 to Sep 15
Trib. to Long Branch Creek (ESI-40)	17100307009083 Private	143.77	Intermittent	Dry Open-Cut	None	None	Jun 15 to Sep 15
Trib. to Long Branch Creek (ESI-38)	17100307000921 Private	144.11	Intermittent	Dry Open-Cut	None	None	Jun 15 to Sep 15
Irrigation Ditch (EDX-42)	17100307006072 Private	144.14	Intermittent	Dry Open-Cut	None	None	Jun 15 to Sep 15
Trib. to S. Fork Long Branch (GSP-5/ESP-48)	17100307004586 Private	144.70	Perennial	Dry Open-Cut	None	None	Jun 15 to Sep 15
South Fork Long Branch Cr (GSI-6/ESP-59)	17100307004616 Private	145.27	Intermittent	Dry Open-Cut	None	None	Jun 15 to Sep 15
Irrigation Ditch (NDX-107)	17100307001458 Private	145.32	Intermittent	Dry Open-Cut	None	None	Jun 15 to Sep 15
Irrigation Ditch (NDX-56)	Private	145.37	Intermittent	Dry Open-Cut	None	None	Jun 15 to Sep 15
Trib. to S. Fork Long Branch (ESI-61)	17100307004636 Private	145.54	Intermittent	Dry Open-Cut	None	None	Jun 15 to Sep 15
Irrigation Ditch (EDX-64)	Private	145.57	Intermittent	Dry Open-Cut (Bored)	None	None	Jun 15 to Sep 15
North Fork Little Butte Creek (ESP-66)	17100307000113 Private	145.69	Perennial	Dry Open-Cut	Coho	Coho, Spawning, Rearing	Jun 15 to Sep 15
Trib. to N. Fork Little Butte Creek (ESI-56)	17100307004681 Private	146.05	Intermittent	Dry Open-Cut	Coho assumed	Unknown	Jun 15 to Sep 15
Trib. to N. Fork Little Butte Creek (ESI-55)	17100307004702 Private	146.38	Intermittent	Dry Open-Cut	None	None	Jun 15 to Sep 15
Irrigation Ditch (EDX-51)	17100307001489 Private	146.80	Intermittent	Dry Open-Cut	None	None	Jun 15 to Sep 15
South Fork Little Butte Creek (ASP-165)	17100307000108 Forest Service-Rogue River-Siskiyou NF	162.45	Perennial	Dry Open-Cut	None	None	Jun 15 to Sep 15
Daley Creek (ESI-76)	17100307000107 Forest Service-Rogue River-Siskiyou NF	166.21	Intermittent	Dry Open-Cut	None	None	Jun 15 to Sep 15

TABLE 3.5.3-3 (continued)

Waterbodies Crossed or Adjacent to the Pipeline within the Upper Rogue Subbasin (HUC 17100307) and in the Range of the SONCC Coho Salmon ESU (updated March 2018)

Waterbodies Crossed and Waterbody ID	NHD Waterbody Reach Code and/or Jurisdiction	Pipeline Milepost (MP)	Waterbody Type	Proposed Crossing Method a/ (potential for blasting) d/	Species Present b/	Habitat Component Present b/	Fishery Construction Window c/

a/ Dry open-cut crossing methods include flume or dam-and-pump procedures. Dam-and-pump methods would be utilized where streambed blasting is anticipated to eliminate blasting around the flume. The dam-and-pump crossing method is the preferred crossing procedure in steep incised drainage valleys where worker safety may be compromised when placing ("threading") the pipe string under the flume pipe and where there is a risk of upsetting the flume during this operation. The dam-and-pump crossing method is also the preferred crossing method on small streams under low flow conditions during the ODFW-recommended in-water work period. Pacific Connector proposes temporary/short-term fish passage restriction when completing dam-and-pump crossings within the ODFW-recommended in-water work period. Table M-1 in appendix M provides details of stream crossings.
b/ ODFW 2017f; ODF 2018
c/ Assumes fisheries construction windows only apply to those waterbodies flowing at the time of construction and windows do not apply to HDD crossings.
d/ Streambed bedrock based on Pacific Connector's Wetland and Waterbody delineation surveys. Streambed bedrock may require special construction techniques to ensure pipeline design depth. Special construction techniques may include rock hammering, drilling and hammering, or blasting. The need for blasting would be determined by the construction contractor and would only be initiated after ODFW blasting permits are obtained.

In-stream construction of the Pipeline would occur before most SONCC coho begin upstream migration and spawning by adults (see figure 3.5.3-1). However, juvenile coho are expected to be rearing in many of those streams at the time of construction. Although there are no data on numbers of juveniles expected to be present in streams crossed by the Pipeline, the following estimation procedure was developed after an estimate for numbers of juveniles present in streams crossed was requested by NMFS (2015e).

Total stream miles occupied by coho salmon within the fourth-field HUCs in table 3.5.3-4, and each of the fifth-field HUCs crossed by the Pipeline in range of SONCC coho were derived with GIS by combining shapefiles of ODFW Fish Distribution data (ODFW 2017f) with watershed shapefiles from the National Hydrography Dataset (NHD; USGS 2018). Stream miles with coho spawning habitats and coho rearing habitat in the range of SONCC coho were similarly derived; stream miles in those habitats were added to provide stream miles for juvenile fry presence in table 3.5.3-4.

TABLE 3.5.3-4

Total Stream Miles with SONCC Coho Habitats in Fourth-Field and Fifth-Field Watersheds and Estimates of Streams with Juvenile Fry Coho

Subbasin and Fifth-Field Watersheds	Total Stream Miles with Coho in HUC a/	Stream Miles with Spawning Habitat	Stream Miles with Rearing Habitat	Stream Miles for Juvenile Fry Presence b/
Upper Rogue Subbasin	**197.88**	**184.00**	**5.47**	**189.46**
Trail Creek	17.15	16.96	0.19	17.15
Shady Cove-Rogue River	35.46	30.58	4.88	35.46
Big Butte Creek	32.56	32.56	0	32.56
Little Butte Creek	60.95	60.95	0	60.95

a/ Total Stream Miles with Coho in HUC includes miles of Historical, Migration, Rearing, Spawning, and Unknown habitats.
b/ Stream Miles for Juveniles' Presence is the sum of Stream Miles for Spawning and Rearing Habitats in HUC
Source: StreamNet 2012; ODFW 2017f.

Numbers of redds and spawning adult coho salmon counted in fourth field watersheds over time are available on the StreamNet (2012) database accessed through the ODFW Natural Resources Information Management Program. Only 20 spawning surveys were conducted within fifth field watersheds crossed by the Pipeline in range of SONCC coho. The most recent survey was conducted in 1999. In addition, the database provided only one record of a redd survey for SONCC coho in the Upper Rogue River subbasin. With so limited information available, numbers of adult coho salmon (not including jacks or subadults) reported as peak live or dead fish were used to estimate numbers of juvenile coho fry present in streams that would be crossed by the Pipeline. Data for numbers of adults counted per mile from StreamNet database are summarized in table 3.5.3-5, below.

TABLE 3.5.3-5

Results of Coho Spawning Surveys Conducted in Streams Crossed by the Pipeline Project

Subbasin and Fifth-Field Watersheds	Number of Surveys	Year(s)	Average Adults per Mile Surveyed	90% Confidence Interval
Upper Rogue Subbasin	25	1996-1999	8.16	± 3.15
Trail Creek	5	1996-1997	10.40	± 6.89
Shady Cove-Rogue River	0	N/A	0	0
Big Butte Creek	0	N/A	0	0
Little Butte Creek	15	1996-1999	9.51	± 4.50

Source: StreamNet 2012.

The following assumptions have been applied to the adult spawning data in the Upper Rogue River subbasin coinciding with SONCC coho and Pipeline waterbody crossings:

- The male:female ratio of live or dead spawners is 1:1 (Knudsen et al. 2003);
- At low to moderate densities of spawners, there is one redd for each female (Lestelle and Weller 2002);
- Redds are only present in stream reaches classified as spawning habitat by ODFW (2014c);
- The average number of eggs per redd is between 300 and 1,200 with 800 to 900 eggs being most frequent (Sandercock 1991);
- Under average conditions, 15 to 27 percent of all eggs would survive during incubation (mean of 27.1 percent survival was observed in Oregon coastal streams (Sandercock 1991);
- Juveniles utilize spawning habitats during rearing as well as rearing habitats as classified by ODFW (2014c); and
- Juveniles distribute themselves in uniformly spaced territories regardless of presence of pools, riffles or runs in the natal stream.

With those assumptions applied to data from the Upper Rogue River in table 3.5.3-6, there would be an average of 4.08 redds per mile (± 1.58 redds per mile) within all spawning habitats in the Upper Rogue River subbasin. That estimate along with the estimate of stream miles of spawning and rearing habitats in HUCs, and the assumptions above for eggs per redd and egg survival rates were used to estimate numbers of juvenile fry per mile of habitat in table 3.5.3-6 for each of the fifth-field HUCs crossed within range of the SONCC ESU. Values for redds per mile with 90 percent confidence intervals were not carried through the analyses in table 3.5.3-6. In reality, estimates of juveniles per mile of habitat would vary from year to year showing at least as much variability as the total coho run size counted at Huntley Park from 2000 to 2016, shown in figure 3.5.3-3, above.

There would be some mortality between juvenile fry and smolt stages and during the period from fry emergence (through the end of May) before pipeline construction (beginning June 15). Therefore, estimates are very conservative. Waterbodies within the Upper Rogue River subbasin would be crossed between June 15 and September 15. Based on figure 3.5.3-1, in-stream construction could coincide with portions of the post-peak juvenile coho smolt outmigration periods during June and July. There could potentially be some post-winter pre-smolt juvenile coho present during construction. However, very few are expected because most smolts outmigrate before June and reported over-winter survival rates of juvenile coho from late summer to winter-spring outmigration are less than 40 percent, at least in waterbodies studied within the Coos Bay Frontal-Pacific Ocean fifth-field watershed (Weybright and Giannico 2017).

TABLE 3.5.3-6

Estimates of Juvenile Coho Fry in the SONCC ESU Present in Fourth- and Fifth-Field Watersheds Crossed by the Pipeline Project

Subbasin and Fifth-Field Watersheds	Total Redds in HUC a/	Total Eggs in HUC b/	Total Juvenile Fry in HUC c/	Juvenile Fry per Mile of Habitat d/
Upper Rogue Subbasin	**751**	**638,100**	**172,925**	**913**
Trail Creek	69	58,821	15,941	929
Shady Cove-Rogue River	125	106,047	28,739	810
Big Butte Creek	133	112,906	30,598	940
Little Butte Creek	249	211,369	57,281	940

a/ Total Redds in HUC = the Average Redds per Mile in Fourth-Field HUC multiplied by Stream Miles of Spawning Habitat in table 3.5.3-4.
b/ Total Eggs in HUC = average of 850 eggs per red (see assumptions) multiplied by Total Redds in HUC.
c/ Total Juvenile Fry in HUC = 27.1 percent average survival rate of eggs to fry (see assumptions in text) multiplied by Total Eggs in HUC.
d/ Juveniles per Mile of Habitat = Total Juvenile Fry in HUC divided by Stream Miles for Juvenile Fry Presence in table 3.5.3-4.

Habitat

Existing conditions of aquatic habitats within the fifth-field watersheds in the Upper Rogue River subbasin that would be crossed by the Pipeline were evaluated with data collected by ODFW in their Aquatic Inventories Project (ODFW 2014c). In cooperation with other agencies, ODFW has conducted stream surveys throughout the state including streams within watersheds crossed by the Pipeline. Four types of habitat information can be used to deduce quantitative evaluations of the overall fish habitat condition within the fifth-field watersheds that would be crossed by the Pipeline: 1) pool habitat conditions, 2) riffle habitat conditions, 3) shade conditions, 4) woody debris habitat condition, and 5) riparian conifer habitat condition. ODFW (Foster et al. 2001) has developed benchmark criteria for each of these habitat conditions that would represent undesirable and desirable habitat conditions. The benchmarks are provided in table 3.5.3-7 along with the various aquatic habitat conditions to which they apply. The conditions of specific streams crossed by the Pipeline are assumed to be comparable to the average conditions for the sampled reaches in each of the corresponding four fifth-field watersheds. Compilations of ODFW stream-reach data (see appendix X) are summarized in table 3.5.3-8 for the four watersheds in the Pipeline Project area occupied by SONCC coho. The percent of sampled stream reaches that are at or above desirable benchmark conditions and percent that are at or below undesirable conditions indicate the aquatic habitat conditions.

TABLE 3.5.3-7

Oregon Department of Fish and Wildlife Aquatic Inventory and Analysis Project Criteria for Aquatic Habitat Conditions and Benchmarks

	Benchmark Level for Condition	
Aquatic Habitat Condition	**Undesirable**	**Desirable**
Pools		
Pool Area (% total stream area)	<10	>35
Pool Frequency (channel widths between pools)	>20	5-8
Residual Pool Depth (m)		
Small Streams (<7m wide)	<0.2	>0.5
Medium Streams (≥7m and <15m width)		
Low Gradient (slope <3%)	<0.3	>0.6
High Gradient (slope >3%)	<0.5	>1.0
Large Streams (≥15m width)	<0.8	>1.5
Complex Pools (pools with ≥3 LW pieces / km of reach length)	<1	>2.5
Riffles		
Width/Depth Ratio (active channel based)		
East Side	>30	<10
West Side	>30	<15
Gravel (% area)	<15	≥35
Silt-Sand-Organics (% area)	>20	<10
Volcanic Parent Material	>15	<8
Sedimentary Parent Material	>20	<10
Channel Gradient <1.5%	>25	<12
Shade (Reach Average, Percent)		
Stream Width <12 meters		
West Side	<60	>70
Northeast	<50	>60
Central-Southeast	<40	>50
Stream Width >12 meters		
West Side	<50	>60
Northeast	<40	>50
Central-Southeast	<30	>40
Large Woody Debris		
Pieces/100m Stream Length	<10	>20
Volume (m3)/100m Stream Length	<20	>30
“Key” Pieces (>60cm and 10m long)/100m	<1	>3
Riparian Conifers (30m From Both Sides of Channel)		
Number >20in dbh/1000ft Stream Length	<150	>300
Number >35in dbh/1000ft Stream Length	<75	>200

Source: Foster et al. 2001
dbh = diameter at breast height; LW = large wood

TABLE 3.5.3-8

Aquatic Habitat Conditions from Samples Taken by ODFW in Stream Reaches within Fifth-Field Watersheds of the Upper Rogue Subbasin Crossed by the Pipeline Project

Aquatic Habitat Condition	Mean Values (with Standard Errors) in Relation to Benchmark Conditions in Surveyed Reaches (by %) of Watersheds a/							
	Trail Creek HUC 1710030706		Shady Cove-Rogue River HUC 1710030707		Big Butte Creek HUC 1710030704		Little Butte Creek HUC 1710030708	
	Mean (Standard Error)	Undesirable/ Desirable Conditions	Mean (Standard Error)	Undesirable/ Desirable Conditions	Mean (Standard Error)	Undesirable/ Desirable Conditions	Mean (Standard Error)	Undesirable/ Desirable Conditions
Pools								
Pool Area (% total stream area)	15.2	42.1%	18.5	22.2%	20.0	34.1%	19.2	32.7%
	(3.0)	5.3%	(5.6)	22.2%	(2.4)	19.5%	(2.3)	11.5%
Pool Frequency (channel widths between pools)	41.5	26.3%	42.1	22.2%	20.4	39.0%	34.5	28.8%
	(13.5)	10.5%	(21.1)	22.2%	(2.2)	7.3%	(11.3)	21.2%
Residual Pool Depth (m) by stream size and gradient	0.6	0.0%	0.4	0.0%	0.6	0.0%	0.6	0.0%
	(0.03)	68.4%	(0.07)	11.1%	(0.04)	48.8%	(0.09)	40.4%
Complex Pools (pools with ≥3 LW pieces ≥3 per km of reach length	No	-	0.2	88.9%	0.2	87.8%	0.1	98.1%
	Data	-	(0.2)	0.0%	(0.1)	2.4%	(0.0)	0.0%
Riffles								
Width/Depth Ratio (active channel based)	13.6	0.0%	17.9	11.1%	13.9	0.0%	26.7	24.5%
	(1.0)	57.9%	(6.5)	77.8%	(0.7)	70.7%	(3.9)	43.4%
Gravel (% of area)	22.7	10.5%	29.6	0.0%	26.6	17.1%	35.8	9.8%
	(1.6)	5.3%	(4.1)	28.6%	(2.2)	14.6%	(2.1)	51.0%
Silt-Sand-Organics (% of area) by parent material and gradient b/	21.3	57.9%	11.0	14.3%	21.9	46.3%	30.1	66.7%
	(1.6)	5.3%	(3.1)	42.9%	(2.6)	24.4%	(2.1)	2.0%
Shade								
Reach Average, % by stream width	87.7	0.0%	56.9	55.6%	69.9	26.8%	75.5	23.7%
	(2.2)	90.0%	(4.2)	11.1%	(2.2)	46.3%	(2.9)	66.1%
Large Woody Debris								
LW Pieces/100m of Stream Length	6.2	80.0%	4.0	88.9%	6.3	82.9%	7.5	64.4%
	(0.9)	0.0%	(1.2)	0.0%	(0.6)	0.0%	(0.9)	6.8%
LW Volume (m^3)/100m of Stream Length	18.5	60.0%	4.8	88.9%	13.5	75.6%	10.3	81.4%
	(3.4)	20.0%	(2.1)	0.0%	(1.8)	9.8%	(1.7)	5.1%
Key Pieces (≥60cm D by ≥12m L)/100m of Stream Length c/	1.3	55.0%	0.2	88.9%	0.7	73.2%	0.6	67.8%
	(0.4)	10.0%	(0.1)	0.0%	(0.1)	2.4%	(0.1)	1.7%
Riparian Conifers								
Number >20in dbh/1000ft of Stream Length	29.0	100.0%	14.3	100.0%	40.3	97.6%	43.8	89.8%
	(8.3)	0.0%	(9.4)	0.0%	(8.2)	0.0%	(9.7)	3.4%
Number >35in dbh/1000ft of Stream Length	6.9	100.0%	4.1	100.0%	8.2	97.6%	6.4	96.6%
	(3.4)	0.0%	(4.1)	0.0%	(2.9)	0.0%	(2.4)	0.0%

a/ Values unweighted by surveyed reach length. Stream reach specific data are in appendix X.
b/ Assumes sedimentary parent material in all surveyed reaches.
c/ D= diameter, L = length
cm = centimeter; dbh = diameter at breast height; LW = large wood; HUC = hydrologic unit code; km =kilometer

Benchmark conditions are not absolute, but they provide a method for comparing values of key aquatic habitat components (Foster et al. 2001). Pools provide refuges for fish during high and low stream flows, slow water habitats for adults and juveniles, over-wintering habitat for some fish species, habitat during periods of low summer flows, and, those associated with LW, provide habitat complexity. Riffles provide spawning habitats for various salmonid species that construct nests or redds in gravels of various sizes, specific to salmonid species. Sand, silt, and organic debris can reduce suitability of spawning habitats by filling pores between gravel particles that are necessary for intergravel stream flows, availability of oxygen, and development of embryos; high percentages of sand, silt, and organic material in riffles indicate poor conditions as spawning habitat.

Riparian trees provide shade over stream channels which reduces deleterious effects of high summer water temperatures. Riparian vegetation stabilizes stream banks, contributes to development of bank undercutting (thermal and hiding cover), limits erosion and sedimentation from stream banks, and provides LW as an important component of the aquatic habitat. LW, especially contributed by riparian conifers, provides cover for fish, physical habitat complexity that influences stream flows and channel diversity, and biological complexity as substrates for macroinvertebrate communities that provide food for salmonids during different life stages (Foster et al. 2001).

BLM and the Oregon Forest Industry Council surveyed 126 stream reaches in the four fifth-field watersheds within the Upper Rogue River subbasin that would be crossed by the Pipeline: 20 in the Trail Creek HUC 1710030706, 9 in the Shady Cove-Rogue River HUC 1710030707, 41 in the Big Butte Creek HUC 1710030704, and 56 in the Little Butte Creek HUC 1710030708. Surveys were conducted during summers in different watersheds between 1994 and 1999.

For most of the stream reaches sampled in the four watersheds, habitat conditions related to pools (area, frequency, residual depths) were between moderate levels and desirable benchmarks. The majority of reaches were deficient in complex pools associated with LW. Numbers of LW pieces, LW volume, and numbers of key pieces were below benchmark conditions in most stream reaches, which helps explain the poor state of pool complexity associated LW. Related to low levels of LW are the low numbers of large conifers (greater than 20 inches dbh) within sampled riparian zones. However, shade conditions are generally at moderate or desirable benchmark levels, primarily due to the narrow widths of most streams and the presence of broadleaf riparian red alders and cottonwoods that provide shade during summer months (Upper Rogue Watershed Association 2006).

In general, riffle habitat conditions are better than pool habitat conditions, but they are not at desirable conditions overall. For example, ratios of stream widths to depths in most stream reaches in the four watersheds were generally low, which indicates that streams are more narrow and deep than wide and shallow. Areas of gravel substrates were not at or above desirable benchmarks in most sample reaches, and areas of fine sediments in riffles generally exceeded the desirable benchmarks. However, some of this analysis is based on data from before the flood event of the winter of 1996-1997, and conditions could have changed significantly from what the data shows (Little Butte Creek Watershed Council 2003).

Monthly average stream discharges over the annual cycle are provided in figure 3.5.3-5 for two waterbodies within the Upper Rogue River subbasin, Big Butte Creek – a tributary to Rogue River with a 245 square mile watershed—and Elk Creek with a watershed area of 379 square miles.

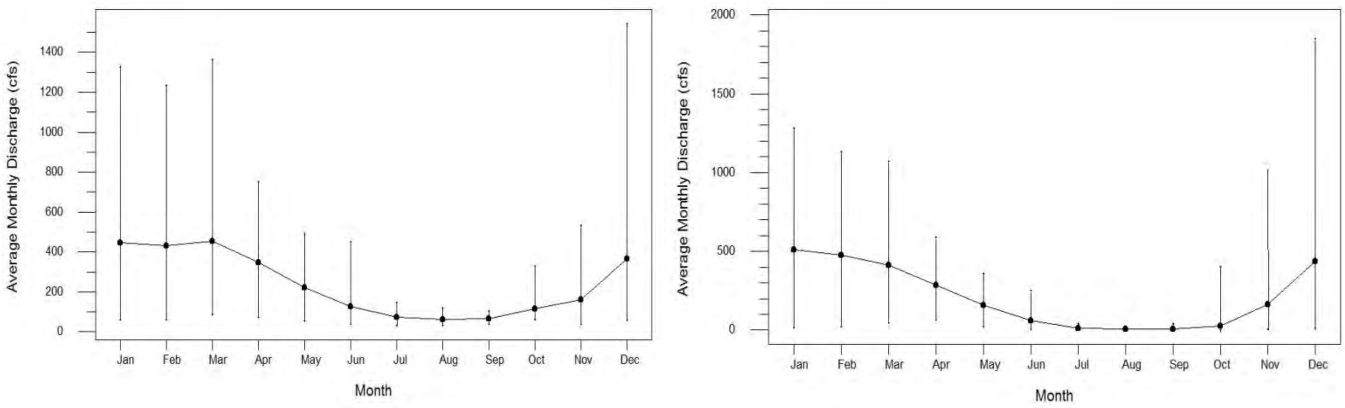


Figure 3.5.3-5 Average Monthly Discharge (cfs) in (A) Big Butte Creek (USGS Gage 14337500) from 1945 to 2016, and (B) Elk Creek (USGS Gage 1433800) from 1946 to 2015. Vertical lines show maximum and minimum discharges during the periods of record.

Monthly flows in the Upper Rogue River below Lost Creek Lake are heavily influenced by irrigation water withdrawals and are highly variable. Water is also diverted for use in hydroelectric power generation (Upper Rogue Watershed Association 2006). Monthly flows in Big Butte Creek and Elk Creek at the confluence with the Rogue River near Trail Creek were selected as representative because neither segment is influenced by dam releases for irrigation or hydropower. Precipitation falling as snow during winter months does not affect discharges until later in the year (April through May). Minimum flows tend to occur during June, July, August, and September. The ODFW (2008) in-stream construction window for Upper Rogue River and tributaries is June 15 to September 15, coinciding with low flows.

Critical Habitat

Critical habitat for coho salmon in the SONCC ESU (NMFS 1999b) includes "all waterways, substrate, and adjacent riparian zones below longstanding, naturally impassable barriers (i.e., natural waterfalls in existence for at least several hundred years)." The Pipeline crosses designated critical habitat associated with waterbodies in the Upper Rogue River subbasin (HUC 17100307), below the Lost Creek, Willow Creek, and Fish Lake Dams. Essential features of coho salmon critical habitat in those waterbodies include adequate 1) substrate, 2) water quality, 3) water quantity, 4) water temperature, 5) water velocity, 6) cover and shelter, 7) food, 8) riparian vegetation, 9) space, and 10) safe passage conditions (NMFS 1999b).

Critical habitat for SONCC coho salmon is designated based on species requirements such as space for growth and behavior, nutritional and physiological requirements, cover and/or shelter, reproduction sites, and habitats that are protected from disturbance or are representative of historically known population sites (NMFS 1999b). Additionally, NMFS uses other known essential physical and biological features that are crucial to species conservation and critical habitat including spawning sites, food resources, water quality and quantity, and riparian vegetation

(NMFS 1999b). Activities that may affect critical habitat and PCEs include, but are not limited to, timber sales, road building, mining, dredge and fill, and bank stabilization activities (NMFS 1999b).

Generally, riparian areas form the basis of healthy watersheds, and impacts on them in turn affect these PCEs (NMFS 1999b). However, the PCEs that create healthy salmonid habitat vary throughout the coho salmon's range, and the extant of the adjacent riparian zone may change accordingly. A site-potential tree height is a suitable benchmark for identifying a riparian zone in some cases, but in order to better assess the features of a specific locale, site-specific analyses provide the best means to characterize the riparian zone (NMFS 1999b).

Riparian areas provide the following functions: shade, sediment, nutrient or chemical regulation, streambank stability, and input of LW or organic matter. In addition, critical habitat includes inaccessible headwater or intermittent streams which provide key habitat elements (e.g., LW, gravel, water quality) crucial for coho salmon in downstream reaches (NMFS 1999b). Widths of adjacent riparian zones may vary by site-specific and/or landscape characteristics, but a distance of one site-potential tree height serves to define riparian zone widths in some cases (NMFS 1999b). With these considerations, all perennial and intermittent streams in table 3.5.3-3 are included in critical habitat within the riverine analysis area and have been summarized in table 3.5.3-9.

No specific geographic data have been developed for SONCC coho salmon critical habitat. Consequently, waterbodies identified with coho presence by ODFW (2014c) were assumed to provide critical habitat for SONCC coho, which includes suitable habitat believed to be used currently or historically by wild, natural, and/or hatchery coho fish populations. Additionally, ODFW winter steelhead GIS layers were reviewed and, if spatially near waterbodies crossed or adjacent to the Pipeline Project, were included as "assumed" coho presence. These data were combined with distributions of SONCC coho in California (UC Davis Center for Watershed Sciences 2016). With distributions in Oregon and California, combined, there are 108 fifth-field watersheds occupied by SONCC covering a total 16,423 square miles with 3,578 stream miles of current and/or historically occupied habitat. Absent any other information, critical habitat for SONCC coho is assumed to coincide with the total stream miles. Approximately 5.5 percent of stream miles with critical habitat for the SONCC coho ESU is within the Upper Rogue River subbasin and 4.1 percent is in the four fifth-field watersheds crossed by the Pipeline. Eight waterbodies within the four fifth-field watersheds crossed by the Pipeline are known to support designated critical habitat for SONCC coho; three others are assumed to support SONCC ESU coho and are included as critical habitat in table 3.5.3-2.

TABLE 3.5.3-9

Critical Habitat – Stream Miles and Riparian – Designated for SONCC Coho within Watersheds Crossed by the Pipeline Project

Subbasins and Fifth-Field Watersheds	Waterbodies with Coho Presence a/			Riparian Zone Width (feet) (1 SPTH) c/	Areas (acres) of Riparian Vegetation within Riparian Zone (1 SPTH)	
	Number of Waterbodies with Critical Habitat b/	Total Stream Miles with Critical Habitat	Proportion of Total Stream Miles in in Project Area watersheds b/		Within Subbasin or Watershed	Within 1 SPTH of waterbodies with Critical Habitat a/
Upper Rogue Subbasin	**94**	**197.9**	**0.055**	**167**	**624,272**	**7,850**
Trail Creek	15	17.2	0.005	159	35,338	657
Shady Cove-Rogue River	13	35.5	0.010	157	74,268	1,347
Big Butte Creek	16	32.6	0.009	187	158,243	1,466
Little Butte Creek d/	17	60.9	0.017	158	238,879	2,325

a/ Data from ODFW GIS database (ODFW 2017f).
b/ ODFW data combined with California SONCC distribution (UC Davis Center for Watershed Sciences 2016).
c/ 1 SPTH = one site-potential tree height.
d/ Includes the Key Watershed designated within the Little Butte Creek fifth-field watershed
SPTH = site-potential tree height

3.5.3.3 Effects of the Proposed Action

Analyses of effects of the proposed action are addressed separately for the marine analysis area and riverine analysis area for the SONCC coho salmon ESU.

Direct and Indirect Effects – Marine Analysis Area

Potential Project-related effects to SONCC coho salmon within the marine analysis area include: 1) acoustic effects to coho from LNG carriers, and 2) inadvertent fuel spills and equipment fluid releases at sea.

Acoustic Effects

Underwater noise may affect coho salmon in the SONCC ESU. LNG carriers transiting the marine analysis area would produce underwater noise. LNG carriers built in 2003 with 138,028 m^3 capacity were reported by Hatch et al. (2008) to produce sound levels (with 1 standard error) of 182 ± 2 dB re: 1 µPa @ 1 meter. Underwater noise levels are expected to vary by ship type and also by carrier length, gross tonnage, carrier speed, and, to some extent, carrier age—older carriers tended to be louder than newer carriers. Based on the general trend for higher underwater noise generated by larger carriers (McKenna et al. 2012), it is possible for some of the LNG carriers that would utilize the LNG Project to generate more noise than the LNG tanker built in 2003 with 138,028 m^3 capacity reported by Hatch et al. (2008) that produced sound levels (with 1 standard error) of 182 ± 2 dB re: 1 µPa @ 1 meter.

It is likely that any LNG carrier noise generated in the marine analysis area would be below thresholds for adverse effects to fish with the possible exception of those fish very near the hull for extended periods, which would be an unlikely event. The criteria for noise levels considered harmful to fish are presented above in the North American green sturgeon discussion (see section 3.5.1), but generally values less than 183 dB are not considered harmful to fish. As a result, only fish within about one meter (three feet) of the vessel would be in danger of direct noise harm. Noise from LNG carriers would likely increase the background noise within the marine analysis area, which is occurring globally (Slabbekoorn et al. 2010). While background levels are not specifically known in the marine analysis area, analyses of more recent vessel-traffic related noise shows that such levels along the U.S. West Coast are holding steady or increasing slightly offshore from southern California but decreasing in the area off Oregon and Washington (Andrew et al. 2011). SONCC coho salmon would be highly unlikely to be within three feet of these vessels especially for extended periods, and thus adverse effects to SONCC coho from LNG carrier noise are not expected.

Fuel or Oil Spills at Sea

Fuel (e.g., diesel) used for LNG carrier propulsion or oil used for mechanical equipment could possibly leak or be inadvertently spilled while LNG carriers are en route in the waterway. The low amount of petroleum products on LNG carrier greatly reduces the chance of impacts in the marine environment from petroleum spills. The Federal Water Pollution Control Act, as amended by the CWA (33 U.S.C. 1251–1387), prohibits the discharge of oil upon the navigable waters of the U.S. LNG carriers calling on the LNG Project would also be required by the Coast Guard to have a vessel response plan in order to be adequately prepared for accidental spills. Therefore, neither fuel nor oil leaks from LNG carriers transiting in the waterway to and from the LNG Project are likely to have adverse effects on aquatic resources including coho salmon.

Direct and Indirect Effects – Riverine Analysis Area

The Pipeline would cross 11 waterbodies known or presumed to be inhabited by coho salmon in the SONCC ESU (see table 3.5.3-3). The details of each of the crossing methods indicated as used in table 3.5.3-10 are summarized in the section 2.4.2 of our EIS. Effects could occur from in-water construction activities, terrestrial/riparian habitat modification, and inadvertent spills or releases of hazardous materials. Construction of the Pipeline Project could directly and/or indirectly affect SONCC coho salmon and critical habitat through one or more of the following pathways:

1. interference with key life history functions;
2. acoustic shock from blasting pipe trench through bedrock streambeds;
3. underwater noise produced during use of a track hoe or impact hammer if fish are proximate to the construction site;
4. suspended sediment (turbidity) generated during construction across waterbodies;
5. inadvertent release of drilling mud during HDD construction;
6. movement blockage during in-stream construction;
7. salvaging fish that are entrained and/or entrapped;
8. removal of riparian vegetation;
9. stream bank and unstable hillslope erosion
10. effects to aquatic habitats including freshwater stream invertebrates;
11. hydrostatic testing and risk of test water entering streams;
12. introduction and/or re-distribution of aquatic nuisance species;
13. accidental release of fuels and entry of other petroleum products into surface waters;
14. risk of channel migration, avulsion, widening, and/or streambed scour;
15. effects to hyporheic exchange and hyporheic zones;
16. run-off from new permanent access roads, new temporary access roads, existing access roads and temporary extra work areas;

17. application of herbicides to control noxious weeds near waterbodies.

All affected waterbodies proximate to the Pipeline that are within the range of SONCC coho salmon ESU are within the Upper Rogue River subbasin and four fifth-field watersheds. The route would include 72 direct waterbody crossings within the Upper Rogue River subbasin (see table 3.5.3-3 and summarized below in table 3.5.3-10). Dry open-cuts using a flume would be utilized at 57 crossings if water is present at the time of construction. Blasting may be necessary for construction at 13 streams that would be crossed by dry open-cut methods (probably by dam-and-pump; see Pipeline Project description in section 2.1.2) because the streambed of each is bedrock (see table 3.5.3-3 and table 3.5.3-10). An HDD crossing would be used at the crossing of the Rogue River (MP 122.7), and a conventional bore would be used at the Medford Aqueduct Ditch (MP 133.4). An additional 18 waterbodies summarized in table 3.5.3-10 would not be crossed by the Pipeline but are adjacent to the centerline in the right-of-way. Of the 90 waterbodies included in the table, 14 are perennial streams, 73 are intermittent streams, and 3 are ponds (see table 3.5.3-3, above).

TABLE 3.5.3-10

Proposed Pipeline Construction Methods for Crossing Waterbodies within the Subbasin and Fifth-Field Watersheds Coinciding With the SONCC Coho Riverine Analysis Area

	Number of Waterbodies with Construction Method							
Subbasin and Fifth-Field Watersheds	**HDD or Direct Pipe**	**Bore**	**Wet Open-Cut**	**Diverted Open-Cut**	**Dry Open-Cut; Fluming**	**Dry Open Cut; Bedrock a/**	**Total Crossed**	**Adjacent Not Crossed b/**
Upper Rogue Subbasin								
Trail Creek					4	2	**6**	2
Shady Cove-Rogue River	1				9	1	**11**	7
Big Butte Creek		1			3	5	**9**	3
Little Butte Creek					41	5	**46**	6
TOTAL	**1**	**1**	**0**	**0**	**57**	**13**	**72**	**18**

a/ Bedrock streambeds would be crossed by dry open-cuts (probably by dam-and-pump) but may require special construction techniques to ensure pipeline design depth including rock hammering, drilling and hammering, or blasting. The need for blasting would be determined by the contractor and would only be initiated after ODFW blasting permits are obtained.

b/ Waterbodies within the construction right-of-way that would not be crossed

Timing to Life History Functions

Waterbodies within the Upper Rogue River subbasin would be crossed between June 15 and September 15 (ODFW 2008), which partially coincides with adult upstream migrations of coho (see figure 3.5.3-1). In general, construction would be timed to miss periods of major juvenile or adult migrations and occur during low stream flows. The in-stream construction window coincides with coho juvenile rearing. Juveniles rear for about 15 months in freshwater before migrating as smolts in spring to the ocean. Consequently, juveniles present would likely be a combination of pre-smolts from the previous year and juvenile fry several months old from the current year. Construction across waterbodies within the Upper Rogue River subbasin could occur during adult upstream migration, beginning in September, but would be completed before spawning in early November (see figure 3.5.3-1).

Acoustic Shock

There are 13 waterbody crossings within the SONCC coho ESU where shallow bedrock may occur, potentially requiring blasting and/or mounted impact hammers to construct a trench through bedrock substrates (see table 3.5.3-3 and summarized in table 3.5.3-10). Four are known to support

SONCC coho: two in the Trail Creek watershed (West Fork Trail Creek at MP 118.9 and Canyon Creek at MP 120.5) and two in the Big Butte Creek watershed (Neil Creek at MP 132.1 and Quartz Creek at MP 132.8). Explosives detonated near water produce acoustic shock waves that can be lethal to fish, fish eggs, and fish larvae by rupturing swim bladders and addling egg sacs (British Columbia Ministry of Transportation 2000). Explosives detonated underground produce two modes of seismic waves: 1) body waves that are propagated as compressional primary (P) waves and shear secondary (S) waves; and 2) surface waves produced when a body wave travels to the earth surface and is reflected back (ADFG 1991). Acoustic shock waves propagated from ground to water are less lethal to fish than those from in-water explosions because some energy is reflected or lost at ground-water interface (ADFG 1991). Peak overpressures as low as 7.2 psi produced by blasting on a gravel/boulder beach caused 40 percent mortality in coho salmon smolts. Other studies revealed 50 percent mortality in smolts with peak overpressures ranging from 19.3 to 21.0 psi (ADFG 1991).

In 1991, the ADFG established a standard for blasting effects to anadromous fish that limited blast-induced overpressures in the water column. ADFG (1991) reported that a pressure change of 2.7 psi is the level for which no fish mortality occurs. ADFG (1991) calculated the straight line distances for a single shot explosive charge of given weight through rock and other materials to dissipate to an overpressure standard of 2.7 psi (non-lethal pressure for anadromous fish). Typical trench blasting scenarios use multiple 1- to 2-pound charges separated by an 8-millisecond delay to excavate the trench. With use of 1- to 2-pound charges in rock, the setback distance (at which 2.7 psi would occur) from the blast trench to the fish habitat is between 34 and 49 feet (see Table 3 in ADFG 1991).

New research (Dunlap 2009) and an in-depth review (Kolden and Aimone-Martin 2013) of empirical studies of the physiological effects of blasting on adult salmonids and embryos prompted ADFG to revise the blasting standard (Timothy 2013):

> *The instantaneous pressure rise in the water column in rearing habitat and migration corridors is limited to no more the 7.3 psi where fish are present. Peak particle velocities in spawning gravels are limited to no more the 2.0 in/s during the early stages of embryo incubation before epiboly is complete.*

Application of the new standard for 7.3 psi in equations in ADFG (1991) was used to derive setback distances from water for 2-pound charges in rock. Based on these calculations, a distance of about 26 feet would result in the avoidance of adverse effects to salmonids in water. The setback distance used in Pacific Connector's *Fish Salvage Plan* (appendix T) added 25 feet to each side of the construction right-of-way, totaling at least 50 feet from the blasting location at the trench. Application of the new ADFG blasting standard for a 2-pound charge in bedrock would indicate that the current setback distance is more than adequate to ensure that any blasting would not adversely affect ESA-listed coho salmon and other salmonid species.

Several approaches have been suggested to reduce risk of injury or mortality to fish in closest proximity to blasting locations (Wright and Hopky 1998):

- Deployment of bubble curtains/air curtains to disrupt the shock wave;
- Deployment of noise generating devices, such as an air compressor discharge line, to scare fish away from the site; or
- Removal or exclusion of fish from the work area before the blast occurs.

To reduce impacts on resources, Pacific Connector developed a *Blasting Plan* that incorporates many of these recommendations. The plan states that Pacific Connector does not anticipate any in-water blasting in any streams crossed by the Pipeline. However, blasting may occur in uplands adjacent to streams or within dry streambeds. In those situations, Pacific Connector would attempt to minimize acoustic shock waves from blasting that may affect aquatic resources by the types of explosives selected, the size of charges, and the sequences of firing. The details of specific site blasting actions would be determined in coordination with managing resource agencies. Prior to any blasting, proper permits would be obtained and agencies notified as required by permits.

Estimates of juvenile coho present at crossing sites in streams with bedrock substrates were based on the following assumptions: 1) all rights-of-way are 95 feet wide at each stream crossing within which coho would be salvaged, and 2) coho would be excluded from an additional 50 feet (a total of 145 feet of stream length) from the right-of-way edges (25 feet from each edge) so total stream length where fish would be salvaged at potential bedrock crossings is 145 feet. Numbers of juvenile coho potentially present or assumed to be present in the streams with bedrock substrates are provided in table 3.5.3-11. Construction of the Pipeline through bedrock at those streams is likely to require blasting and the estimates in table 3.5.3-11 represent numbers of juvenile coho (103 juveniles expected) that would be displaced and or salvaged prior to blasting. The estimates in table 3.5.3-11 are based on no fish being herded out of the work area prior to dewatering (see appendix T). The actual number that would be salvaged is expected to be much less. Fish salvaged at other non-bedrock stream crossings is discussed below under *Entrapment and Fish Salvage*.

TABLE 3.5.3-11

Worst Case Estimates of Juvenile Coho Fry Present or Assumed as Present at Streams with Bedrock Substrates and Juvenile Fry Salvaged Prior to Blasting during Construction of the Pipeline Project within the SONCC ESU

Subbasin and Fifth-Field Watersheds	Dry Open-Cut w/ Juvenile Coho Fry Present	Juvenile Fry Present at Each Crossing a/	Total Juvenile Fry Present b/	Juvenile Fry Salvaged at Each Crossing c/	Total Juvenile Fry Salvaged d/
Upper Rogue Subbasin					
Trail Creek	2	26	51	17	51
Shady Cove-Rogue River	0	N/A	0	N/A	0
Big Butte Creek	2	26	52	17	52
Little Butte Creek	0	N/A	0	N/A	0
TOTAL	**4**		**103**		**103**

a/ Juvenile Fry Present at Each Crossing based on Juveniles per Mile (see table 3.5.3-6) within a stream crossing length of 145 feet (95 feet construction right-of-way plus an additional 25 feet on each side, a worst case, see text).
b/ Total Juveniles Present (worst case) = number of Juveniles Present at Each Crossing multiplied by number of Dry Open-Cut crossings with potential for blasting and with Juvenile Coho Fry Present.
c/ Juvenile Fry Salvaged at Each Crossing based on Juvenile Fry per Mile (table 3.5.3-6) within a stream crossing length of 145 feet (worst case, see text),.
d/ Total Juvenile Fry Salvaged (worst case) = number of Juvenile Fry Salvaged at Each Crossing multiplied by number of Dry Open-Cut crossings with blasting and Juvenile Coho Fry Present. The estimate is based on no fish being herded out of the work area prior to dewatering (see *Fish Salvage Plan*). The actual number that would be salvaged is expected to be much less.

Underwater Noise

Dry open-cut construction, more than likely dam-and-pump methodology, would be used at sites where blasting and/or mounted impact hammers would be required to construct a trench through bedrock substrates. Impulsive type sounds, sound generated by impact hammers for example, create stress waves in the piling material that radiate sound throughout the surrounding media of substrate, air, and water and may propagate outward from the source through bottom sediment (Popper and Hastings 2009). Various studies have reported fish mortality, physical injury, auditory tissue damage, decreased viability of eggs, and decreased larval growth due to noise, mostly explosive blasts, seismic survey blasts, and air gun blasts (Hastings and Popper 2005).

State agencies in Washington, Oregon, and California, along with federal agencies have developed interim noise exposure threshold criteria for pile driving effects on fish (WSDOT 2019; Popper et al. 2006).[35] The threshold noise levels are assumed to be applicable to noise from a mounted impact hammer operating on bedrock substrates for 13 waterbodies potentially affected by the Pipeline Project in the Upper Rogue River subbasin (see tables 3.5.3-3 and 3.5.3-10).

Average maximum noise produced by mounted impact hammers due to impact on substrates (e.g., rock) has been reported at 90 dBA from 50 feet away in the air (see Table 7-4 in WSDOT 2019).[36] Using a simplified conversion of dB between air and water (see footnote below and Pacific Marine Environmental Laboratory 2012), the noise produced by the impact hammer in air would be equivalent to about 182 dB re: 1 µPa @ 1 meter in water. However, there is no information available to determine whether that noise level would be equivalent to peak sound levels or root mean square (RMS) levels, which are the basis for evaluating potential harm to fish, particularly related to cumulative sound exposure levels caused by multiple impact hammer strikes. However, using the most conservative criteria (cumulative levels which assume multiple impacts over a short period), an impact hammer value of 182 dB is at the limit of the current criteria considered to cause harm (i.e., 183 dB – see *Acoustic Effects* section above).

Further, the estimate of noise produced by in-water use of an impact hammer in any waterbody would be influenced by water currents, water depth, and bottom material and topography, as well as configuration and materials of the river banks. The effects of these factors are unknown (WSDOT 2019). However, noise propagation in any waterbody upstream and downstream from the construction site would be limited by the stream channel's sinuosity because the propagation is limited to straight-line distance from the source (WSDOT 2019). Noise produced by impact hammers would be much reduced if construction does not occur within the water column, similar

[35] Interim noise exposure threshold criteria for pile driving effects on fish (WSDOT 2019) include 1) a cumulative sound exposure level (SEL_{cum}) of 187 dB re 1 µPa^2 ● s for fishes more than 2 grams, 2) a SEL_{cum} of 183 dB re 1 µPa^2 ● s for fishes less than 2 grams, and 3) a single-strike peak level (SPL_{peak}) of 206 dB re 1 µPa for all sizes of fishes.

SEL_{cum} is the cumulative sound pressure squared, integrated over time, and normalized to one second. SEL_{cum} is calculated as SEL (single strike at 10 meters from the pile) + 10 Log(number of strikes).

[36] For consistency, the maximum noise level (L_{max} of the impact hammer at 1 meter (3.28 feet) is computed as:

$$L_{max} = \text{Construction } L_{max} \text{ at 50 feet} - 25\ \text{Log}(D/D_o) = 119.58 \text{ dBA at 1 meter (3.28 feet).}$$

Where Construction L_{max} = 90 dBA, D = distance from the noise source (3.28 feet) and D_o = the reference measurement distance (here, 50 feet). Noise measured on the A-weighted decibel scale is based on the reference pressure of 20 micro-Pascal (µPa), where one Pascal is the pressure (force of 1 newton) exerted over an area of 1 square meter and applies to sound in the air. Sound in water is referenced (abbreviated as "re:" in reference expressions) to 1 µPa instead of 20 µPa referenced in air.

The characteristic impedance of sound in water (related to the density of water and speed of sound) is approximately 3,600 times the impedance in air, so conversion for the intensity of sounds of equal pressures in air compared to water is 10 Log(3,600) = 36 dB (Pacific Marine Environmental Laboratory 2012). Taking into account the different reference pressures for sound in air and in water (20 µPa and 1 µPa), the intensity measurements for sound of equal pressures differ by 26 dB + 36 dB = 62 dB (Pacific Marine Environmental Laboratory 2012). Using this simplified conversion of dB between air and water, the noise produced by the impact hammer in air (120 dB re: 20 µPa @ 1 m) would be equivalent to about 120 dB + 62 dB = 182 dB re: 1 µPa @ 1 m in water.

to reduction set back distances from the blast trench to the fish habitat to reduce blast overpressures to below 2.7 psi, discussed above.

Sounds produced by a mounted impact hammer operating in dry conditions might be conducted through bedrock substrate to approach the hearing threshold of fish, as for example the Atlantic salmon, which is around 90 dB re: 1 µPa (see Figure 3 in Hastings and Popper 2005). It is assumed that salmonids in the Pipeline Project area at the time of construction would have hearing thresholds similar to Atlantic salmon. With that assumption, listed and non-listed salmonids present at the time of construction might detect the noise produced by an impact-hammer striking bedrock, but the noise is not expected to be of sufficient intensity to cause them injury as would SELs produced by pile driving.

Dry open-cut construction would be used at sites where blasting and/or mounted impact hammers would be required to construct a trench through bedrock substrates. When using the dam-and-pump stream crossing methodology, the typical right-of-way distribution of an isolated streambed (dry open-cut) would be no less than 25 feet on one side of the pipe trench and *at least* 50 feet or more on the opposite side of the pipe trench depending on whether it is a 75- or 95-foot-width crossing. Therefore, an area within the waterbody crossing equivalent to length of the blasting trench and approximately 25 feet wide (in the worst-case scenario) would be exposed to instantaneous hydrostatic pressure changes above 2.7 psi. In reality, the distance in water affected outside of the 25 feet on land would be less than an additional 25 feet because water does not transmit acoustic shock waves (acoustic shock) as well as rock (only about 70 percent of the distance away from the charge relative to rock, the most conductive substrate of pressure waves; see calculations in ADFG (1991), which the maximum distance is based upon. As noted above (see the *Acoustic Shock* subsection), a *Fish Salvage Plan* is in place that would result in any fish present being removed from the area within this 25-foot potential effect area, eliminating potential noise effects from stream crossings.

Monitoring for efficacy of each stream crossing and fish salvage would be conducted throughout the entire process, including function of upstream block nets to exclude fish from areas where they might be affected by blasting in the dry, thus eliminating potential noise effects to fish during stream crossings. In situations where blasting occurs in uplands adjacent to streams or within dry streambeds, Pacific Connector would attempt to minimize acoustic shock waves from blasting that may affect aquatic resources by optimizing variables such as the types of explosives selected, the size of charges, and the sequences of firing. In-air noise due to blasting would be mitigated in all noise-sensitive areas as described in Pacific Connector's *Blasting Plan* (see Appendix C to the POD [in appendix B of this BA]).

<u>Suspended Sediment by Pipeline Crossing Methods</u>

The three crossing methods that would be used for crossings where SONCC coho salmon may occur include dry crossing, conventional direct bore, and HDD. Dry crossing methods including diverted open cut would result in minimal impacts, including temporary increases in suspended sediments in restricted areas. Bores and HDDs would be installed without in-water work and would not directly affect the aquatic environment and associated species, except in the case of an inadvertent return during an HDD crossing, which could affect stream suspended sediment levels as discussed below.

Suspended Sediment – Dry Open-Cut

Pipeline crossings of surface waterbodies would cause some downstream turbidity and sedimentation. The type of crossing and the existing stream sediment characteristics affect turbidity and suspended sediment in streams. The details of crossing methods to be used are provided in appendices K and W and summarized in section 2.4.2 of our EIS (FERC 2019). The dry crossing methods to be used are flumed or dam-and-pump:

All streams in the range of SONCC coho salmon ESU would be crossed using the dry open-cut method (flume and dam-and-pump) (table 3.5.3-3 and table 3.5.3-10), except for two waterbodies crossed by HDD and bore. Within the range of the SONCC ESU, the Rogue River would be crossed with an HDD, while the Medford Aqueduct would be crossed by a bore. Turbidity and sedimentation impacts from the dry open-cut methods are associated with: 1) installation and removal of the upstream and downstream dams used to isolate the construction area; 2) water leaking through the upstream dam and collecting sediments as it flows across the work area and continues through the downstream dam; 3) movement of in-stream rocks and boulders to allow proper alignment and installation of the flume and dams; and 4) when streamflow is returned to the construction work area after the crossing is complete and the dams and flume are removed. "Dry" techniques produce much less sediment in the water than alternative "wet" open cut methods (Reid and Anderson 1999; Reid et al. 2002; Reid et al. 2004, Reid et al. 2008, Harper 2012). Therefore, if properly installed and maintained during construction and restoration, dry open-cut construction across waterbodies would produce minor levels of sediment and turbidity.

Pacific Connector would minimize impacts on surface waters and aquatic resources by implementing the waterbody crossing and erosion and sediment control measures as described in the Pipeline Project-specific ECRP. The details of the crossing risk assessment and actions that would be taken to reduce risk to stream channels and banks are discussed below under the Streambank Erosion and Streambed Stability section.

GeoEngineers (2017f) evaluated the potential risk of turbidity increasing during construction of the Pipeline across waterbodies. The qualitative evaluation was based on each affected waterbody's hydroperiod, presence of erodible clay and loam soils in streambanks, presence of clay in streambed (suspended clay contributes to turbidity disproportionally to its erodibility), long-term stability of stream channels, and level/duration of construction effort and stabilization measures likely to be added at the time of construction. The turbidity risk was scored from 1 (low) to 5 (high). Of 86 waterbodies evaluated within range of SONCC coho, 58 were scored with a low risk (score of 1 or 2) of turbidity increase over a 24-hour period, and 27 were scored with a moderate risk (score of 3 or 4), generally due to soil erosion potential, presence of clay or mud, and/or the presence of steep slope or an incised channel that would require construction of a deep trench (GeoEngineers 2017f). The evaluation concluded that turbidity generated during construction may exceed Oregon water quality standards for short distances and short durations downstream from each stream crossing, either coinciding with construction across perennial waterbodies or in intermittent streams coincidental with autumn precipitation.

Construction across waterbodies would be completed as quickly as possible to shorten the duration of sedimentation and turbidity. If channels are dry during construction, small streams (less than 10 feet) are projected to be crossed in less than 24 hours, and intermediate streams (10 to 100 feet) usually in less than 48 hours. Times may be longer when flow diversion is required. Reid et al.

(2004) examined stream crossing data from 46 crossings (23 dam and pump, 12 flumed, and 11 open cut) over a range of stream types across Canada and the U.S. from streams that were mostly less than 10 meters wide. Reid et al. (2004) noted that in flowing streams they monitored, in-stream work averaged 38 and 64 hours for dam-and-pump and flumed crossings, respectively. However, the times noted for crossings include all activities that occur, which influence when active suspended sediment may occur, but do not indicate the actual periods when increased suspended sediment development would occur, which is mostly influenced by periods of active in-stream installation or removal of flow diversions for dry open-cut methods. If circumstances required a construction delay, adequate site stabilization measures would be employed in accordance with the ECRP and permit conditions. However, failure of flow sealing and other in-stream structures at upstream diversions structures can occur from a variety of malfunctions such as pump failure, dam and flume failure, poor dam seal and others. Reid et al. (2004) noted seal failures of monitored diverted open cut crossing in one of 23 dam-and-pump projects and five of 12 for flumed projects. Should these failures occur, suspended sediment levels would be relatively elevated over those projects without failure, but immediate repair work could reduce the magnitude and duration of the elevated levels.

Alternatively, Harper (2012) modeled sediment generated following dry open-cut crossing of intermediate and minor waterbodies but was restricted to a one hour period of duration associated with a “quick-flush” that occurs after a pipe is installed, the trench is backfilled, and water barriers, upstream and downstream from the workspace, are removed and turbulent, high energy flow across the backfilled trench suspends sediments which are expected to last for one hour (Harper 2012). The effect on suspended sediment from planned dry crossings and unintended wet cuts crossings with repairs is discussed below in this subsection.

Severity of Effects from Suspended Sediment

Salmonids may avoid areas of increased turbidity levels at 20 mg/l suspended sediment, and possibly lower concentrations depending on length of exposure (Newcombe and Jensen 1996). Elevated suspended sediment conditions would be short term during pipeline installation and would not be continuous at any one location. This would reduce the chances of continuous elevated exposure for fish that are relatively sedentary. Some other studies have found varied effects including lesser effects at these concentrations, with overall effects related to both duration as well as concentration (Newcombe and Jensen 1996).

Sediment resuspended into the water column can be redeposited on downstream substrates, which could bury aquatic macroinvertebrates (an important food source for salmonids, and other fish in estuarine areas). Additionally, downstream fine particle sedimentation could affect spawning substrate habitat, spawning activities, eggs, larvae, and juvenile fish survival, as well as benthic community diversity and health (reviewed and compiled by Bash et al. 2001). Because the effects of increased sedimentation and turbidity are often limited to the period of in-stream work, the duration of these effects is usually relatively short. One long-term study (during construction through three years after construction) of multiple pipeline crossings of coldwater streams found no measurable effect to fish or benthic resources or their habitat within two months to three years of construction (Blais and Simpson 1997), and Gartman (1984) reported rapid recolonization of benthic organisms on 30 pipeline projects post-construction.

Newcombe and Jensen (1996) compiled research from many sources that demonstrate effects to anadromous and resident salmonids by various levels of suspended sediment and exposure over time. This modelling process is used to assess the possible effects to salmonid resources in the project area from in-stream pipeline construction based on estimates of TSS concentration and exposure duration. The developed models that approximate the level of effect are based on known levels of suspended sediment concentration and duration of exposure to that concentration in a stream. In order to use these models to estimate effects to salmonids, an estimate of these two parameters is needed.

Output from each model provides SEV scores that are summarized below. Values range from 0 to 14, where an SEV of 0 indicates no effects, an SEV between 1 and 3 indicates behavioral effects, an SEV from 4 to 8 indicates sublethal effects, and an SEV from 9 through 14 indicates lethal and paralethal effects (see Table 1 in Newcombe and Jensen 1996).

Behavioral Effects SEV scores

- 1 = Alarm reaction
- 2 = Abandonment of cover
- 3 = Avoidance response

Sublethal Effects SEV scores

- 4 = Short-term reduction in feeding rates and/or feeding success
- 5 = Minor physiological stress (increase coughing rate and/or increased respiration rate)
- 6 = Moderate physiological stress
- 7 = Moderate habitat degradation; impact on homing
- 8 = Major physiological stress; long-term reduction in feeding rate- feeding success; poor condition

Lethal and Paralethal Effects SEV scores

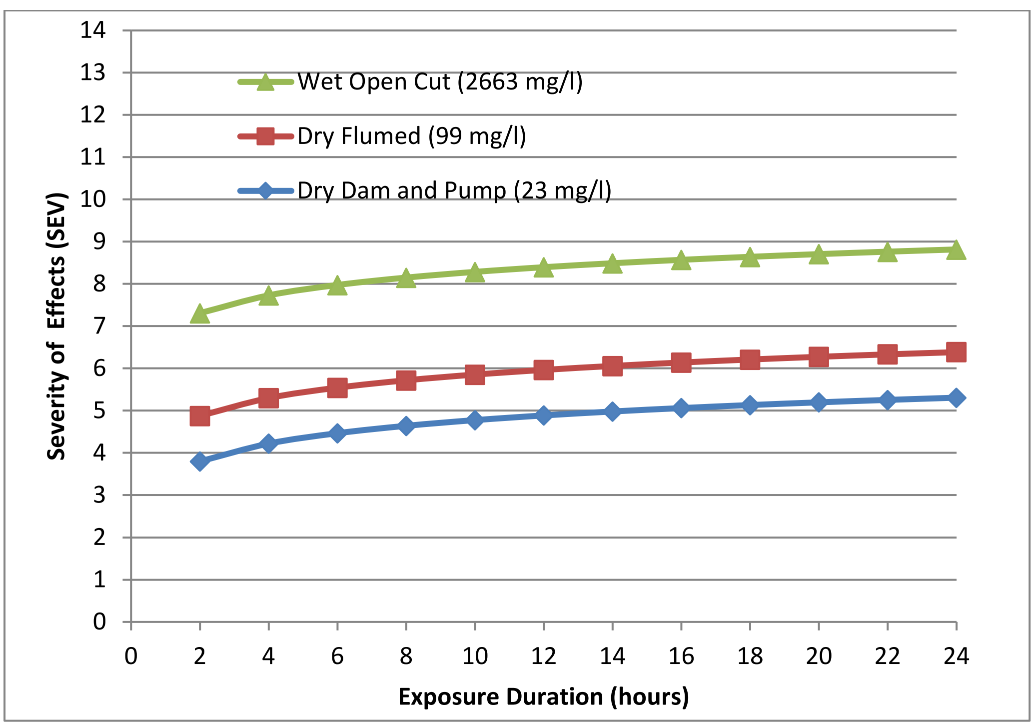
- 9 = Reduced growth rate, delayed hatching, and/or reduced fish density
- 10 = 0 to 20 percent mortality, increased predation, and/or moderate to severe habitat degradation
- 11= >20 to 40 percent mortality
- 12= >40 to 60 percent mortality
- 13= >60 to 80 percent mortality
- 14= >80 to 100 percent mortality

SEV scores are complex interactions of TSS concentrations and time of exposure to those concentrations where higher concentrations and longer exposures result in higher SEV scores and greater impact to fish. Effects of high concentrations may be ameliorated by brief exposures, and conversely effects of low concentrations may be exacerbated by prolonged exposures. In the analyses, downstream effects of TSS are primarily caused by very fine sand, silt, and clay particles; coarser sediments settle out of suspension over relatively short distances downstream, closer to the crossing site.

Because of the lack of both available site-specific information and the unknown accuracy of models when applied to varied locations of the specific route, two approaches were taken to estimate the concentration of suspended sediment and its effect on SONCC coho salmon based on SEV levels discussed above. One method used literature values from other stream pipeline studies concerning concentrations and durations of the activity to estimate reasonable approximations of likely sediment concentrations and effects to fish. The other method was a detailed approach using models to predict sediment concentrations at Project stream pipeline-crossing sites based on known and assumed values.

Literature-Based Assessment of Sediment Effects

Application of the Newcombe and Jensen (1996) Model 1 to a collection of stream pipeline crossing locations supplies an approximation of what the likely range of effects may be to both juvenile adult salmonid coho salmon. The Reid et al. (2004) data are the most complete set of literature information available on likely ranges of suspended sediment that may occur from various crossing methods and likely in-stream construction duration. Reid et al. (2004) measured suspended sediment downstream from 12 flumed pipeline crossings and 23 dam-and-pump crossings (dry open-cut or isolated pipeline construction crossings) and 11 wet open-cut construction crossings. Reid et al. noted that average suspended sediment concentrations near these 11 “wet cut” crossing sites were 2,663 mg/l, whereas values were much lower at “dry crossing” sites, which averaged 99 mg/l (12 sites) and 23 mg/l (23 sites) for flumed and dam-and-pump sites, respectively. Using the mean sediment concentration values from Reid et al. (2004) and the Newcombe and Jensen (1996) sensitivity Model 1, the effects to salmonid resources can be approximated (see figure 3.5.3-6). While crossing times for construction may be in the range of less than one day to four days for dry crossings, actual periods of elevated sediment would occur primarily during periods of installation and removal of isolation structures (see below under model effects of sediment for details on duration times of elevated sediment from crossing construction). Therefore, time of elevated sediment for any one crossing would only be a few hours, which is why the range of duration in the figure 4.5-3 is limited to 24 hours, which would more than cover the period of likely elevated sediment resulting from crossing under normal crossing conditions.



Note: Based on the Newcombe and Jensen (1996) effects model based on typical suspended sediment concentrations levels (data from Reid et al.2004) by crossing type.

Figure 3.5.3-6. Effects of Pipeline Stream Crossing Suspended Sediment Concentrations on Salmonids

Based on the estimate of likely average conditions of construction at a crossing assuming the average of the Reid et al. (2004) suspended sediment values, SEVs for dam-and-pump crossings would be most likely in the range of 4 to 5, which could include short-term reduced feeding rate or minor physiological stress. Flumed crossing sites would on average have slightly greater effects, with SEVs mostly in the range of 5 to 6, which could result in minor to moderate physiological stress. If some failure occurred in crossing methods, short-term concentrations and duration would be greater with SEV values similar to those of wet open-cuts, likely in the range of SEV 8, implying adverse factors such as long-term reduction in feeding success and major physiological stress, with wet open cut crossing time closer to 14 hours (Reid et al. 2004). All levels of effects would remain sublethal even with some short-term failure in crossing methods, based on the literature concentration and duration values.

Active monitoring of pipeline crossing construction of mostly coldwater fish streams in New Hampshire found similar SEV level results to those shown above. Trettel et al. (2002) monitored suspended sediment levels within 50 to 150 meters (160 to 500 feet) downstream of the active pipeline crossing constructions sites and used information from 75 perennial streams consisting 71 dry dam-and-pump or flumed crossings and 4 open-cut wet sites to estimate SEV levels. They found that the average SEV of the dry crossings was 6.5 with no measurable difference between types of dry crossing, while the four wet crossings averaged an SEV of 7.4. The SEV level of 6 corresponds to moderate stress while SEV 7 suggests the lowest level where some habitat effects would occur. They found that about one-third of the dry crossings equaled or exceeded this SEV level (7) of potential adverse habitat effects. Additionally, 99 percent of all crossings were less than the designated paralethal or lethal range (SEV of 9 or above). The biggest factor affecting elevated SEV levels was the portion of fines in the sediment at the crossing. These results suggest a very low probability of any direct fish mortality from construction, with local crossing area effects consisting of mostly sublethal effects (e.g., physiological stress, short-term reduction of feeding), and limited habitat degradation.

The distance downstream effects could occur is dependent on many factors (e.g., substrate composition, velocity, flow, channel width). Ritter (1984) estimated that for a minor perennial stream (likely average only half a foot deep, and less than 20 feet wide), suspended sediment concentrations may be near background levels in the range of 60 meters (200 feet) to 150 meters (500 feet) downstream during open-cut crossings. These stream sizes would be most typical of crossings along the pipeline route. Reid et al. (2002) found that below four separate dam-and-pump crossings, mean suspended sediment was less than 20 mg/l within 30 meters (100 feet) downstream. However, at another crossing where some high suspended sediment concentrations occurred from leakage, values 340 meters (1,100 feet) downstream were reduced to 20 percent of those at 45 meters (150 feet) downstream. Low concentrations during construction of crossings appear to be more common when BMPs are closely followed. For example, according to Pacific Connector, a Williams Northwest pipeline completed in Washington State had only one state turbidity standard exceeded out of 67 waterbodies crossings. Estimates of the changes of suspended sediment concentrations were made based on the Ritter (1984) model downstream of 13 Project subwatersheds using estimates of substrate sediment composition and other physical conditions at the crossing sites (e.g., width, depth, and flow).

Based on the Reid et al. (2004) average values, effects to salmonids would be low, other than when sealing failure events occur at the planned dry crossings; the effects would likely range from short-term behavioral to short-term sublethal effects. Trettel et al. (2002) monitoring suggests adverse effects may be somewhat greater but still sublethal, with occasional local habitat degradation.

Modeled Estimates of Likely Effects from Suspended Sediment

Specific information about each waterbody crossing is required to estimate amounts of suspended sediment that would be generated, transported, and deposited downstream. That information includes: 1) stream width and depth, 2) water velocity, 3) streambed roughness, 4) grain size of excavated materials, and 5) background (ambient) levels of suspended sediment (Reid et al. 2008). The methods used to determine or approximate the values of each of these parameters are presented below. Once TSS concentrations generated by in-stream activities have been determined, they are applied in the dose-response assessments of sediment exposure, the SEV models by Newcombe and Jensen (1996). Pacific Connector incorporated site data, regional data, and available literature based models to provide an estimate of both suspended sediment levels and extent of effects to SONCC coho salmon ESU from construction across streams.

Average Channel Characteristics. Specific channel characteristics for streams crossed by the Pipeline are not available. However, data provided in the ODFW (2014c) stream surveys included bankfull channel widths, bankfull depths, and stream gradients, in addition to substrates (Sand-Silt-Organics) noted in table 3.5.3-8 above, for multiple streams within fifth-field watersheds crossed by the Pipeline (see table 3.5.3-12). Those data were used to develop stream channel characteristics in each fifth-field watershed crossed that are assumed to apply to the actual streams that would be crossed in each of the watersheds.

TABLE 3.5.3-12

Channel Conditions for Streams Sampled during the Aquatic Habitat Inventory (ODFW 2014c) in Four Watersheds within the SONCC ESU that would be Crossed by Pipeline Project

		Average Values for Stream Reaches Sampled in Watershed a/			
Subbasin and Fifth-Field Watersheds	**Number of Stream Reaches Surveyed a/**	**W = Bankfull Width (meters)**	**D = Bankfull Channel Depth (meters)**	**S = Channel Gradient (percent slope)**	**Percent Sand, Silt, Organics in Substrate**
Upper Rogue Subbasin					
Trail Creek	20	7.97	0.70	6.95	19.70
Shady Cove-Rogue River	9	11.81	0.74	5.37	11.89
Big Butte Creek	41	8.70	0.57	3.88	25.22
Little Butte Creek	56	9.11	0.58	5.37	30.36

a/ Stream reach-specific values are provided in appendix Y.

Estimates of Bankfull Flows. Sediment transport in streams depends, in part, on stream channel characteristics. Stream-specific values that were averaged in table 3.5.3-12 were used to determine stream discharged rate (Q) and water velocity (V_A). Manning's Formula (Limerinos 1970; Arcement and Schneider 1989) was used to estimate Q, the stream discharge rate (cubic meters per second):

$$Q = A\ (k/n)\ (R^{2/½}(S^{1/2})$$

with estimates of A, the cross-sectional area of a stream (square meters); R, the hydraulic radius (meters, where R = A/P, and P is the wetted perimeter in meters); S, the slope of channel (channel gradient); the constant *k* equals 1.486 if English units are used or 1 with metric units; and n, Manning's roughness coefficient. Stream-specific Aquatic Habitat Inventory data (see appendix Y) were used to estimate the stream channel cross-section shape and cross-section area. If the predominant depth was greater than half the bankfull width, the cross-section channel shape was assumed to be a V. If the bankfull depth was less than half the bankfull width, the cross-section channel shape was assumed to be a trapezoid with each bank as a 1:1 slope, dependent on predominant depth (bottom = W – 2 D). If the bankfull depth was equal or greater than half the bankfull width, the cross-section channel shape was assumed to be a V. Manning's n was estimated from various sources (Chow 1959; Limerinos 1970; Arcement and Schneider 1989) and ranged from n = 0.060 for floodplain channels with light brush and trees in summer, to n = 0.050 for channels with pools, shoals and stones, to n = 0.045 for mountain streams with bottom gravels, cobbles, and boulders and no vegetation in the channel (Chow 1959).

Estimates of Q derived with Manning's Formula are assumed to be measures of the carrying capacity (bankfull flow) of a particular channel section (Arcement and Schneider 1989). Carrying capacity of a channel section is assumed to occur during periods of high flow, generally during winter months in the project area. Stream flow rate or discharge rate, Q, is related to cross-sectional area (A) and average streamflow velocity (V_A):

$$Q = A \cdot V_A, \text{ alternatively } V_A = Q / A$$

Estimates of variables used to derive Q and V_A are provided in table 3.5.3-13, averaged by watershed.

TABLE 3.5.3-13

Estimates Used to Derive Bankfull Flow and Bankfull Velocity in Four Watersheds within the SONCC ESU that would be Crossed by Pipeline Project

	Average Estimates for Streams Sampled in Watershed a/				
Subbasin and Fifth-Field Watersheds	**A = Channel Cross Sectional Area (meter^2)**	**P = Wetted Perimeter (meters)**	**R = Hydraulic Radius (meters)**	**Q = Bankfull Flow (meter^3/sec)**	**V_A = Bankfull Velocity (meter/sec)**
Upper Rogue Subbasin					
Trail Creek	5.40	8.54	0.59	19.10	3.79
Shady Cove-Rogue River	9.65	12.43	0.65	31.06	3.24
Big Butte Creek	4.74	9.17	0.48	11.01	2.45
Little Butte Creek	5.68	9.58	0.50	15.87	2.86

a/ Stream-specific estimates are provided in appendix Y.

Seasonal Discharge. Pipeline construction across waterbodies would occur during ODFW (2008) in-stream construction windows (see the section "Timing to Life History Functions" above). Hydrographs of monthly discharges of waterbodies within the Upper Rogue Subbasin to be crossed by the Pipeline (see figure 3.5.3-5) show peak seasonal flows during winter months, December through February. Lowest flows occur during summer months, coinciding with the ODFW construction windows. Assuming that high winter stream flows correspond to the bankfull carrying capacities of channel sections (Arcement and Schneider 1989), in-stream flows during the ODFW construction window would be some fraction of the winter flows. Those fractions are included in table 3.5.3-14 with the mid-point which is used to adjust bankfull flows and velocities to low flows and velocities for each of the sampled reaches in the ODFW Aquatic Habitat Inventory data (see appendix Y).

TABLE 3.5.3-14

Recorded High Flows During Winter and Average Low Flows During the ODFW In-stream Construction Window in Hydrographic Data within the Upper Rogue Subbasin Crossed by the Pipeline Project

Hydrograph	High Flow (cfs) (Month)	In-stream Construction Window	Average Low Flows (cfs) During Window	Percent of High Flow During Window	Percent Mid-Point
Big Butte Creek	372 (Jan)	Jun 15- Sep 15	62.1	16.7	9.65
Elk Creek	537 (Jan)	Jun 15- Sep 15	13.7	2.6	

The 10-year average of low water stream flows in the Upper Rogue River subbasin during the ODFW in-stream construction window is assumed to be 9.65 percent of high winter flows (see table 3.5.3-15), based on discharge data for Big Butte Creek and Elk Creek during December (see figure 3.5.3-5). Stream depths for all waterbodies within the Upper Rogue River subbasin were reduced by the same proportion through iterations that reduced bankfull flows to approximately 9.7 percent in all streams in the Aquatic Habitat Inventory samples. Reduced stream depths generate reduced values of A, P, and R in Manning's Formula. Stream-specific estimates of Q and V_A during low water flow conditions were likewise derived and are provided in table 3.5.3-15, averaged by watershed. Reduced stream depths generated reduced values of A, P, and R in Manning's Formula.

TABLE 3.5.3-15

Estimates Used to Derive Low Water Flows and Velocities During In-stream Construction in Four Watersheds within the SONCC ESU that would be Crossed by Pipeline Project

Subbasin and Fifth-Field Watersheds	Average Estimates for Streams Sampled in Watershed a/				
	A = Channel Cross Sectional Area ($meter^2$)	P = Wetted Perimeter (meters)	R = Hydraulic Radius (meters)	Q = Low Water Flow ($meter^3$/sec)	V_A = Low Water Velocity (meter/sec)
Upper Rogue Subbasin					
Trail Creek	1.23	7.05	0.16	1.84	1.63
Shady Cove-Rogue River	2.25	10.84	0.18	3.00	1.36
Big Butte Creek	1.10	7.96	0.13	1.06	1.05
Little Butte Creek	1.32	8.35	0.14	1.53	1.20

a/ Stream-specific values are provided in appendix Y.

Background Turbidity and Suspended Sediment. Turbidity, generally reported in NTUs, is a measure of the lack of transparency (cloudiness) of water caused by suspended or dissolved substances that cause light to be scattered and adsorbed. Turbidity is often measured on-site using a turbidity meter that measures the scattering of light in a water sample relative to a known range of turbidity standards. Turbidity is directly related to the concentration of sediments suspended in water, but the relationship between turbidity and suspended sediment is complicated by sediment particle size, particle composition, and water color (ODEQ 2010).

Ambient turbidity was not addressed by GeoEngineers (2017f). Turbidity (NTU) has been evaluated by ODEQ (2013) and retrieved from Laboratory Analytical Storage and Retrieval (LASAR) Web Application in 2013 before ODEQ discontinued support of the site (ODEQ 2017), making the data unavailable. Turbidity within individual streams may be highly variable, but during the period coinciding with ODFW (2008) in-stream construction windows, reported turbidity was minimal and of low variability in streams for which data exists (see table 3.5.3-16).

The majority of ODEQ LASAR data were turbidity measurements (in NTU) taken in the field. TSS values were occasionally reported but mostly without measuring the corresponding turbidity. Relationships between turbidity and suspended solid concentrations are best if determined on a stream-by-stream basis (Downing 2008). However, because stream-specific data for turbidity and TSS were not available, four available literature-generated models were used to supply a reasonable range of the possible relationships. Relationships are reported for streams in Alaska (Lloyd 1987; Lloyd et al. 1987) and streams in the Puget Lowlands (Packman et al. 1999); the models are non-linear. At low turbidity levels (see table 3.5.3-16), conversions of NTUs to TSS are relatively consistent among the models. Based on these conversions, an overall background level of 2 mg/l is assumed for TSS concentrations for all streams crossed by the Pipeline during the ODFW in-stream construction window. Turbidity data (NTU) from the stations included in the table averaged for July, August, and September yielded an average of 1.3 NTUs. When converted to TSS using the models in the table, the conversion yields an average of 1.9 mg/l as a background level within range of the SONCC coho. In support of that assumption, ODEQ (2010) reported that during dry seasons, background turbidity levels are relatively low and consistent in small streams throughout Oregon. A background TSS concentration of 2 mg/l during summer is also consistent with measurements reported by USGS in Myrtle Creek, Big Butte Creek, and the Rogue River mainstem during summers 1977, 1978, and 1979 (historical data provided by the Forest Service). Results from the ODEQ data analysis and other sources reported above support using 2 mg/l as ambient TSS levels during the in-stream crossing period including all or portions of July, August, and September.

TABLE 3.5.3-16

Turbidity (NTU) Records Measured by ODEQ during Periods of ODFW In-stream Construction Windows (July to September) in Waterbodies Proximate to the Pipeline Project in the Upper Rogue Subbasin and Conversion to TSS by Available Models

Waterbody	Number of Records	Period of Record	Mean Turbidity (NTU) (Maximum) (Minimum)	Model Conversion to TSS (mg/l) a/			
				Model 1 Mean TSS (Maximum) (Minimum)	Model 2 Mean TSS (Maximum) (Minimum)	Model 3 Mean TSS (Maximum) (Minimum)	Model 4 Mean TSS (Maximum) (Minimum)
Trail Creek	6	1998-2000	1.8 (2) (1)	5.3 (5.8) (2.6)	2.1 (2.3) (1.1)	1.1 (1.3) (0.5)	2.6 (2.9) (1.2)
West Fork Trail Creek	7	1998-2002	3.0 (5) (0.9)	9.6 (17.0) (2.3)	3.5 (5.9) (1.0)	2.3 (4.2) (0.4)	5.2 (9.7) (1.0)
South Fork Little Butte Creek	11	1998-2000	2.0 (4) (1)	5.9 (13.1) (2.6)	2.3 (4.7) (1.1)	1.3 (3.2) (0.5)	3.0 (7.2) (1.2)
South Fork Little Butte Creek	6	2001	0.9 (1) (0.7)	2.3 (2.6) (1.7)	1.0 (1.1) (0.7)	0.5 (0.5) (0.3)	1.0 (1.2) (0.7)

a/ Models used to convert Turbidity (NTU) to Suspended Solids Concentration (SSC) or Total Suspended Solids (TSS) in waterbodies crossed or proximate to the Pipeline Project. Turbidity information source: ODEQ (2013) included data collected prior to 2013.
Model 1 (Lloyd 1987; Lloyd et al. 1987) applicable to waters throughout Alaska: $T = 0.44\ (SSC)^{0.858}$
Model 2 (Lloyd 1987; Lloyd et al. 1987) applicable to interior Alaskan streams: $T = 1.103\ (SSC)^{0.968}$
Model 3 (Packman et al. 1999) Rutherford Creek, King County, Washington: $\ln(TSS) = 1.32 \ln(NTU) - 0.68$
Model 4 (Packman et al. 1999) nine streams sampled in the Puget Lowlands, Washington: $\ln(TSS) = 1.32 \ln(NTU) + 0.15$

NTU – nephelometric turbidity unit

Particle Transport. Sediment particles would be transported distances downstream (L, in meters) based on 1) the particle size and settling velocity (V_S, - centimeters per second – in water at 20°C, see for example the Wentworth Grain Size Chart, USGS 2003), 2) the average streamflow velocity– (V_A - meters per second), and 3) the average depth of flow (D, meters) downstream, using the following "velocity-distance-time" equation:

$$L = V_A\ (D / V_S)$$

Estimates of transport distances (L, meters) for various sediment particles ranging in sizes from clay to coarse gravel are provided, as examples, in table 3.5.3-17 for three waterbodies in the Pipeline Project vicinity for which data are available. Particle sizes deleterious to salmonids (250 µm or less in the models of Newcombe and Jensen 1996, above) could settle out of suspension less than 1 meter (0.2 feet) downstream (e.g., medium sand in low flows for Tributary to Catching Creek). Alternatively, particles could remain suspended for 4.7 km (2.9 miles) or more (very fine silt in Willis Creek).

TABLE 3.5.3-17

Estimated Downstream Transport Distances for Particles (ranging from Very Fine Silt to Coarse Gravel) in Three Streams (as examples)

Particle Description	Particle Diameter a/	Settling Velocity (V_S)	Estimated Particle Transport Distance (L) Downstream b/		
			Tributary to Catching Creek	Steele Creek	Willis Creek
Coarse Gravel	1.60 cm	90 cm/s	0 m	0 m	0 m
Very Coarse Sand	0.1 cm	15 cm/s	0 m	0 m	0 m
Coarse Sand	0.05 cm	8 cm/s	0 m	0 m	1 m
Medium Sand	0.025 cm	3 cm/s	0 m	0 m	2 m
Fine Sand	0.0125 cm	1.25 cm/s	0 m	1 m	5 m
Very Fine Sand	0.0062 cm	0.329 cm/s	1 m	4 m	20 m
Coarse Silt	0.0031 cm	0.085 cm/s	3 m	16 m	78 m
Medium Silt	0.0016 cm	0.023 cm/s	9 m	59 m	289 m
Very Fine Silt-Clay	0.0004 cm	0.0014 cm/s	153 m	977 m	4,742 m

a/ Note that 0.025 cm = 250 µm

b/ Parameter values used to estimate L:
Trib. Catching Creek: V_A =0.27 m/s; D = 0.01 m.
Steele Creek: V_A = 0.53 m/s; D = 0.03 m.
Willis Creek: V_A = 0.66 m/s; D = 0.1 m.

Sediment Generated During Pipeline Construction. Modeled concentrations of TSS produced in waterbodies during wet open-cut pipeline construction were developed from empirical data collected during construction across 15 to 19 streams in North America (Reid et al. 2004). Models were developed to predict mean TSS concentrations immediately downstream (approximately 50 meters) of pipeline construction sites. Models included TSS generated by all construction activities and by trenching, pipe lowering, and backfilling. The models predicting mean TSS generated by all activities (including trenching, pipe lowering, and backfilling) had the highest correlation coefficients (Reid et al. 2004). The model predicting mean TSS (**C_{av}**) at about 50 meters downstream by all activities associated with wet open-cut pipeline construction is:

$$C_{av} = 1.5 \text{ x } 10^6 \; U^{1.09} \, d_{50}^{0.95} \, P_f^{0.35} \, q^{-1}$$

where U = mean flow velocity (m per second) at the crossing location during the construction period, equivalent to V_A derived using Manning's Formula (table 3.5.3-14 and appendix Y); d_{50} = the median sediment size (m) of the excavated material by weight, P_f = percentage of fines (silt and clay) in the excavated material (%) and is assumed to equal the percent of silt and organics in surface substrates for all streams within a given fifth-field watershed (estimated as 2/3 of the Percent Sand, Silt, Organics in Substrate tabulated in table 3.5.3-12); q = the width adjusted stream flow rate where $q = Q/B$, (m^2 per second) with B = the watercourse width (m) adjusted for a particular flow rate and Q = stream flow rate (m^3 per second) derived using Manning's Formula (values for Q are in table 3.5.3-15 and appendix Y). Values for d_{50} in these analyses were derived by regressing values of d_{50} and P_f provided in Table 2 of Reid et al. (2004); the relationship of d_{50} to P_f from that study is $d_{50} = 38.12 \text{ e}^{-0.0963\,Pf}$ (r^2 = 0.636, P<0.001).

In these simulations, Q is related to B through Manning's Formula and as B increases numerically, Q also increases but at a faster numerical rate (as a power function). If all other model parameters are held constant in the Reid et al. (2004) model, increased width adjusted stream flow rate, q (due to high flow, Q, and proportionally smaller watercourse widths, B) would decrease the TSS concentration (C_{av}) because q is factored as q^{-1} in the equation. Conversely, lower q values would generate higher C_{av} with all other parameters in the equation held constant. Stream reach-specific estimates of U, d_{50}, P_f, q^{-1}, and C_{av} during low water flow conditions are provided in appendix Y and averaged by watershed in table 3.5.3-18.

TABLE 3.5.3-18

Estimates Used to Predict TSS Concentrations at 50 meters Downstream from Wet Open-Cut Pipeline Construction in Four Watersheds within the SONCC ESU that Would Be Crossed by the Pipeline Project

	Average Estimates for Stream Reaches Sampled in Watershed a/					
Subbasin and Fifth-Field Watersheds	***U*** **Low Water Velocity (m/sec)**	**d_{50} Median Sediment Size (m)**	**P_f Percent Fines (Silt, Clay)**	***q*** **Width Adjusted Stream Flow (m^2/sec)**	***B*** **Watercourse Width (m)**	**C_{av} Predicted TSS Concentration at 50 meters (mg/l)**
Upper Rogue Subbasin						
Trail Creek	1.63	0.034	13.13	0.27	6.91	803
Shady Cove-Rogue River	1.36	0.236	7.93	0.25	10.69	712
Big Butte Creek	1.05	0.027	16.81	0.16	7.85	1,111
Little Butte Creek	1.21	0.005	20.24	0.17	8.24	1,197

a/ Stream Reach-specific values are provided in appendix Y.

In addition to developing predictive models of TSS concentrations generated by wet-open cut pipeline construction, Reid et al. (2004) measured TSS downstream from 12 flumed pipeline crossings and 23 dam-and-pump crossings (dry open-cut or isolated pipeline construction crossings) with comparisons to 11 wet open-cut construction crossings. By accounting for flow, background TSS concentrations, sampling distance downstream, and duration of construction, Reid et al. (2004) determined that mean TSS concentrations generated during dry open-cut construction by fluming were 3.7 percent of the wet open-cut concentrations and were 0.85 percent of the wet open-cut concentrations for dam-and-pump construction. These relationships were used in table 3.5.3-19 to adjust average TSS concentrations estimated at 50 meters downstream from wet open-cut pipeline crossings to average TSS concentrations at flumed pipeline crossings and dam-and-pump pipeline crossings.

Estimated Downstream Concentration of Suspended Sediments. Ritter (1984) provided a variant of the "velocity-distance-time" equation, above to estimate concentrations of suspended sediments (C_X, as mg/l) some distance (x) downstream from a pipeline trench being constructed across a waterbody. Ritter's model for downstream sediment transport distance during construction across minor streams, with complete mixing of sediment particles, estimates the concentration downstream C_X by:

$$C_X = C_O\, e^{-(vs / d)\,(x / u)}$$

where C_O (mg/L) is the initial concentration of suspended solids in the water column at the trenching site, vs = the settling velocity (m/second) of sediment particles, d = stream depth (m), and u = stream current velocity (m/second).

The formula for estimating the concentration downstream (Ritter 1984) is used to estimate the distance downstream for TSS concentrations at 50 meters (C_O) to equal assumed ambient concentrations (C_X = 2 mg/l). The estimate is calculated by solving for x (distance) in the equation with appropriate transformations and inclusion of only the estimated clay fraction as TSS concentration since the silt fraction would have settled out of suspension:

$$x = (l–(C_X) - \ln(C_O)) + (d / vs)\ u$$

where x = distance (m) downstream, C_O = the initial concentration (mg/l) of suspended solids in the water column at the trenching site, vs = the settling velocity (m/second) of the clay fraction, d = stream depth (m), u = stream current velocity (m/second), and x = distance (m) downstream. The distances x for TSS generated by wet open-cut construction techniques to attenuate to ambient TSS (C_X) is provided in table 3.5.3-19.

TABLE 3.5.3-19

Estimates of Average TSS Concentrations Generated during In-stream Construction and Estimated Downstream Distance from Wet Open-Cut Construction to Attenuate to Ambient TSS in Four Watersheds within the SONCC ESU that Would Be Crossed by the Pipeline Project

	Average Estimates for Stream Reaches Sampled in Watershed a/			
Subbasin and Fifth-Field Watersheds	**Wet Open–Cut TSS (mg/l) at 50 m**	**Fluming TSS (mg/l) at 50 m**	**Dam & Pump TSS (mg/l) at 50 m**	**Distance (m) for TSS (Clay Fraction) to Equal Ambient (= 2 mg/l)**
Upper Rogue Subbasin				
Trail Creek	804	30	7	18,591
Shady Cove-Rogue River	712	27	6	16,534
Big Butte Creek	1,112	41	9	10,563
Little Butte Creek	1,198	45	10	11,439

a/ Stream-specific values are provided in appendix Y

Inverse relationships between TSS concentrations produced at 50 meters from in-stream construction and TSS concentrations at variable distances downstream were evaluated for each of the three pipeline crossing techniques by nonlinear regressions of distance downstream (from 1 to 1000 m) and total TSS concentrations at distance x, solving for x in the above equation [$x = (l–(C_X) - \ln(C_O)) + (d / vs)\ u$]. Best fit regressions were selected (exponential vs. logarithmic) to model the inverse relationships between distance and TSS concentration for data averaged in each watershed. Those regression equations provided in table 3.5.3-20 define the nonlinear relationships between y = concentration (mg/l) and x = downstream distance (m).

TABLE 3.5.3-20

Nonlinear Regression Equations (with Coefficients of Determination, r^2) for Estimating TSS Concentrations (y, mg/l) at Distances Downstream (x, m) during In-stream Construction in Four Watersheds within the SONCC ESU to Be Crossed by the Pipeline Project

Subbasin and Fifth-Field Watersheds	**Wet Open–Cut Regression TSS = y Distance (m) = x**	**Fluming Regression TSS = y Distance (m) = x**	**Dam & Pump Regression TSS = y Distance (m) = x**
Upper Rogue Subbasin			
Trail Creek	$y = 531.19\ e^{-0.0004x}$ $r^2 = 0.994$	$y = 19.77\ e^{-0.0004x}$ $r^2 = 0.994$	$y = 4.54\ e^{-0.0004x}$ $r^2 = 0.994$
Shady Cove-Rogue River	$y = 467.58\ e^{-0.0005x}$ $r^2 = 0.988$	$y = 17.40\ e^{-0.0005x}$ $r^2 = 0.988$	$y = 3.99\ e^{-0.0005x}$ $r^2 = 0.988$
Big Butte Creek	$y = 692.19\ e^{-0.0008x}$ $r^2 = 0.947$	$y = 25.76\ e^{-0.0008x}$ $r^2 = 0.947$	$y = 5.90\ e^{-0.0008x}$ $r^2 = 0.947$
Little Butte Creek	$y = 742.68\ e^{-0.0007x}$ $r^2 = 0.958$	$y = 27.64\ e^{-0.0007x}$ $r^2 = 0.958$	$y = 6.33\ e^{-0.0007x}$ $r^2 = 0.958$

Suspended Sediment Downstream Effects. Newcombe and Jensen (1996) developed six different models assessing effects of TSS on various fish and habitat groupings. As noted above, the model addressing effects on both adult and juvenile stages of salmonids (Model 1) provides the best overall assessment of general level of severity of effects for juvenile and adult coho salmon in project area streams at the time of in-stream construction. Input for the model includes TSS concentration (mg/l) and duration (hours) of exposure to the suspended sediments and has the form:

$$z = a + b (\log_e x) + c (\log_e y)$$

where z = SEV score, x = duration of exposure in hours, and y = concentration of suspended sediment in mg/l. Constants a, b, and c were empirically derived for Model 1, used here, and other models (see Table 3, in Newcombe and Jensen 1996). If duration of exposure is known, and z (SEV) is set as a defined value, TSS concentration for that defined SEV score can be computed as:

$$y = e^{((z – a) – b (\text{loge } x)) / c} \text{ or } y = \exp (((z – a) – (b (\log_e x))) / c$$

In any of the Newcombe and Jensen models, there is a nearly consistent range for the whole number z, varying from z – 0.5 to z + 0.49. For example, if SEV = 3, the range for that score in the exponential equation above would be between 2.50 and 3.49; for SEV = 5, the range is 4.5 to 5.49, and so on. For any given duration of exposure (x), the TSS concentration (y) is minimized using (z – 0.5) in the solution. Using the minimum TSS concentration for any given SEV score maximizes the predicted downstream distances for that concentration when solving the regression equations in table 3.5.3-20 for each of the three waterbody crossing methods in each of the four watersheds.

Duration of Exposure. Following recommendations by NMFS (2017j), personnel with pipeline contractor EnSite USA were asked to provide typical durations, based on their experience, for in-stream time requirements for placing and removing isolation structures for streams in different width categories. High pulses of sediment suspended during dry open-cut procedures are generated during installation and removal of isolation structures prior to and after fluming or dam-and-pump installation, trenching, pipe installation, and trench backfilling. EnSite provided the following durations of typical sediment pulses for four stream width classes during installation of stream-crossing structures: for widths ≤10 feet, 2 hours; widths >10 feet to ≤25 feet, 4 hours; >25 feet to ≤50 feet, 5 hours; and >50 feet to ≤100 feet, 6 hours. EnSite also provided the following durations of sediment pulses for the same four width classes during removal of dry open-cut crossing structures: for widths ≤10 feet, 2 hours; widths >10 feet to ≤25 feet, 3 hours; >25 feet to ≤50 feet, 4 hours; and > 50 feet to ≤100 feet, 5 hours. Numbers of streams in range of SONCC coho and streams with assumed coho presence and corresponding critical habitat within those four width categories that would be crossed by the Pipeline in each watershed are provided in table 3.5.3-21 using the duration of structure installation. In general, there are very few streams with widths >25 feet.

TABLE 3.5.3-21

Numbers of Streams in Range of SONCC Coho within Four Width Classes that Would Be Crossed by Dry Open-Cuts (Fluming and Dam-and-Pump) and Estimated Durations of Sediment Pulses for In-stream Sediment Generating Actions

Subbasin and Fifth-Field Watersheds	Total Number of Streams Crossed	Total Streams Crossed with Coho and Critical Habitat a/	Number by Width Class and In-stream Duration b/			
			≤10 ft 2 hours	>10 to ≤25 ft 4 hours	>25 to ≤50 ft 5 hours	>50 ft 6 hours
Upper Rogue Subbasin						
Trail Creek	6	3	4	2	0	0
Shady Cove-Rogue River	11	2	9	1	0	0
Big Butte Creek	9	2	6	1	1	0
Little Butte Creek	46	4	30	11	5	0

a/ Includes assumed presence from table 3.5.3-3.
b/ Durations for structure installation by width class provided by personnel with pipeline contractor EnSite USA.

SEV Scores Downstream. Durations for in-stream sediment generating actions (i.e., in-stream sediment plume duration) provided by EnSite USA from table 3.5.3-21 are used in table 3.5.3-22 with minimum TSS concentrations for specific SEV scores ranging from minor behavioral effects (SEV = 1, alarm reaction) to extreme sublethal effects (SEV = 8, major physiological stress) to estimate the maximum downstream distances at which those SEVs would occur to SONCC coho by in-stream construction across streams in the four watersheds.

Failures of isolation structures to exclude streamflow during fluming or dam-and-pump would result in suspended sediment entrained downstream, assumed to be equal to TSS levels generated during wet open-cut in table 3.5.3-22. Scenarios of exposures as long as six hours could occur while work crews repair the failed isolation structures. Six-hour exposure would cause SEV = 7 (moderate habitat degradation, impaired homing) for all stream widths but would not cause major physiological stress (SEV = 8) to SONCC coho. Longer exposures could be required if dry open-cut construction (flume or dam- and-pump) is abandoned, and the waterbody crossing is completed using wet open-cut construction.

Values of 0, in columns associated with specific SEV scores and TSS concentrations in table 3.5.3-22, indicate that there are no distances downstream from construction by wet open-cut or dry open-cut (flume or damp-and-pump) that the specified TSS concentration and exposure duration during a particular crossing method would generate the SEV score for that column in that watershed. For example, there is no distance downstream for construction during fluming in the Trail Creek watershed at which a SEV score = 5 if the TSS value is 59.4 mg/l and the exposure duration is 2 hours.

TABLE 3.5.3-22

Maximum Distances Downstream to Attain SEV Scores 1 to 8 with TSS Concentrations and Durations due to Wet Open-Cut, Flumed, and Dam-and-Pump Crossing Procedures in Each Watershed within the SONCC Coho ESU to be Crossed by the Pipeline Project

Construction Method Stream Widths	Duration a/	Concentration	SEV=1	SEV=2	SEV=3	SEV=4	SEV=5	SEV=6	SEV=7	SEV=8
Wet Open Cut										
All Stream Widths	**6 hours**	**TSS (mg/l) =**	**0.11**	**0.41**	**1.60**	**6.21**	**24.1**	**93.2**	**361**	**1,399**
Watersheds:			**Maximum Distance (m) to Equal SEV Level with Duration and Concentration b/**							
Trail Creek			21,279	17,893	14,507	11,122	7,736	4,351	965	0
Shady Cove-Rogue River			16,768	14,060	11,351	8,643	5,934	3,225	517	0
Big Butte Creek			10,970	9,278	7,585	5,892	4,199	2,506	813	0
Little Butte Creek			12,638	10,704	8,769	6,834	4,900	2,965	1,030	0
Fluming										
Widths ≤10 ft =	**2 hours**	**TSS (mg/l) =**	**0.26**	**1.02**	**3.95**	**15.3**	**59.4**	**230**	**9,520**	**12,906**
Watersheds:			**Maximum Distance (m) to Equal SEV Level with Duration and Concentration b/**							
Trail Creek			10,794	7,409	4,023	637	0	0	0	0
Shady Cove-Rogue River			8,380	5,672	2,958	250	0	0	0	0
Big Butte Creek			5,728	4,035	2,342	649	0	0	0	0
Little Butte Creek			6,647	4,712	2,778	843	0	0	0	0
Widths >10 ft to ≤25 ft =	**4 hours**	**TSS (mg/l) =**	**0.15**	**0.58**	**2.24**	**8.67**	**33.6**	**130**	**504**	**1,952**
Watersheds:			**Maximum Distance (m) to Equal SEV Level with Duration and Concentration b/**							
Trail Creek			12,218	8,833	5,447	2,061	0	0	0	0
Shady Cove-Rogue River			9,520	6,811	4,102	1,394	0	0	0	0
Big Butte Creek			6,440	4,747	3,054	1,362	0	0	0	0
Little Butte Creek			7,461	5,526	3,591	1,657	0	0	0	0
Widths >25 ft to ≤50 ft =	**5 hours**	**TSS (mg/l) =**	**0.12**	**0.48**	**1.86**	**7.21**	**28**	**108**	**419**	**1,625**
Watersheds:			**Maximum Distance (m) to Equal SEV Level with Duration and Concentration b/**							
Trail Creek			12,677	9,291	5,905	2,520	0	0	0	0
Shady Cove-Rogue River			9,886	7,178	4,469	1,761	0	0	0	0
Big Butte Creek			6,669	4,976	3,284	1,591	0	0	0	0
Little Butte Creek			7,723	5,788	3,853	1,919	0	0	0	0
Dam-and-Pump										
Widths ≤10 ft =	**2 hours**	**TSS (mg/l) =**	**0.26**	**1.02**	**3.95**	**15.3**	**59.4**	**230**	**9520**	**12,906**
Watersheds:			**Maximum Distance (m) to Equal SEV Level with Duration and Concentration b/**							
Trail Creek			7,118	3,733	347	0	0	0	0	0
Shady Cove-Rogue River			5,433	2,724	16	0	0	0	0	0
Big Butte Creek			3,886	2,193	500	0	0	0	0	0
Little Butte Creek			4,542	2,607	672	0	0	0	0	0
Widths >10 ft to ≤25 ft =	**4 hours**	**TSS (mg/l) =**	**0.15**	**0.58**	**2.24**	**8.67**	**33.6**	**130**	**504**	**1,952**
Watersheds:			**Maximum Distance (m) to Equal SEV Level with Duration and Concentration b/**							
Trail Creek			8,542	5,157	1,771	0	0	0	0	0
Shady Cove-Rogue River			6,572	3,863	1,155	0	0	0	0	0
Big Butte Creek			4,598	2,905	1,212	0	0	0	0	0
Little Butte Creek			5,355	3,421	1,486	0	0	0	0	0
Widths >25 ft to ≤50 ft =	**5 hours**	**TSS (mg/l) =**	**0.12**	**0.48**	**1.86**	**7.21**	**28.0**	**108**	**419**	**1,625**
Watersheds:			**Maximum Distance (m) to Equal SEV Level with Duration and Concentration b/**							
Trail Creek			9,001	5,615	2,229	0	0	0	0	0
Shady Cove-Rogue River			6,939	4,230	1,522	0	0	0	0	0
Big Butte Creek			4,827	3,134	1,441	0	0	0	0	0
Little Butte Creek			5,617	3,683	1,748	0	0	0	0	0

a/ Durations for wet open-cut indicate time to repair isolation structures after failure. Durations for dry open-cut from table 3.5.3-21.

b/ Maximum downstream distances from solving SEV equation ($Y = e^{((z - a) - b\,(\log_e x))/c}$) for concentration (Y) by minimizing SEV scores (Z -0.5) and using durations (hours) from table 3.5.3-21. Concentrations derived from appropriate equations, table 3.5.3-20.

The modeling results provided in table 3.5.3-22 reveal the maximum downstream distances that TSS generated by each of the crossing methods would attenuate to the concentrations shown (rows labeled TSS (mg/L) with specific durations based on stream width (groupings labeled with width category and hours) that would yield a specific SEV score (columns SEV=1 to SEV=8) for fluming or dam-and-pump crossing methods. Using estimates for fluming in streams <10 feet wide within the Little Butte Creek watershed as an example, for the range from distance = 0 (actually 50 meters downstream from the trench as applied in the Reid et al. (2004) model for average TSS generated by all activities) to distance = 843 meters, SEV =4 with TSS concentration = 15.3 mg/l and duration = 2 hours. Other estimates include:

- From downstream distance = 843 meters to distance = 2,778 meters, SEV = 3 with TSS concentration = 3.95 mg/l and duration = 2 hours.
- From downstream distance = 2,778 meters to distance = 4,712 meters, SEV = 2 with TSS concentration = 1.02 mg/l and duration = 2 hours.
- From downstream distance = 4,712 meters to distance = 6,647 meters, SEV = 1 with TSS concentration = 0.26 mg/l and duration = 2 hours.
- Past distance = 6,647 meters downstream, SEV = 0.

Evident from examining table 3.5.3-22, no flumed crossings in any of the four watersheds would yield SEV scores greater than 4 (sublethal effects including short-term reduction in feeding rates and/or short-term reduction in feeding success) for any of the stream crossing width categories. Likewise, no crossings with dam-and-pump procedures applied would cause SEV scores greater than 3 (behavioral effects, specifically avoidance response) for any of the stream crossing width categories. Except for possible failures of isolation structures that would cause TSS concentrations similar to wet open-cut procedures with exposures as long as 6 hours (discussed above), no in-stream construction would cause minor or major physiological stress (SEV scores 5 to 8, respectively; see Newcombe and Jensen 1996) or cause lethal conditions for juvenile and adult salmon. A failure of crossing isolation structures lasting for 6 hours or more would cause an SEV score of 7 or higher for at least 965 meters downstream from dry open-cut crossings within three streams with critical habitat crossed in the Trail Creek watershed, for at least 517 meters for one stream with critical habitat cross in the Shady Cove-Rogue River watershed, for 813 meters downstream within two streams with critical habitats in the Big Butte Creek watershed, and for 1,030 meters downstream within two streams with critical habitats in the Little Butte Creek watershed. To ensure an SEV score less than 7 (moderate habitat degradation; impact on homing), in-stream work to repair a failed containment structure would likely have to be restricted to less than 4 hours. However, all of these estimates of sediment and distances of effects are based on the average of many parameters within a watershed. Individual stream crossing are thus likely to have some lower or higher values. For example, a range of sediment concentrations at a hypothetical crossing at a specific stream reach is noted in appendix Y for each of the individual reaches as modeled. While the maximum potential severity of effects noted was SEV of 7, which is based on averages of all of the database reaches in that watershed, the estimates at some of the reaches would be higher (e.g., SEV of 8) if the actual stream crossing had similar characteristics to some of the worst-case reach conditions reported in appendix Y. Yet even considering the ranges presented in appendix Y, the severity of effects would remain below lethal or paralethal levels.

Similar analyses were conducted for individual streams to be crossed in each watershed that provide critical habitat and fresh water EFH for SONCC coho salmon. The specific stream value was determined by using the average values for the streams having the same width category and crossing method in the respective watershed. Based on stream width-specific durations of exposure to TSS (table 3.5.3-21) and the minimum TSS concentrations and concomitant maximum distances downstream produced by fluming or dam-and-pump to equate to specific SEV scores (table 3.5.3-22), the greatest risk to SONCC coho would be 1,919 meters downstream during fluming in streams >25 but ≤50 feet wide within the Little Butte Creek watershed (in Salt Creek) and 1,394 meters downstream during fluming streams >10 but ≤25 feet wide within the Shady Cove-Rogue River watershed (in Indian Creek, table 3.5.3-23). At those distances, SEV would be 4, causing a short-term reduction in feeding rates and/or short-term reduction in feeding success for juvenile or adult coho within the distances.

The possibility for known or assumed salmon-bearing streams to be affected by TSS generated during dry open-cutting neighboring streams was also explored at the request of NMFS (2017j). Distances of nearest neighboring streams from each salmon-bearing stream are included in table 3.5.3-23. Nearest-neighbor streams are only considered for effects if they are within the same fifth-field watershed as the targeted stream. Distance for the confluence of a nearest neighbor stream with a coho-bearing stream is assumed to be the same as the distance between the two stream crossing sites, forming an equilateral triangle. For each neighboring stream, downstream distances for TSS concentrations that produced the highest SEV score were computed with the same procedure described and available in table 3.5.3-22. If a nearest neighbor stream had bedrock substrate, a dam-and-pump crossing was assumed; otherwise, a flumed crossing was assumed.

Based on site conditions and crossing characteristics, the likelihood of, or risks to, coho salmon or their habitat actually being affected by sediment severity modeled from the direct crossings or nearest neighbor construction was given a rating from "none" to "high." If the nearest neighbor distance to a salmon-bearing stream exceeded the maximum distance with highest SEV score downstream from the neighbor stream, then "None-Low" of TSS to the salmon-bearing stream produced during construction of the neighboring stream is assumed. In table 3.5.3-23, the nearest neighbor to the Rogue River is 5,248 meters away, which is with the downstream distance of 5,667 meters at which the TSS concentration would cause an SEV score of 2 during construction across that nearest neighbor stream. Consequently, there would be no effects from crossing the nearest neighbor stream to the Rogue River. Risks from downstream TSS by crossing any stream with a bedrock substrate are considered "None-Low" because fine sediment (silt and clay) would not be mobilized in the water column; risks of downstream TSS crossing intermittent streams are considered "None-Low" because those streams would likely be dry during the in-stream construction period (ODFW 2008). Risks from downstream TSS by crossing perennial streams are considered "Moderate-High" because flowing water would be present at the time of construction. In all other cases, construction across nearest neighbors could generate some level of risk for elevated TSS concentrations in the known or assumed salmon-bearing streams crossed in the range of SONCC coho. Even for these, the potential severity of effects would be low because no SEVs would exceed 4 for sediment produced in a coho-bearing stream by crossing a nearest neighbor stream. Additionally, the dilution of sediment concentration from increased flow volume below confluences of the tributary and main stream would result in an even lower SEV level than estimated below the confluence in the main stream.

A similar analysis of sediment effects on EFH streams known to support SONCC coho that are not directly crossed by the Pipeline but have a tributary that would be crossed and which could have an effect on the EFH fish-bearing stream is provided in section 4.2.3.2. However, conducting the analysis required a different methodology than used in the nearest neighbor analysis provided for SONCC coho above.

TABLE 3.5.3-23

Waterbodies with Critical Habitat and Known or Assumed to Support SONCC Coho with Risks of TSS Effects Downstream Generated during Crossing and Risks of TSS Effects Generated by Crossing Nearest Neighbor Waterbodies

Waterbodies Supporting SONCC Coho, Critical Habitat, and EFH								Nearest Neighbor with Risk of Downstream Effects to Coho				
Waterbodies Crossed and Waterbody ID	**Pipeline Milepost (MP)**	**Critical Habitat**	**EFH**	**Proposed Crossing Method**	**OHM Width (feet)**	**Risk of TSS Downstream During Crossing (rationale) a/**	**Maximum Distance (m) Downstream from Crossing with Highest SEV Score b/**	**Crossing Distance (m) from Coho Stream c/**	**Proposed Crossing Method**	**OHM Width (feet)**	**Risk of TSS at Confluence by Crossing Nearest Neighbor (rationale) a/**	**Maximum Distance (m) Downstream from Nearest Neighbor with Highest SEV Score b/**
Upper Rogue (HUC 17100307) Subbasin, Trail Creek (HUC 1710030706) Fifth-Field Watershed, Jackson County												
West Fork Trail Creek (ASP-202)	118.89	Yes	Spawning, Rearing	Dam-and-Pump	24	None-Low (bedrock)	1,771 SEV= 3	145	Fluming	2	None-Low (intermittent)	637 SEV= 4
Canyon Creek (NSP-11)	120.45	Yes	Spawning, Rearing	Dam-and-Pump	4	None-Low (bedrock)	347 SEV= 3	724	Fluming	5	None-Low (intermittent)	4,023 SEV= 3
Trib. to Trail Creek (ASI-206)	121.57	Yes	Spawning, Rearing	Fluming	8	None-Low (intermittent)	637 SEV= 4	1,079	Fluming	5	None-Low (intermittent)	4,023 SEV= 3
Upper Rogue (HUC 17100307) Subbasin, Shady Cove-Rogue River (HUC 1710030707) Fifth-Field Watershed, Jackson County												
Rogue River (ASP-235)	122.65	Yes	Rearing, Migration	HDD	50	None (HDD)	N/A	5,248	Fluming	4	None-Low (distance)	5,667 SEV= 2
Indian Creek (AW-278)	128.61	No	Assumed	Fluming	12	Moderate-High (perennial)	1,394 SEV= 4	113	Dam-and-Pump	15	None-Low (bedrock)	1,155 SEV= 3
Upper Rogue (HUC 17100307) Sub-basin, Big Butte Creek (HUC 1710030704) Fifth field Watershed, Jackson County												
Neil Creek (ASP-252)	132.12	Yes	Spawning, Rearing	Dam-and-Pump	5	None-Low (bedrock)	500 SEV = 3	145	Fluming	2	None-Low (intermittent)	649 SEV = 4
Quartz Creek (ASI-265)	132.75	Yes	Spawning, Rearing	Dam-and-Pump	1	None-Low (bedrock)	500 SEV = 3	32	Dam-and-Pump	1	None-Low (bedrock)	500 SEV = 3
Upper Rogue (HUC 17100307) Sub-basin, Little Butte Creek (HUC 1710030708) Fifth field Watershed, Jackson County												
Salt Creek (ESP-34)	142.57	Yes	Spawning, Rearing	Fluming	40	Moderate-High (perennial)	1,919 SEV = 4	129	Fluming	1	None-Low (intermittent	843 SEV = 4
Trib. to Long Branch Creek (ESI-38)	144.11	No	Assumed	Fluming	1	None-Low (intermittent)	843 SEV = 4	48	Fluming	3	None-Low (intermittent)	843 SEV = 4
NF Little Butte Creek (ESP-66)	145.69	Yes	Spawning, Rearing	Fluming	49	Moderate-High (perennial)	1,919 SEV = 4	193	Fluming	2	None-Low (intermittent)	843 SEV = 4
Trib. to NF Little Butte Ck. (ESI-56)	146.05	No	Assumed	Fluming	17	None-Low (intermittent)	1,657 SEV = 4	531	Fluming	3	None-Low (intermittent)	843 SEV = 4

a/ Risks from downstream TSS by crossing all streams with bedrock substrate are considered None to Low; risks of downstream TSS crossing intermittent streams are considered None to Low; risks from downstream TSS by crossing perennial streams are considered Moderate to High.

b/ Highest SEV scores for each given crossing method and stream width category in specific watershed provided in table 3.5.3-22.

c/ Distance for confluence of nearest neighbor stream with coho stream is assumed to be the same as the distance between the two stream crossing sites, forming an equilateral triangle.

EFH = essential fish habitat; HDD = horizontal directional drill; OHM = ordinary highwater mark; SEV = severity-of-ill effects; TSS = total suspended solids

Summary of Effects of Dry Open-Cut Suspended Sediment

While the modeled results supply a reasonable estimate of likely level of effects to the SONCC coho salmon ESU, the models rely on multiple input parameters (e.g., substrate composition and size distribution of fines, median substrate size [d_{50}], flow and water velocity at each stream) that are specific to fish streams in the watershed but not to specific crossing locations. Therefore, the overall summary assessment of effects considered both literature results from other pipeline crossings and the modeled results by fifth-field watershed in making overall assessments of effects to coho salmon. For both the modeled and literature-based assessments, effects would be mostly short term (mostly less than one to four days) and remain near the crossing location (downstream distance a few hundred feet based on literature, and a few hundred to a few thousand feet based on models).

Modeled estimates of effects of suspended sediment to coho salmon resources from typical pipeline installation across streams would remain low to moderate (most SEV 4 or less) in the short term. These effects to coho salmon would include likely short-term avoidance and short term reduction in feeding. Based on modeled results, effects would be similar among all four fifth-field watersheds. Considering the literature-based average conditions, most effects for coho salmon (SEV mostly 4 to 7) are also expected be short-term behavioral and other sublethal (e.g., reduced feeding rate short and long term, minor to moderate physiological stress, rarely habitat degradation). Based on literature values, if dry crossing methods have sealing failures, it is possible some local long-term effects (up to SEV 8) could occur to coho such as long-term reduction in feeding rate or success. Modeled results suggest lower effects (SEV 7) from failure which could result in effects on homing. The occurrence of this type of effect would be rare due to implementation of proper construction methods, but some system sealing failures are possible, resulting in increased suspended sediment levels and likely short-term adverse effects to fish.

Overall, model results, while approximating regional (watershed) conditions, are based on averages, and site-specific conditions may vary from these averages, affecting site-specific model estimated values. The literature-based values of typical project-wide effects provide similar though slightly more severe effect estimates, suggesting modeled watershed-specific estimated effects are likely reasonable. The result for either estimating method suggests crossing would cause at least some short term adverse effects, primarily avoidance, short term feeding reduction, and likely minor stress. No long-term adverse effect would likely occur to SONCC coho salmon unless some major failure beyond those considered in the models occurred during construction.

Suspended Sediment – HDD

An HDD crossing would be used on the Rogue River at MP 122.7. An HDD involves drilling a pilot hole, then enlarging that hole through successive reaming. High pressure drilling fluids, usually consisting of a slurry made of bentonite clay mixed with water, would be jetted at the drill head to advance the hole. Pipe sections long enough to span the entire crossing would be staged and welded along the construction work area on the opposite side of the waterbody, hydrostatically tested, and then pulled through the drilled hole. The right-of-way between the entry and exit hole of an HDD would generally not need to be cleared or graded, except for the area of the guide wires, and direct impacts on the waterbody, adjacent riparian vegetation, and associated aquatic resources would be avoided through an HDD. An HDD should not result in an increase of suspended sediments into the stream crossed, unless there is an “inadvertent return” or release of drilling mud, as discussed below.

According to GeoEngineers' 2017 Feasibility Analysis for construction using HDD across the Rogue River (see appendix E), the design length of the Rogue River HDD crossing is approximately 3,050 feet. The proposed entry point is located in a relatively flat, lightly wooded area east of Rogue River and west of Old Ferry Road, approximately 650 feet from the east river bank. The exit point and pipe-stringing area are located within uplands approximately 2,100 feet west of the river within a drainage basin that drains to the river south of the crossing. The HDD exit location was extended away from the west river bank to avoid affecting several roads including State Highway 62, which is between the river bank and the exit. The HDD design indicates 56 feet of streambed cover in the river channel over the pipe. Based on the evaluation, an HDD crossing is feasible from geologic, land use, and geotechnical perspectives.

A qualitative hydraulic fracture and drilling fluid surface release analysis to characterize the risk of hydraulic fracture and drilling fluid surface release was conducted. However, a numerical analysis was not conducted because the vast majority of the HDD path is located within bedrock, and the numerical analysis method (cavity expansion theory) generally applies to soil materials rather than hard rock. There is a relatively low risk of drill hole collapse along the portions of the HDD profile that are located within the bedrock, although there is a moderate risk for localized hole instability along the HDD profile, specifically within about 50 to 100 feet of the entry and exit points where the HDD profile passes through alluvial and colluvial soils, and the cover between the HDD profile and the ground surface is relatively thin. As is typical with most HDD installations, the risk of drilling fluid surface release within about 100 feet of the entry and exit points increases (see appendix E). The potential disturbance of riparian vegetation at the Rogue River HDD would be limited to incidental trimming of vegetation using hand tools directly over the pipeline along an approximately five-foot-wide footpath. This minor clearing is required to facilitate the temporary deployment of HDD guidance (telemetry) cables along the ground during construction and to perform a leakage survey after installation and commissioning. This is a relatively small area along the riparian zone of any stream and would have minimal adverse effect on aquatic resources.

Inadvertent Release of Drilling Mud (Inadvertent Return)

The HDD installation method is considered an effective technique for significantly reducing in-stream impacts by eliminating the need for in-stream excavation (Reid and Anderson 1998; Reid et al. 2004). Even with this technique, there is a potential for impact as a result of the HDD process. Drilling requires use of a drilling mud for lubrication of the bit and removal of cuttings. A non-toxic, biodegradable bentonite clay mixture makes up drilling mud. Because the drilling mud is under pressure during drilling, if the bit encounters substrate fractures or channels, it is possible for bentonite to escape from the hole (termed an "inadvertent return"). Bentonite can escape to the surface through fractures in the drilled substrate.

Bentonite by itself is generally considered a non-toxic drilling mud (Breteler et al. 1985; Hartman and Martin 1984; Sprague and Logan 1979), although according to Reid and Anderson (1998), the toxicity of bentonite (sodium montmorillonite) in fresh water ranges from 5,000 to 19,000 ppm (mg/liter) based on 96-hour tests for LC_{50} on rainbow trout. The toxicity classifications based on LC_{50} values ranged from "slightly toxic" (5,000 ppm) to "practically non-toxic" (19,000 ppm) (Reid and Anderson 1998). In other tests, toxicities to lake whitefish and rainbow trout demonstrated threshold concentrations of 16,613 and 49,838 ppm (mg/l), respectively (Reid and Anderson 1998). More recently, toxicity to rainbow trout (LC_{50}, 96-hour) was reported to be

19,000 mg/l (ClearTech 2015). LC_{50} concentrations >10,000 ppm would be considered "practically non-toxic" (Reid and Anderson 1998).

Bentonite, as with any fine particulate material, can interfere with oxygen exchange by the gills of aquatic organisms (EPA 1986). The degree of interference generally increases with water temperature (Horkel and Pearson 1976). Impacts would be localized and would normally be limited to individual fish in the immediate vicinity of the inadvertent return. The majority of highly mobile aquatic organisms, such as fish, would be able to avoid or move away from turbidity spots and plumes (Reid and Anderson 1999). Other less mobile or immobile organisms, such as mussels and other macroinvertebrates, would incur direct mortality. Bentonite can smother macroinvertebrates and adversely affect filter-feeders (Falk and Lawrence 1973 in Hair et al. 2002 and Land 1974 in Cameron et al. 2002). Bentonite can also exacerbate or enhance the effects of toxic compounds to fish and aquatic invertebrates if those compounds are present in aquatic habitats (Hartman and Martin 1984). Similar to other fine-grained particulates, bentonite in flowing water is more likely to remain in suspension longer than in standing water. Consequently, effects to coho salmon by a release of bentonite into a waterbody would ultimately depend on volume of the release, volume of water present, and current.

The effects of an in-stream inadvertent return on spawning habitat, eggs, and juvenile survival depend on the timing of the release. If spawning habitat is nearby, redds could be affected in the vicinity of inadvertent return (Reid and Anderson 1999). While spawning would not occur during the crossing, effects may possibly occur within the immediate future unless high flows flush residual bentonite from the spawning areas. During establishment of the spawning bed, a minor addition of sediment would likely be cleaned out by the female as part of the normal preparation behavior. However, a heavy sediment load dispersing downstream could settle into spawning beds and clog interstitial spaces, reducing the amount of available spawning habitat, which could be a limiting factor in areas of already reduced habitat. When redds are active, eggs could be buried, disrupting the normal exchange of gases and metabolic wastes between the egg and water (Anderson 1996). The impacts of sediment intrusion into the redd on larval survival are more severe during the earlier embryonic stages than following development of the circulatory system of larvae, possibly because of a higher efficiency in oxygen uptake by the older fish (Bash et al. 2001). Clogging of interstitial spaces also reduces cover and food availability for juvenile salmonids (Cordone and Kelley 1961). Benthic organisms, which coho salmon would feed on, could also be affected by burial. However, bentonite is more likely to stay in suspension than settle like common bottom sediment; therefore, in flowing water areas, effects to benthic organisms from burial due to inadvertent return are likely to be low. The location where any inadvertent return may occur is the Rogue River, which would be affected less because of the dilution factor of large volume of water from any spill.

In the event an inadvertent return occurs into the river, drilling fluid would enter the waterway causing short-term, temporary water quality impacts downstream of the Pipeline Project area including sedimentation and turbidity. In the event drilling fluid is inadvertently released into the river, the behavioral avoidance response of SONCC coho is presumed to be triggered within the immediate vicinity of the release, and the fish are expected to return and utilize the affected area shortly after the inadvertent release has been halted. Pacific Connector developed its *Drilling Fluid Contingency Plan for Horizontal Directional Drilling Operations* (see appendix D), which describes how the drilling operations would be conducted and monitored to minimize the potential for inadvertent drilling mud releases. The HDD Contingency Plan also includes procedures for cleanup of drilling mud releases. If significant concentrations are found during monitoring as a result of a release, the following possible corrective measures would be taken:

- Deploy containment structures, if feasible, and remove drilling mud from substrate and streambanks, if possible.
- Increase the drilling fluid viscosity in an attempt at sealing the point at which fluid is leaving the drilled hole. The drilling operation may be suspended for a short period (i.e., overnight) to allow the fractured zone to become sealed with the higher viscosity drilling fluid.
- If increasing the drilling fluid viscosity is ineffective, LCM may be introduced into the hole by incorporating them in the drilling fluid and pumping the material down-hole. The drilling operation may again be suspended for a short period (i.e., overnight) to allow the fractured zone to become sealed with the lost circulation materials.
- Depending on the location of the fractured zone, a steel casing may be installed that is of sufficient size to receive the largest expected down-hole tools for the crossing. This casing installation provides a temporary conduit for drilling fluids to flow while opening the remaining section of the hole to a diameter acceptable for receiving the proposed pipe sections. To alleviate future concerns with the steel casing after the HDD installation is completed, the casing is generally extracted from the hole prior to or just after completing the HDD installation. However, there have been instances when attempts at extracting the steel casing were unsuccessful.
- In the event drilling fluid flow is not regained through the annulus of the drilled hole and a steel casing installation is not utilized, the HDD contractor may elect to install a grout mixture into the drilled hole in an attempt to seal the fractured zone. The down-hole drilling assembly is generally extracted, and the existing hole is re-drilled to the point at which it had previously been drilled prior to having encountered the loss of drilling fluid.
- In addition, a grouting program may be implemented from the surface in the event that the installation of grout into the drilled hole is unsuccessful. This approach is only practical in areas where drilling rigs with vertical drilling capabilities can access the HDD alignment. If a surface grouting program is utilized, the HDD drilling assembly is extracted from down-hole. Multiple holes are then drilled vertically on either side and along the HDD alignment to allow for grout slurry to be pumped into the fracture zone where the drilling fluid had previously been lost from the drilled hole. This process can take several days to complete in order to insert the grout in a grid pattern that covers the full fractured zone, during which time the HDD operation is suspended. Upon completion of the surface grouting program, the HDD operation would resume and the pilot hole would be reestablished through the grouted formation.

In some instances, it may be determined that the existing hole encountered a zone of unsatisfactory soil material, and the hole may have to be abandoned. If the hole is abandoned, it would be filled with cuttings and drilling fluid.

Overall at the site of any inadvertent return, the amount of drilling mud released into a waterbody would be low. The HDD location on the Rogue River has large volumes of water and swift flows, where the drilling mud would be diluted. In the unlikely event of an inadvertent release of drilling mud from an HDD in the Rogue River, there would be minor short-term adverse effects to aquatic resources including coho salmon.

Suspended Sediment – Conventional Boring

A direct bore method would be used at the crossing of the Medford Aqueduct Ditch at MP 133.7. There are different kinds of boring methods, including jack and bore, slick bore, and hammer bore. The type of method to be used at specific locations has not yet been determined by Pacific Connector. During a standard boring operation, pits are excavated on both ends, with spoil from the bore passed into the pit and removed by trackhoe. The walls of the bore pits may have to be supported by trench boxes or metal sheet piling. If groundwater seeps in to the bore or bore pits, a dewatering system would need to be used. Pipe would be welded in the pit, and passed through the bore hole. Bores should not result in increasing suspended sediments into the streams crossed. Although there may be some risks of failure associated with conventional boring (examples include cobble, gravel other substrates incapable of supporting the bore hole, deflection of the bore by undetected buried wood or boulders, and high water tables risking collapse of bore work pits), taking into consideration that the crossing is at an aqueduct that does not contain the listed coho salmon and that active BMPs and monitoring would be used during crossing operations, no adverse effects are expected to occur to SONCC coho from the direct bore even if some boring mishap were to occur.

Movement Blockage

Of the 11 waterbodies with confirmed or assumed presence of SONCC coho salmon, all but one (Rogue River) would be crossed by dry open-cut. Dry open-cut construction is expected to temporarily preclude upstream and downstream movement by adult salmonids and juvenile coho. As discussed above, fish are expected to abandon cover and/or avoid turbidity plumes generated by in-stream construction. In-stream construction would be completed prior to most upstream migrations by SONCC coho.

In addition, as described previously, block nets would be employed at all waterbody crossings in which water is present at the time of construction. Also, procedures to exclude fish from the construction right-of-way, maneuvering fish downstream of the crossing site, isolating and dewatering the construction site, removing fish from within the isolated construction site during dewatering, fish handling, holding and release, and monitoring with documentation would all be implemented.

Reid et al. (2004) reported that 12 flumed crossings averaged 64 hours of in-stream work (with standard error of 14.1 hours) and in-stream work at dam-and-pump crossing averaged 37.8 hours of in-stream work (with standard error of 8.4 hours). Though not specified in the study, isolation barriers are assumed to have been present in the streams for those durations. Based on the data, the assumed range of time required for flumed crossings and dam-and-pump crossings is the mean ± two standard errors reported for each technique by Reid et al. (2004). Consequently, estimated durations for fluming would range from 36 to 92 hours, and for dam-and-pump, the range is from 20 to 56 hours. Flumes would maintain streamflow and fish might move upstream or downstream through the flume. With the dam and pump method, coho would not be able to move upstream or downstream through the work area until the dams have been removed. Flumes and isolation structures (e.g., dams) would be removed as soon as possible following backfilling of the trench. Overall, the presence of temporary physical structures (likely less than one up to about 4 days for flumed and dam-and-pump crossings based on typical conditions reported by Reid et al. 2004) would not cause meaningful delays to adult upstream migrating coho salmon resulting in unsubstantial affects to coho salmon individuals.

Newcombe and Jensen's (1996) SEV scale includes avoidance behavior (SEV = 3), a behavioral effect that changes the activity patterns or alters the kinds of activity usually associated with an undisturbed environment (Muck 2010) and may indicate juvenile and/or adult coho in-stream movements would be affected. Likewise, an SEV score of 3 indicates a "measured change in habitat preference" in models developed by Anderson et al. (1996). SEV scores of 3 and higher due to elevated TSS concentrations are assumed to block or interfere with fish movements during durations of exposure to the suspended sediment downstream (provided in table 3.5.3-21). Downstream distances at which SEV ≥ 3 during fluming or dam-and-pump construction in each fifth-field watershed were provided in table 3.5.3-22.

Entrapment and Fish Salvage

Waterbody crossings using the "dry" crossing methods, may result in some fish being entrapped in streams. For typical crossings, once streamflow is diverted through the flume pipe or pumped drains, but before trenching begins, fish trapped in any water remaining in the work area between the dams would be removed and released (salvaged) following procedures in the *Fish Salvage Plan* (see appendix T). Salvage methods could include seines, and/or dip nets and electrofishing (see Conservation Measures). Seining would be the primary method used to salvage fish but electrofishing methods may be used if all fish cannot be removed from the area potentially dewatered (see appendix T). All methods of capture and holding have risks of stress, injury, or mortality of fish. Fish inadvertently left within the dammed-off construction zone would be captured by either an ODFW biologist or a qualified consultant. Fish removal personnel would be approved by ODFW and NMFS for this listed species. Personnel that would handle and/or remove fish on federal lands would also be approved by the Forest Service or the BLM or be done directly by agency personnel if approved by ODFW. Even with an approved biologist on site, some listed juvenile coho salmon fry are likely to suffer injury or mortality, but with the implementation of project conservation measures this impact would be minor.

There are 70 waterbodies that would be crossed by dry open-cut procedures in the Upper Rogue Subbasin (table 3.5.3-3), including 14 with bedrock streambeds that may necessitate blasting and/or use of mounted impact hammers (discussed above under Acoustic Shock). However, only seven of these are known to support SONCC coho, and three others are assumed to be occupied by coho. The 10 streams (see table 3.5.3-23, excluding the Rogue River) include three in the Trail Creek watershed, one in the Shady Cove-Rogue River, two in the Big Butte Creek watershed, and four in the Little Butte Creek watershed.

Estimates of juvenile coho fry present in at crossing sites in streams were based on all rights-of-way being 95 feet wide at each stream crossing within which coho would be salvaged. Numbers of juvenile coho fry potentially present or assumed to be present in the streams with crossed by dry open-cut (no blasting) are provided in table 3.5.3-24 and do not include numbers within streams with bedrock substrates that were provided in table 3.5.3-11. In the 10 waterbodies known or assumed to be inhabited by SONCC coho, 167 juvenile coho fry would be displaced and or salvaged prior to construction, which does not include the 103 juvenile coho fry that would be salvaged from streams with bedrock prior to blasting (table 3.5.3-11). The estimates in table 3.5.3-24 are based on no fish being herded out of the work area prior to dewatering (see *Fish Salvage Plan*). The actual number that would be salvaged is expected to be much less.

TABLE 3.5.3-24

Worst-Case Estimates of Juvenile Coho Fry Present or Assumed as Present at Streams Crossed by Dry Open-Cut (No Blasting Assumed) and Juvenile Fry Salvaged Prior to Construction of the Pipeline Project within the SONCC ESU

Subbasin and Fifth-Field Watersheds	Dry Open-Cut w/ Juvenile Coho Fry Present, Assumed	Juvenile Fry Present at Each Crossing a/	Total Juvenile Fry Present b/	Juvenile Fry Salvaged at Each Crossing c/	Total Juvenile Fry Salvaged d/
Upper Rogue Subbasin					
Trail Creek	1	17	17	17	17
Shady Cove-Rogue River	1	15	15	15	15
Big Butte Creek	2	17	34	17	34
Little Butte Creek	6	17	101	17	101
TOTAL	**10**		**167**		**167**

a/ Juvenile Fry Present at Each Crossing based on Juveniles per Mile (see table 3.5.2-5) within a stream crossing length of 95 feet (worst case, see text).
b/ Total Juvenile Fry Present (worst case) = number of Juvenile Fry Present at Each Crossing multiplied by number of Dry Open-Cut crossings with Juvenile Coho Fry Present or Assumed.
c/ Juvenile Fry Salvaged at Each Crossing based on Juvenile Fry per Mile (table 3.5.3-5) within a stream crossing length of 95 feet (worst case, see text).
d/ Total Juvenile Fry Salvaged (worst case) = number of Juvenile Fry Salvaged at Each Crossing multiplied by number of Dry Open-Cut crossings with Juvenile Coho Fry Present. The estimate is based on no fish being herded out of the work area prior to dewatering (see *Fish Salvage Plan*). The actual number that would be salvaged is expected to be much less.

Riparian Vegetation Removal and Modification

Vegetated areas adjacent to waterbodies have been classified/defined in different ways depending on the resource and/or management objective being analyzed. Analyses conducted for SONCC coho have considered effects to riparian vegetation present within a one site-potential tree height (SPTH) buffer on either side of a waterbody on both federal and non-federal lands. This analysis area was determined in discussions with NMFS, FWS, and other federal agencies during Interagency Task Force meetings.

Riparian Reserves are areas that are managed to protect habitat for fish species, as well as other riparian-dependent plants and animals on federal lands (BLM and NFS lands). Riparian Reserves include areas that range in size from 1SPTH to 2SPTH buffers on either side of a waterbody, depending on the waterbody type. Analyses to coho salmon here do not consider effects to Riparian Reserves because those effects would be limited to certain federal lands and analyses provided below consider effects on all lands, hence the analysis of effects to Riparian Zones rather than to Riparian Reserves. This analysis considered all intermittent and perennial waterbodies crossed and adjacent to the Pipeline in the range of SONCC coho and also included waterbodies that are not assumed to have coho present.

Aquatic resources could be affected as a result of removal of vegetation and habitat at the waterbody crossing sites as required for construction. Short-term, physical habitat disruption would occur during trenching activities. Long-term degradation of habitats could occur if the stream contours are modified in the area of the crossing; the flow patterns are changed; and if erosion of the bed, banks, or adjacent upland areas introduces sediment into the waterbody. Loss of riparian vegetation along the banks would reduce shade, potentially resulting in minor increases in water temperatures, remove sources of terrestrial food for aquatic organisms, decrease LW and the associated reduction in habitats, and potentially increase slope failures adjacent to waterbodies.

Much of the impact to coldwater anadromous and resident fisheries by past land uses have been alterations of riparian habitats by logging, road building, agriculture, or other developments such as residences and utility corridors. A total of 94.06 acres of vegetation with riparian zones 1SPTH wide (ranging from 159 feet wide for Trail Creek, to 157 feet wide for Shady Cove-Rogue River, 187 feet wide for Big Butte Creek, and 158 feet wide in Little Butte Creek watersheds) associated with waterbodies within range of SONCC coho ESU would be directly affected by all construction-related activities. Less than half of the affected vegetation (41.59 acres) would be non-forested vegetation, but 20.24 acres of LSOG forest and 17.97 acres of mid-seral forest would be removed within riparian zones (see table 3.5.3-25a). As discussed in section 3.5.3.2, Habitat, and presented in table 3.5.3-8, the LW components of most aquatic habitats in watersheds occupied by SONCC coho and crossed by the Pipeline are LW-deficient and below benchmark conditions established by ODFW.

In forested habitats, conifer trees would be replanted within the construction right-of-way and TEWAs outside of the 30-foot-wide maintenance corridor, which would revert to their pre-construction state over time. The 30-foot-wide maintenance corridor centered over the pipeline would be maintained in an herbaceous/shrub state during the life of the Pipeline, assumed to be 50 years (see table 3.5.3-25b). Over the long term, 5.02 acres through riparian LSOG forest and 3.78 acres through mid-seral forest would be maintained in an herbaceous/shrub state within riparian zones associated with SONCC coho (see table 3.5.3-25b).

TABLE 3.5.3-25a

Total Terrestrial Habitat (acres) Affected/Removed (a/) by Construction within Riparian Zones (One Site-Potential Tree Height Wide) Adjacent to Perennial and Intermittent Waterbodies within Range of SONCC Coho Crossed by and Adjacent (b/) to the Pipeline Project

	Forest Habitat c/					Other Habitat c/						
Fifth-Field Watershed (Hydrologic Unit Code [HUC]) and Landowner	**Late Successional Old Growth Forest**	**Mid-Seral Forest**	**Regenerating Forest**	**Clearcut, Forest**	**Forest Total**	**Forested Wetland**	**Nonforested Wetland**	**Unaltered Nonforested Habitat**	**Agriculture**	**Altered Habitat**	**Other Total**	**Total Riparian Zone Impact (acres)**
Trail Creek (HUC 1710030706)												
BLM-Medford District	1.24	0.64	0	0	**1.88**	0	0	0.20	0	0	**0.21**	**2.09**
Forest Service-Umpqua National Forest	0	1.47	0	0	**1.47**	0	0	0	0	2.45	**2.45**	**3.92**
Non-Federal	0.86	1.93	0.02	0	**2.82**	0	0	1.48	0	0.47	**1.96**	**4.77**
Watershed Total	**2.10**	**4.04**	**0.02**	**0**	**6.17**	**0**	**0**	**1.69**	**0**	**2.93**	**4.61**	**10.78**
Shady Cove-Rogue River (HUC 1710030707)												
BLM-Medford District	2.74	0.12	0	0	**2.86**	0	0	0.75	0	0	**0.75**	**3.62**
Non-Federal	1.19	3.48	0.48	0	**5.15**	0	0.32	7.68	0	0.35	**8.35**	**13.5**
Watershed Total	**3.93**	**3.6**	**0.48**	**0**	**8.01**	**0**	**0.32**	**8.43**	**0**	**0.35**	**9.10**	**17.12**
Big Butte Creek (HUC 1710030704)												
BLM-Medford District	3.97	0.07	0	0	**4.04**	0	0	0.88	0	0.04	**0.92**	**4.96**
Non-Federal	0	1.70	0	0	**1.70**	0.08	0.29	2.20	0	0.72	**3.30**	**5.00**
Watershed Total	**3.97**	**1.77**	**0**	**0**	**5.74**	**0.08**	**0.29**	**3.08**	**0**	**0.77**	**4.22**	**9.96**
Little Butte Creek (HUC 1710030708)												
BLM-Medford District	3.80	0	0	0	**3.8**	0	0	4.12	0	0.20	**4.32**	**8.12**
Forest Service-Rogue River National Forest	0.63	0.12	1.07	0	**1.82**	0	0	0.19	0	0	**0.19**	**2.01**
Non-Federal	5.82	8.45	1.79	0	**16.06**	0	4.31	24.77	0	0.92	**30.01**	**46.07**
Watershed Total	**10.24**	**8.56**	**2.87**	**0**	**21.67**	**0**	**4.31**	**29.09**	**0**	**1.12**	**34.53**	**56.2**
All Fifth-Field Watersheds and Jurisdictions												
BLM-Medford District	11.75	0.83	0	0	12.58	0	0	5.95	0	0.24	6.20	18.79
Forest Service-Umpqua National Forest	0	1.47	0	0	1.47	0	0	0	0	2.45	2.45	3.92
Forest Service-Rogue River National Forest	0.63	0.12	1.07	0	1.82	0	0	0.19	0	0	0.19	2.01
Federal Subtotal	**12.38**	**2.42**	**1.07**	**0**	**15.87**	**0**	**0**	**6.14**	**0**	**2.69**	**8.84**	**24.72**
Non-Federal Subtotal	**7.87**	**15.56**	**2.29**	**0.00**	**25.73**	**0.08**	**4.92**	**36.13**	**0.00**	**2.46**	**43.62**	**69.34**
Overall Total	**20.24**	**17.97**	**3.37**	**0.00**	**41.59**	**0.08**	**4.92**	**42.29**	**0.00**	**5.17**	**52.46**	**94.06**

a/ Project components considered in calculation of habitat "Removed:" Pacific Connector construction right-of-way, temporary extra work areas, aboveground facilities, and permanent and temporary access roads (PAR, TAR).

b/ Includes riparian zones of adjacent streams within the construction right-of-way that are not crossed but listed in table 3.5.3-3 and streams off the right-of-way, not included in table 3.5.3-3.

c/ Habitat Types within Riparian Zones generally categorized as: Late Successional (Mature) or Old Growth Forest (coniferous, deciduous, mixed ≥80 years old); Mid-Seral Forests (coniferous, deciduous, mixed ≥40 but ≤80 years old); Regenerating Forest (coniferous, deciduous, mixed ≥5 but ≤40 years old); Clearcut Forests; Forested and Nonforested Wetland, Unaltered Nonforested Habitat (grasslands, sagebrush, shrublands), Agriculture and Altered Habitats (urban, industrial, residential, roads, utility corridors, quarries).

TABLE 3.5.3-25b

Total Terrestrial Habitat (acres) a/ within the 30-foot-wide Corridor Maintained during the Pipeline Project within Riparian Zones (One Site-Potential Tree Height Wide) on Federal and Non-Federal Lands within Range of SONCC Coho Crossed by and Adjacent to (b/) the Pipeline Project

Fifth-Field Watershed (Hydrologic Unit Code [HUC]) and Landowner	Forest Habitat c/					Other Habitat c/						
	Late Successional Old Growth Forest	Mid-Seral Forest	Regenerating Forest	Clearcut, Forest	Forest Total	Forested Wetland	Nonforested Wetland	Unaltered Nonforested Habitat	Agriculture	Altered Habitat	Other Total	Total Riparian Zone Impact (acres)
Trail Creek (HUC 1710030706)												
BLM-Medford District	0.35	0.20	0	0	**0.55**	0	0	0.06	0	0	**0.06**	**0.61**
Forest Service-Umpqua National Forest	0	0	0	0	**0**	0	0	0	0	0	**0**	**0**
Non-Federal	0.23	0.62	0	0	**0.85**	0	0	0.29	0	0.13	**0.42**	**1.27**
Watershed Total	**0.58**	**0.83**	**0**	**0**	**1.41**	**0**	**0**	**0.35**	**0**	**0.13**	**0.48**	**1.89**
Shady Cove-Rogue River (HUC 1710030707)												
BLM-Medford District	0.72	0.01	0	0	**0.73**	0	0	0.33	0	0	**0.33**	**1.06**
Non-Federal	0.42	0.50	0.13	0	**1.05**	0	0.09	0.68	0	0.02	**0.79**	**1.84**
Watershed Total	**1.14**	**0.51**	**0.13**	**0**	**1.78**	**0**	**0.09**	**1.01**	**0**	**0.02**	**1.12**	**2.9**
Big Butte Creek (HUC 1710030704)												
BLM-Medford District	0.75	0.01	0	0	**0.76**	0	0	0.16	0	0.01	**0.17**	**0.92**
Non-Federal	0	0.39	0	0	**0.39**	0.02	0.10	0.50	0	0.07	**0.69**	**1.08**
Watershed Total	**0.75**	**0.40**	**0**	**0**	**1.15**	**0.02**	**0.10**	**0.66**	**0**	**0.07**	**0.85**	**2**
Little Butte Creek (HUC 1710030708)												
BLM-Medford District	0.93	0	0	0	**0.93**	0	0	1.06	0	0.02	**1.09**	**2.01**
Forest Service-Rogue River National Forest	0.18	0.04	0.36	0	**0.58**	0	0	0.06	0	0	**0.06**	**0.64**
Non-Federal	1.45	2	0.74	0	**4.18**	0	0.79	6.28	0	0.17	**7.24**	**11.42**
Watershed Total	**2.55**	**2.04**	**1.09**	**0**	**5.68**	**0**	**0.79**	**7.41**	**0**	**0.19**	**8.39**	**14.08**
All Fifth-Field Watersheds and Jurisdictions												
BLM-Medford District	2.75	0.22	0	0	2.97	0	0	1.61	0	0.03	1.65	4.6
Forest Service-Umpqua National Forest	0	0	0	0	0	0	0	0	0	0	0	0
Forest Service-Rogue River National Forest	0.18	0.04	0.36	0	0.58	0	0	0.06	0	0	0.06	0.64
Federal Subtotal	**2.93**	**0.26**	**0.36**	**0**	**3.55**	**0**	**0**	**1.67**	**0**	**0.03**	**1.71**	**5.24**
Non-Federal Subtotal	**2.10**	**3.51**	**0.87**	**0.00**	**6.47**	**0.02**	**0.98**	**7.75**	**0.00**	**0.39**	**9.14**	**15.61**
Overall Total	**5.02**	**3.78**	**1.22**	**0.00**	**10.02**	**0.02**	**0.98**	**9.43**	**0.00**	**0.41**	**10.84**	**20.87**

a/ Considers terrestrial habitats that were present prior to construction within the 30-foot wide maintenance corridor.

b/ Includes riparian zones of adjacent streams within the construction right-of-way that are not crossed but listed in table 3.5.3-3 and streams off the right-of-way, not included in table 3.5.3-3.

c/ Habitat Types within Riparian Zones generally categorized as: Late Successional (Mature) or Old Growth Forest (coniferous, deciduous, mixed ≥80 years old); Mid-Seral Forests (coniferous, deciduous, mixed ≥40 but ≤80 years old); Regenerating Forest (coniferous, deciduous, mixed ≥5 but ≤40 years old); Clearcut Forests; Forested and Nonforested Wetland, Unaltered Nonforested Habitat (grasslands, sagebrush, shrublands), Agriculture and Altered Habitats (urban, industrial, residential, roads, utility corridors, quarries).

Pacific Connector would neck down to a 75-foot-wide construction right-of-way at most waterbody crossings and maintain a setback between waterbody banks and TEWAs in forested areas. Following construction, Pacific Connector would implement measures to replant native trees and shrubs where they had been before in riparian areas and would minimize vegetation maintenance by providing a riparian strip at least 25 feet wide to be permanently revegetated on private lands and 100 feet wide on federally-managed lands as measured from the edge of the waterbody. In forested areas, replanting of native trees would occur beyond the 25- and 100-foot-wide areas, respectively. Following planting, vegetation monitoring would occur for two to three years to ensure successful revegetation. If vegetation does not meet designated goals, additional planting would occur and monitoring would continue until the desired revegetation is achieved. Within the 30-foot-wide pipeline corridor, the plants would be maintained by periodic vegetation maintenance. As required by the FERC's *Plan*, Pacific Connector consulted with the NRCS, BLM, and Forest Service regarding specific seeding dates and recommended seed mixtures for the Pipeline Project area. The recommendations have been incorporated into the Pipeline Project-specific ECRP (see appendix F). The ECRP describes the procedures that would be implemented to minimize erosion and enhance revegetation success for the entire Pipeline Project.

For the Rogue River, which would be crossed by HDD, the potential disturbance in riparian areas would be incidental trimming of vegetation using hand tools directly over the pipeline along an approximately five-foot-wide footpath. This minor clearing is required to facilitate the temporary deployment of HDD guidance (telemetry) cables along the ground during construction and to perform a leakage survey after installation and commissioning. This is a relatively small area along the riparian zone of any stream and would have minimal adverse effect on aquatic resources.

Overall, restricting the low-growth vegetation area to a small portion of the total riparian right-of-way clearing would allow much of ecological function of the riparian conditions relative to coho salmon needs (e.g., shade, future LW and organic input) to return more quickly. This would limit the overall long-term impacts of loss of riparian habitat to a small portion of each stream crossed reducing future negative effects to coho salmon resources. Some limited intermediate-term adverse effects to coho salmon habitat function would remain relating primarily to LW reduction. Potential effects of riparian vegetation removal on water temperature and LW are presented below.

A series of tables (M-2 through M-5, provided in appendix M) identify the areas (acres) of vegetation within riparian zones (1SPTH) affected by construction and operation of the Pipeline Project across or adjacent to waterbodies with expected Oregon Coast and SONCC coho presence, by fifth-field watershed. The tables identify general vegetation (forested by age class/non-forested) within riparian zones that would be affected from the Pipeline crossing the waterbodies or from waterbodies adjacent to the Pipeline, as well as identify the acres of vegetation affected within the riparian zone that is federally designated critical habitat. Tables M-2 and M-4 identify areas (acres) of vegetation affected within Riparian Zones of waterbodies known or suspected to have Oregon Coast coho salmon presence, and tables M-3 and M-5 identify acres of vegetated affected within Riparian Zones of waterbodies known or suspected to have SONCC coho salmon presence.

Effects to waterbodies and Oregon Coast and SONCC coho due to removal of riparian vegetation and maintenance within the construction and operation corridor adjacent to but not crossed by the Pipeline Project would be similar to effects to riparian vegetation for streams crossed by the Pipeline:

- Loss of riparian vegetation along the banks would reduce shade, potentially resulting in minor water temperatures increases.
- Decreased LW recruitment in streams and on adjacent uplands.
- A minor reduction in food for aquatic organisms.
- Potentially increase slope failures and/or erosion due to surface runoff adjacent to waterbodies that could increase sediment in the waterbody.

Where vegetation is cleared from the riparian zone of a waterbody not crossed but adjacent to the Pipeline, a vegetation buffer (of some width but less than 1SPTH) adjacent to the waterbody is expected to remain. Consequently, effects from the Pipeline would be even less than those described for riparian zones and associated waterbodies that would be crossed. Riparian vegetation within 1SPTH that would be maintained in a herbaceous state within the 30-foot maintenance corridor during the life of the Pipeline is included in tables M-4 and M-5; the majority of riparian vegetation affected by the Pipeline is associated with waterbodies crossed by the right-of-way (61 percent with potential Oregon Coast coho presence and 81 percent with potential SONCC coho presence) not riparian vegetation associated with waterbodies adjacent to the right-of-way.

Water Temperature

Clearing the right-of-way would remove shading vegetation from uplands and riparian areas, exposing the land and water to increased sunlight, potentially resulting in minor increases in water temperatures. Additionally, minor indirect increases in stream water temperatures may occur as water flows over the warmer land surface and eventually reaches the waterbody (Beschta and Taylor 1988).

The effects of water temperature on salmonid life stages have been extensively reviewed by McCullough (1999) and Richter and Kolmes (2005). Maximum water temperatures ranging from 22 to 24°C (71.6 to 75.2°F) limit distribution of many salmonid species. No salmonids can survive water temperatures exceeding 25°C (77°F) for extended periods (Ice 2008). High water temperatures can cause migratory species (including anadromous salmonids) to delay upstream migration (Bjornn and Reiser 1991), can decrease survival of spawners by increasing metabolic rates (Ice 2008), and can positively influence rates of embryo development and emergence but negatively influence dissolved oxygen concentrations, which alternatively limit rates of embryo development (Bjornn and Reiser 1991). High temperatures inversely influence solubility of oxygen in water (Ice 2008) so that introduction of organic matter with decomposition by microorganisms reduces dissolved oxygen, exacerbated by high temperatures. Along with increased fines (suspended silt and clay) and decreased relative rate of oxygen input to water (reaeration) through reduction in stream flows (Ice 2008), high temperatures can adversely affect various salmonid life stages. Coho upstream migration water temperature requirements range from 7.2 to 15.6°C (46.0 to 62.1°F), spawning requirements from 4.4 to 9.4°C (42.9 to 52.9°F), and for incubation from 4.4 to 13.3°C (42.9 to 61.9°F); their preferred temperature is 12.1°C (60.8°F) and upper lethal temperatures range from 26.0 to 28.8°C (86.8 to 92.8°F), depending on previous acclimation temperatures (Bjornn and Reiser 1991).

Vegetative cover that provides shade, especially during summer, is one factor that regulates water temperature. Construction across waterbodies would necessitate removal of trees and riparian shrubs at the crossing locations that may influence stream temperature. Available information on the effects of pipeline construction in other regions on water temperature has found no or immeasurable change in temperatures. The total width of riparian area affected by shade tree removal would be small (less than 100 feet) relative to the length of any stream crossed. In one study, construction across two coldwater, fish-bearing streams in Alberta required removing forested riparian vegetation; water temperatures at construction sites and downstream did not increase above temperatures at control sites upstream from construction (Brown et al. 2002). In the Alberta study, the highest water temperature recorded was 66°F (19°C in August). In a New York study, the highest temperature was 79°F (26°C) sometime between August and October. Similarly, water temperatures measured at four coldwater streams in New York before and during pipeline construction and for three years following construction showed no short- or long-term effects on water quality parameters, including water temperature, even though such effects were expected because streambank vegetation had to be cleared, which reduced shading (Blais and Simpson 1997).

Another recent right-of-way clearing study in Oregon found little to no effect from existing and proposed right of way clearing on coldwater Cascade mountain streams (Tetra Tech 2013). Monitoring of 22 existing cleared right-of-ways for transmission lines in the Cascade region along the upper North Santiam River averaging 244 feet wide found no significant temperature (peak daily average, and daily maximum) change across the clearings compared to existing uncleared areas on each of these streams. While temperature changes did occur across the clearing (average of peak daily maximum change 0.19°F/100 feet of stream), these increases were no different from the temperature changes in the uncleared wooded areas just upstream of these clearing. While these streams did retain some vegetation in the right-of-way, they were kept relatively low to ensure no issues with the power lines. Modeling of these streams using the Stream Segment Temperature Model (SSTEMP; Bartholow 2002) estimated some relatively small increases, which were generally greatest for smallest streams. The model assumed all or most vegetation would be removed from banks over a 150-foot-wide projected clearing. The results for both existing (summer 2012) and projected worst-case (likely maximum summer air temperature) environmental conditions with very conservative shade assumptions (0 and 25 percent for entire 150-foot clearings) showed an average increase of about 1.1°F (median of about 0.4°F) in the modeled maximum and maximum daily mean temperature across the assumed future clearing of these 22 streams. The small size of the streams in this study affected the model results. All but three of the streams had flow less than 1 cfs and width less than 10 feet. The three larger streams had modeled maximum temperature changes ranging from 0.0 to 0.2°F. Most of these streams had relatively low to moderate temperatures (mean maximum about 55°F); therefore, these low temperature increases were generally not expected to affect fish resources (Tetra Tech 2013).

Following requests by the Forest Service, Pacific Connector had temperature models run by North State Resources (NSR) on six different stream segments on NFS lands in the Umpqua River basin on tributaries to East Fork Cow Creek (five crossings) and on the upper Rogue River basin on Little Butte Creek (NSR 2009). While not all of these streams are in the range of SONCC coho salmon, they are suitably representative of likely temperature changes that could be expected of streams of similar characteristics (i.e., width, flow, slope, vegetation, etc.) in regions where the ESU is located using these model parameters. Of the three smallest streams (with base flows <0.1 cfs, widths ≤3 feet), modeled average temperature increases ranged from 1.0 to 8.6°C (1.8 to 15.4°F) right after construction. Because these streams were so small, they likely also would have temperatures reduced rapidly downstream of the clearing from groundwater inflow and likely would have no measurable effects on streams they flow into downstream. The two five- and six-foot-wide streams would have estimated maximum increases ranging from 0.4 to 0.5°C (0.7 to 0.9°F) with maximum temperature remaining at or below 15.6°C (60.1°F) in these two streams just downstream of the crossing. These temperatures would remain well within suitable range for salmonids. The largest stream (22 feet wide) increase was estimated to be 0.02 to 0.1°C (0.04 to 0.2°F) depending on the temperature model. The modeled results, based on assumptions used about rate of vegetation regrowth, found that most temperature increases remained within the first 5 years but were approaching pre-project temperatures within 10 years. Conditions at other streams along the pipeline route may vary from these due to site-specific differences, but these results may be fairly representative of changes that may occur at forested streams along the route. Overall results suggest that, other than the very smallest streams where fish resources would be limited, changes in temperature from vegetation removal are likely to remain small and immeasurable, having unsubstantial effects on fish resources.

GeoEngineers (2017c) used the SSTEMP model by Bartholow (2002) to estimate potential temperature effects within fourth-field watersheds. Using this model, 15 proposed pipeline crossing locations along the whole route would be affected within the assumed 95-foot-wide construction corridor for the short term (table 3.5.3-25a) and within the 30-foot maintenance corridor over the long term (see table 3.5.3-25b, above). A total of 12 of these were in the watershed range of the Oregon Coast coho salmon ESU and two were in the range of the SONCC coho salmon ESU. These sites would be generally representative of watershed habitat conditions where Project area coho salmon may be present along the Pipeline route, although not necessarily where coho salmon are directly present. The streams selected varied from 2 to 85 feet wide (average 29 feet), moderately large streams, with only eight of these having a less than 10-foot flowing width. Conditions modeled were based on conditions measured during late August 2010 and did not consider maximum potential air temperatures though they were likely representative of summer conditions. The average modeled increase for these 15 streams was 0.03°F, and the maximum increase among the streams was 0.3°F. Overall, these estimated changes are relatively low. They are lower than the NSR (2009) estimates for one comparable stream, but model conditions were slightly different. The GeoEngineers model assumed a 75-foot-wide clearing, whereas the NSR model assumed a 95-foot-wide clearing and other parameter differences that would contribute to the different results. The conclusion drawn by GeoEngineers (2017c) was that the magnitude of thermal impact caused by construction would not be expected to cause a thermal barrier to fish migration.

As a rule, the effect of water temperature of a non-fish-bearing tributary on water temperature of a fish-bearing receiving stream is determined as the weighted mean of the two water temperatures, weighted by respective volumes or in-stream flows. If T_1 = temperature of tributary with F_1 = flow rate, and T_2 = temperature of receiving stream with F_2 = flow rate, then the resulting water temperature T_R at the confluence of the two waterbodies would be:

$$T_R = (T_1 F_1 + T_2 F_2) / (F_1 + F_2)$$

For example, Hydrofeature N is an unnamed tributary to East Fork Cow Creek crossed at MP 111.01. Pipeline construction would increase the water temperature by 8.6°C (15.5°F) from its base temperature of 11°C (51.8°F) (see NSR 2009). The water temperature would be increased to 19.6°C (67.3°F), but its reported summer base flow is 0.002 cfs. 2 measured water temperature within East Fork Cow Creek during September 1998, reported at 13.5°C (56.3°F). No in-stream flow data are available for East Fork Cow Creek, but the USGS (Gage 14309500) has measured flows in West Fork Cow Creek, reporting an average flow of 11.4 cfs during September. Using those data to illustrate how water temperatures would be combined by the weighted average, the resulting water temperature of Hydrofeature N and the receiving stream would be T_R = (19.6°C x 0.002 cfs + 13.5°C x 11.4 cfs) / (0.002 cfs + 11.4 cfs) = 13.501°C (56.302°F). The increase of water temperature in the receiving stream by the tributary water temperature would be immeasurable [in this illustration the increase would be 0.001°C (0.002°F)].

Pacific Connector has proposed supplemental riparian plantings as outlined in the ECRP (see appendix F) to help ensure that the core cold-water habitat temperature criteria are not exceeded at the maximum point of impact. This would include, as mitigation for loss of riparian shade vegetation, replanting the equivalent of 1:1 ratio for construction or 2:1 for permanent riparian vegetation loss (GeoEngineers 2017d). These measures are designed to speed up the rate of riparian area recovery and provide more effective shade immediately following construction. Much of the riparian area would be allowed to regrow from plantings with herbaceous plants (only 10 feet wide would be maintained without some growth) and conifer and other trees (all but 30-foot width). On small streams and to a lesser extent on larger streams, even 10- to 15-foot-high trees would supply shade, reducing solar heating effects on streams. Thus, plantings and vegetation regrowth in riparian areas would help moderate potential temperature increases in the short-term (a few years). Pacific Connector would install supplemental transplanted trees on the Umpqua National Forest within the riparian areas of East Fork Cow Creek (i.e., 15 to 20 feet tall with full crowns) to increase riparian area canopy closure and placing LW and boulders to create micro-topography within the wetted stream channel (see the ECRP).

Shading from transplanted vegetation and micro-topographic features incorporated into the final grading plan are likely to reduce the heat load enough to reduce the likelihood of measurable water temperature increases. Pacific Connector modeled the potential benefit of post project effective shade created by these mitigation measures on the Umpqua National Forest. The results of the 10-year post-project modeling time step was used to predict the benefits of the mitigation measures because the trees that would be transplanted provide at least the same shade values as predicted for this time step. The predicted water temperature changes are small, with less than a 0.3°C (0.5°F) change at the point of maximum impact, with no increase at the stream network scale (NSR 2009). Thus, based on the model, the slight effects of solar heating from clearing would gradually be reduced or completely eliminated over time, at most between 5 and 10 years. Inclusion of the measures improves the certainty that riparian area clearance and stream channel disturbance activities within the construction right-of-way would not cause measurable water temperature increases at the maximum point of impact or at the stream network scale.

Based on available information, any changes in water temperature related to the 75-foot-wide right-of-way vegetation clearing[37] at waterbody crossings are likely to be very small and undetectable through measurements, except for possibly the very smallest and often intermittent flowing streams. Any temperature changes that may occur would gradually be reduced or eliminated over time as most riparian vegetation, from plantings and natural vegetation growth, increases in size and thus increases stream shading. Adverse effects on coho salmon resources along the route would be discountable due to limited distribution of any measurable changes to

[37] It is expected riparian clearings on all flowing streams would be 75 feet wide, but if the rare case where clearing width could not be necked down, a 95 feet area temperature change would still be slight as addition clearing (about 20%) would unsubstantial.

water temperature within the 11 waterbodies with confirmed or assumed presence of SONCC coho.

Large Wood

Large logs provide in-stream hydraulic complexity, which contributes to habitat complexity and the formation and maintenance of pools, riffles and other habitats which are critical to salmonid spawning and juvenile rearing. As the size of individual logs or accumulations of logs increases, the size and stability of pools that are created also increase (Beschta 1983). Riparian forests that undergo harvesting of large trees take on secondary-growth characteristics and contribute lower quantities of woody debris than unmanaged, old-growth forests (Bisson et al. 1987). However, sufficiently wide, carefully managed riparian buffers that retain a full complement of ages, sizes, and species of native trees and vegetation can ensure adequate recruitment of LW to streams (Bisson et al. 1987; Murphy and Koski 1989).

Existing conditions associated with riparian vegetation within all fifth-field watersheds in the Upper Rogue Subbasin crossed by the Pipeline (see discussion related to table 3.5.3-8) are generally undesirable based on the ODFW-developed criteria (Foster et al. 2001). Streams in the watersheds are deficient in numbers of LW pieces per length of stream channel, in volume of LW, and in numbers of key pieces (60 cm or greater in diameter by 12 meters or greater in length) per unit of stream length. There are too few large conifers along most stream reaches and LW numbers, volume, and presence of key pieces tend to be below benchmark levels. The Pipeline Project would remove 18.08 acres of LSOG forest and 17.47 acres of mid-seral forest within riparian zones in watersheds occupied by SONCC coho (see table 3.5.3-25a), which would affect recruitment of LW at those sites. Of the total riparian forest affected (including regenerating forest stands), 6.11 acres would be removed in the Trail Creek watershed, 7.93 acres within the Shady Cove-Rogue River watershed, 4.80 acres within the Big Butte Creek watershed, and 19.97 acres within the Little Butte Creek watershed.

Pacific Connector has proposed to use on-site mitigation for impacts to waterbodies by installing LW at agency and land owner-approved and appropriate areas within the construction right-of-way across certain waterbodies (see section 3.5.3.4, Conservation Measures). The use of LW as a mitigation measure for impacts associated with in-stream construction has been documented as an effective means of creating in-stream habitat heterogeneity, reducing streambank erosion, reducing sediment mobilization (Bethel and Neal 2003), and enhancing local fish abundance (Scarborough and Robertson 2002). Placement of LW on the streambanks and in the streams can provide slight shade and increase bank stability while vegetation is maturing following construction. Additionally, placement of LW in streams or on streambanks can provide habitat as substrate for benthic invertebrates, an important food source for salmonids and also increase habitat for forage species with the creation of pools and enhancement of the salmonid rearing potential of an area (Cederholm et al. 1997; Slaney and Martin 1997). Long-term losses of LW input would largely be mitigated through riparian replanting of conifers in the right-of-way as discussed under Riparian Vegetation and Removal above. While there may be some reduction in total stream LW between short and long-term, the amount would be relatively small considering that, at most, 75 to 95 feet of the channel would be initially affected, and only the 30-foot-wide maintenance corridor would be absent trees during the length of the Project and that mitigation and enhancements would be implemented (see section 3.5.3.4, Conservation Measures). As a result, LW changes would result in only minor intermediate-term adverse effects to SONCC coho salmon habitat.

Streambank Erosion and Streambed Stability

The clearing and grading of vegetation during construction could increase erosion along streambanks resulting in higher turbidity levels in the waterbodies crossed. Alteration of the natural drainage ways or compaction of soils by heavy equipment near streambanks during construction may accelerate erosion of the banks, runoff, and the transportation of sediments into waterbodies. Streambank erosion, sedimentation, and higher turbidity levels related to the Pipeline Project could affect aquatic resources, as discussed above. The degree of impact on aquatic organisms due to erosion would depend on sediment loads, stream velocity, turbidity, streambank composition, and sediment particle size.

The rootwad network of trees adjacent to stream supplies bank stability. Those networks within 25 feet of the stream are considered important at providing the root source aiding in bank stability (WDNR 1997). To aid in maintaining this bank stability, Pacific Connector would cut most trees near the bank, except those in the trench line, at ground level, leaving the root systems in place helping to maintain riparian stability. Roots would be removed over the trench line or from any steam banks that would need to be cut down or graded to accomplish the pipeline crossing.

To minimize these impacts, Pacific Connector would use temporary equipment bridges, mats, and pads to support equipment that must cross the waterbody (perennial, intermittent, and ephemeral if water is present) or work in saturated soils adjacent to the waterbody. Pacific Connector would also install sediment barriers, such as silt fence and straw/hay bales, across the right-of-way at the edge of waterbodies throughout construction except for short periods when the removal of these sediment barriers is necessary to dig the trench, install the pipe, and restore the right-of way. Practices to minimize streambank erosion are provided in the ECRP (see appendix F).

The FWS expressed concerns that more detailed site-specific information on bank material, streambed composition, shoreline vegetation and other information is needed to adequately ensure that actions occurring at a stream crossing do not significantly increase streambank erosion and streambed instability. Pacific Connector, in response to these requests, conducted an initial assessment of crossing conditions of all streams suitable for analysis based on the FWS risk matrix (GeoEngineers 2017d). GeoEngineers, using a combination of field and GIS data, rated proposed stream crossings based on the matrix along the entire route including 20 streams in the range of SONCC coho, included in table 3.5.3-3. Each crossing was rated as low, medium, or high for each of the two axes based on the Pipeline impact potential at the crossing and the relative stream response potential at the crossing (all of the 20 stream crossings were placed into one of nine categories, such as Low–Low, Low–Medium, and Medium–High). Crossings of all streams except for Neil Creek were evaluated as having sensitive streambed, banks, or riparian revegetation conditions that would require site-specific measures to maintain channel stability or replace disturbed habitat (GeoEngineers 2017d). The crossing of Neil Creek would require typical stream crossing methods because it is rated as a low level of sensitivity. No crossing was rated as having both high risk of project impact potential and high risk of stream and site response potential. Pacific Connector would stabilize the construction site, including the streambanks, immediately following installation of the Pipeline. Pacific Connector would also install and maintain throughout construction sediment barriers, such as silt fence and straw/hay bales, to prevent sedimentation from surface runoff into a stream.

In the range of SONCC coho, Project-typical BMPs would be applied to all streams, while site-specific BMPs would be applied to 19 stream crossings based on their rated category of risk as having sensitive streambed, banks, or riparian revegetation conditions. Stream crossings that are unstable can ultimately adversely affect aquatic resources through loss of local habitat and impacts to downstream habitat from the addition of highly unstable sediment, increasing the recovery time of the specific site to stable conditions.

In addition, substrate characteristics and physical habitat features would be determined through pre-construction surveys, and the upper one foot of existing substrate would be replaced and other physical conditions matched during reconstruction after pipe installation. Clean spawning gravel would be top dressed as appropriate and composition would be based on pebble counts or other appropriate methods on a site-specific basis. Pacific Connector would make some exceptions to this in areas difficult to access, in which case native material comparable to the existing substrate would be used. Many of these actions would be determined prior to construction based on results of the pre-construction survey (see below) and determined by a qualified EI or suitably trained professional who would have the authority to select appropriate site-specific BMP construction methods, bank stability actions, revegetation types, and methods to help reduce the risk of instability of the crossing and potential for future erosion (GeoEngineers 2017d).

A pre-construction survey would be conducted by a technically qualified team on all stream crossings to confirm and clarify conditions developed in the aforementioned matrix analysis. This team would be professionals qualified to assess terrestrial and aquatic habitat and the geotechnical and geomorphic conditions relative to construction across stream channels and ditches. Following these surveys, if significant changes were to occur to parameters of the risk matrix for a crossing, changes would be made to risk level and appropriate final methods of crossing and BMPs applied at each stream crossing. If any crossing is moved into the "high" impact and "high" stream response risk matrix category, a site-specific crossing design would be developed for that site. Project construction would then move forward as described in the permit documents including implementation of special additional BMPs, as described in GeoEngineers (2017d, 2017e, and 2018a), depending on individual site conditions. For waterbodies evaluated as having Low to Moderate Project Impact Potential and Low Site or Stream Response Potential in the Risk Matrix Evaluation[38] (the Blue management category, with Pacific Connector Project Typical Construction), BMPs potentially utilized for post-construction site restoration include seeding, planting, and hydromulch or erosion control blankets to minimize surface erosion while new vegetation becomes established, as outlined in the ECRP (see appendix F). Typical site revegetation and backfill would be used to address habitat issues at these sites.

For waterbodies evaluated as having Low to Moderate Project Impact Potential and Moderate Site or Stream Response Potential in the Risk Matrix Evaluation (the Yellow management category, having sensitive bed, bank or riparian revegetation conditions selected by the EI or Pacific Connector representative during construction), special, more robust BMPs (in addition to Project Typical BMPs noted in the paragraph above) would include those targeting the streambed component (stratified backfill for high gradient streams, structural fill placement, bank graded/terraced to 3:1, geotextile reinforced slope, fiber rolls) and the streambank component (stream barbs/flow deflectors, toe rock placement, riprap placement, biotechnical "vegetation" riprap, tree revetments). As indicated in GeoEngineers (2017e), typical BMPs were developed for

[38] The Risk Matrix Evaluation considers two major parameters—stream and bank characteristics and construction methods at specific crossings—when determining relative risk to the stream. See GeoEngineers (2017d, 2017e, and 2018a) for more details.

sites in the Yellow management category to address risks posed by bed and bank instability or degradation to existing high quality aquatic habitat. These site-specific BMPs were developed based on field observations of natural analog structures and widely accepted techniques for bank restoration, bed restoration, and aquatic habitat restoration techniques; typical designs of these BMPs are provided in Appendix B to GeoEngineers (2017e).

Waterbodies evaluated as having Low to Moderate Project Impact Potential and High Site or Stream Response Potential in the Risk Matrix Evaluation (the Orange management category, having sensitive bed, bank or riparian revegetation conditions selected by qualified professional prior to construction based on site-specific information from pre-construction evaluation) have the highest potential risk for short and long-term channel stability. As described in GeoEngineers (2018a), site-specific restoration plans were developed for crossings that were assessed to be within the Orange management category based on the findings of the preconstruction surveys. The need for site-specific designs is due to more complex geomorphic or hydraulic features that increase risk of channel response to the pipeline or unique, high-value habitat features. Site-specific designs were developed using results of the preconstruction surveys, including geomorphic/hydraulic/habitat observations, topographic cross sections, and profiles collected using a hand level and stadia rod. A written description of site-specific features and restoration priorities, and design drawings are presented for each crossing in Appendix C to GeoEngineers (2017e).

For waterbodies evaluated as having High Project Impact Potential and Low to Moderate Site or Stream Response Potential in the Risk Matrix Evaluation (the Green management category, applying Project Typical BMPs with habitat enhancement BMPs), Pacific Connector would use Project Typical Construction BMPs (see above). Channels in this category typically are those that disturb a greater proportion of the existing floodplain or, in narrower streams, potentially disturb more varied aquatic habitat. During site restoration, however, particular effort would be made for opportunistic habitat enhancement BMPs as detailed from observations obtained during the pre-construction survey. These enhancements could include riparian planting to improve existing habitat conditions in the floodplain, placement of large wood or rock to improve in-stream habitat, or modification of existing riprap to improve habitat. A number of the typical BMPs included in Appendix B to GeoEngineers (2018a) were designed to maintain or enhance the aquatic habitat present in the stream. These structures will often act to create complexity in the channel by scouring pools and sorting gravels as well as by providing refugia for juvenile fish. Site-specific restoration plans are provided in Appendix C (GeoEngineers 2018a).

As a follow-up measure to help ensure crossing actions would not adversely affect stream bank and channel structure, Pacific Connector would monitor stream crossings to ensure long-term success of the restoration, maintenance of fish passage, and to identify channel erosion, scour or migration that could destabilize the site or expose the pipeline. As requested by FERC, Pacific Connector developed a monitoring plan (GeoEngineers 2018a) following consultation with representatives from FWS and NMFS (Castro 2015). The monitoring plan would be customized, where necessary, to address risks of stream crossings identified in the Risk Analysis and those identified in subsequent preconstruction surveys.

Monitoring would consist of:

- Annual visits to all stream crossings, regardless of risk level, as part of Pacific Connector's monitoring of pipeline integrity. These visits would be completed by Pacific Connector staff and would note any obvious signs of channel erosion, pipeline exposure, or major shifts in restoration elements. Potential problem areas would be subsequently visited by Pacific Connector and a geoprofessional.
- Aerial reconnaissance would be completed annually for the life of the Pipeline, and stream crossings would be reviewed for major landscape changes such as channel migration and excessive erosion. Potential problem areas would be subsequently visited by Pacific Connector and a geoprofessional.
- Quarterly site visits to all sites in the Orange management category (sites with low-moderate project impact potential and high site or stream response potential; see GeoEngineers 2018a) for two years after construction to monitor revegetation success, structural stability of the restoration elements, any changes to fish passage potential resulting from the Pipeline, evidence of channel migration, erosion, head-cutting, or other stream channel movement that could influence stream or pipeline stability. Field measurements would be taken to monitor adjustments to the channel profile and cross-sectional area.
- Annual site visits to 15 percent of all sites in the Blue management category (sites with low-moderate project impact potential and low site or stream response potential) and 100 percent of all sites in the Yellow management category (sites with low-moderate project impact potential and moderate site or stream response potential; see GeoEngineers 2018a) for two years after construction to monitor revegetation success, structural stability of the restoration elements, any changes to fish passage potential resulting from the Pipeline, evidence of channel migration, erosion, head-cutting, or other stream channel movement that could influence stream or pipeline stability. Field measurements would be taken to monitor adjustments to the channel profile and cross-sectional area.
- Annual site visits to 50 percent of the sites in the Yellow and 100 percent of sites in the Orange management category (see GeoEngineers 2018a) by a geo-professional in Years 3, 5, 7, and 10 to monitor revegetation success, structural stability of the restoration elements, any changes to fish passage potential resulting from the project, evidence of channel migration, erosion, head-cutting, or other stream channel movement that could influence stream or pipeline stability. Field measurements would be taken to monitor adjustments to the channel profile and cross-sectional area.
- Observations would be made during all site visits on the effects of cattle/elk browsing on restoration success and of impacts associated with recreational use.
- Revegetation planning along the right-of-way is detailed in the ECRP (appendix F). The ECRP describes monitoring and performance standards for revegetation.
- Records would be maintained annually to document any significant hydrologic events (flow or rainfall) that occur in between site visits. This shall be done to better understand the site response to moderate or large flood events. As gauging stations are extremely limited over the majority of the crossings along the Pipeline route, rainfall records would be used to identify the potential flooding that may occur in between scheduled monitoring events. These climatic events would be considered during annual monitoring when evaluating site response.

- Unscheduled site visits may be completed at stream crossings on BLM and Forest Service jurisdiction following localized rainfall events exceeding a 25-year rainfall intensity to monitor revegetation success, structural stability of the restoration elements, any changes to fish passage potential resulting from the Pipeline, evidence of channel migration, erosion, head-cutting, or other stream channel movement that could influence stream or pipeline stability. Field measurements would be taken to monitor adjustments to the channel profile and cross-sectional area.
- Annual reporting in Years 1, 2, 3, 5, 7, and 10 following construction would be provided to outline observations of stream crossings and any remedial action taken to restore site conditions.
- Monitoring frequency and locations may be modified in response to demonstrating site restoration success in the Annual Monitoring reports.

Overall, these actions would reduce potential adverse effects from bank and bed stability to listed coho salmon to discountable levels.

Crossing of Unstable Slopes

Potential impact to waterbodies by deep-seated landslides and shallow, rapidly moving landslide hazards on unchannelized slopes is difficult to evaluate. Slope failure near the waterbody during pipeline operation could result in soil and sedimentation falling into the waterbody. Pacific Connector evaluated all likely unstable areas during selection of the proposed route, and moved the route as necessary to areas considered to have low risk (GeoEngineers 2017k). No surveyed unstable areas have been detected within the route crossing fifth-field watersheds containing the SONCC coho salmon ESU, so adverse effects from slope failure from landslide areas are unlikely.

Aquatic Habitat

There also are potential indirect effects to aquatic habitat from increased suspended sediment from stream crossings. The same approach utilizing TSS concentration and exposure to evaluate levels of risk to fish (Newcombe and Jensen 1996) was applied to quantifying effects of sediment on fish habitat, termed the HADD of habitat by Anderson et al. (1996). HADD risk includes concentration and exposure to sediment along with sensitivity of the habitat affected. Most likely, suspended sediment would increase embeddedness of spawning gravels with increasing adverse habitat effects closer to the construction location.

Anderson et al. (1996), adopting the approach of Newcombe and Jensen (1996), used sediment concentration and duration to model the level of adverse effects to fish habitat based on empirical studies.

Anderson et al. (1996) described five severity of ill effect (SE) ranks to habitat:

- SE 3: Measured change in habitat preference.
- SE 7: Moderate habitat degradation measured by a change in the invertebrate community.
- SE 10: Moderately severe habitat degradation as defined by measurable reductions in the productivity of habitat for extended periods (months) or over a large area (kilometers).
- SE 12: Severe habitat degradation as measured by long-term (years) alterations in the ability of existing habitats to support fish or invertebrates.
- SE 14: Catastrophic or total destruction of habitat in the receiving environment.

The Anderson et al. (1996) HADD model utilizes the same form as the Newcombe and Jensen (1996) models, that is:

$$z = a + b (\log_e x) + c (\log_e y)$$

where z = SE score, x = duration of exposure in hours, and y = concentration of suspended sediment in mg/l. However, constants a, b, and c in Newcombe and Jensen's Model 1 for juvenile and adult salmonids (a=1.0642, b=0.6068, and c=0.7384) differ in the Anderson et al. (1996) multivariate model for SE to habitat (a=0.032, b=1.008, and c=0.978). As a consequence, for any given duration of exposure (from 2 hours to 6 hours, see table 3.5.3-22), the TSS concentration that would produce an SEV = 3 in the Newcombe and Jensen Model 1 is less than the TSS concentration that would produce an SE = 3 in the Anderson et al. HADD habitat model. Because of nonlinearities in both models, the TSS concentration that would produce an SEV = 7 in the Newcombe and Jensen Model 1 is more than the TSS concentration that would produce an SE = 7 in the Anderson et al. habitat model. The SEV and SE scores are more closely aligned at lower TSS concentrations than at higher concentrations for any given duration of exposure but remain fairly similar in the range of 7.

Based on the models for suspended sediment concentration and duration of exposure discussed above (see tables 3.5.3-22 and 3.5.3-23), estimates were made for effects to habitat of SONCC coho salmon. Calculated values less than SEV 7 (which are similar to SE values less than 7) would likely be considered to have little or no substantial effect to functional habitat, while those equal to or greater than SEV 7 likely would be substantial relative to changes in functional habitat conditions for coho salmon.

During a failure of dry open-cut construction, TSS concentrations of up to 361 mg/l over background TSS concentrations could last for 6 hours, based on the Newcombe and Jensen Model 1 during a wet open-cut (see table 3.5.3-22). If that same concentration is applied in the Anderson et al. HADD model with duration of 6 hours, the SE score is greater than 7 but less than 8, indicating slightly more damage to habitat than "moderate habitat degradation measured by a change in the invertebrate community." Values in table 3.5.3-22 are based on the average of watershed streams, and some streams may have values of SE greater than 7. To ensure an SEV or SE score less than 7 for either model, in-stream work to repair a failed containment structure would likely have to be restricted to less than 4 hours. In cases of uninterrupted dry open-cut construction, no substantive adverse effects to coho salmon habitats downstream are expected to occur from sediment generated during stream crossings.

<u>Freshwater Stream Invertebrates</u>

Substrates downstream from in-stream construction sites could be impacted by sediments. Mayflies, caddisflies, and stoneflies prefer large substrate particles in riffles and are adversely affected by fine sediment deposited in interparticulate spaces (Cordone and Kelley 1961; Waters 1995; Harrison et al. 2007). Fish and benthic macroinvertebrate abundance downstream of pipeline construction sites have been reported as short-term reductions following construction-generated suspended sediment (Reid and Anderson 1999). Macroinvertebrate abundance and community composition are highly related to the degree to which substrate particles are embedded by fine material (Birtwell 1999).

Fish emigrate from construction sites and benthic taxa drift downstream to sites where sediment deposition has not affected habitat suitability (Reid and Anderson 1999). In Ontario, stream-crossing construction using fluming produced less turbidity and sediment concentrations downstream than construction by wet open cutting streams; wet open cutting resulted in a significant decrease in aquatic invertebrates downstream three days post-construction (Baddaloo 1978 cited in Gartman 1984). One year after construction, there were no significant differences in benthos numbers. Reid et al. (2008) summarized the results of nine wet open-cut pipeline stream crossing studies and noted all measured effects to downstream stream invertebrate population abundance or diversity (six of nine studies) were less than a year in duration, with three studies having no measured effects on invertebrate abundance. In general, the percentage of types of stream benthos and invertebrate taxa affected by construction would be in proportion to their abundance during the season of construction, which is likely to be relatively high as crossings would occur during the summer growing season.

Although the discussed studies indicate pipeline construction reduces downstream benthic organism presence, rapid colonization by benthic organisms of disturbed substrate following pipeline construction has been demonstrated elsewhere. In Pennsylvania, samples taken before and 30 days after pipeline construction revealed rapid recolonization of the disturbed and newly-exposed stream substrate by benthic macroinvertebrates (Gartman 1984). Similarly, the number and diversity of aquatic invertebrate taxa in coldwater streams in New York State were unchanged two to four years following pipeline construction from those measured prior to construction (Blais and Simpson 1997). Additionally, most studies of effects on stream invertebrates are based on wet open-cut crossings, which normally have much higher suspended sediment concentrations than the isolated dry stream crossing methods that would be used by the Project. Therefore, the overall level of effect of the pipeline crossings on freshwater stream invertebrates, unless crossing sealing failures occur, would be even less than that noted by literature and would not result in substantial reduction in growth or survival of listed coho salmon individuals.

Hydrostatic Testing

Water would be required to hydrostatically test the pipeline. Potential impacts associated with hydrostatic testing include entrainment of fish and transfer of exotic organisms between basins.

There are four potential locations within the range of SONCC coho ESU where water would be withdrawn for hydrostatic testing and/or dust control. SONCC coho are present in the Rogue River from which an estimated 2.9 million gallons would be withdrawn from critical habitat. An estimated 3.1 million gallons would be withdrawn from Star Lake or possibly the Medford Aqueduct; however, no SONCC coho are known or assumed to be present in these waterbodies.

There are 10 proposed hydrostatic test break sections where test water would be discharged that are within range of SONCC coho ESU. Of the 10, seven hydrostatic test break sections are farther than 0.5 mile from any waterbodies supporting SONCC coho and the other three are farther than 760 feet from coho critical habitat. There would be little to no risk of discharged hydrostatic test water accidentally entering the waterbodies with designated critical habitat.

Discharge volume at each site would range from about 0.2 to 3.3 million gallons at rates ranging from several hundred to several thousand gallons per minute. Total water used would be about 65 million gallons, with about half from impoundments or lakes, and the rest from streams, including Coos River, East and Middle Forks Coquille Rivers, Ollalla Creek, South Umpqua River, Rogue River, Klamath River, and Lost River. Estimates of potential water intake amounts from the one potential flowing stream having SONCC coho, the Rogue River, indicate flow below intake would be reduced by less than one percent from typical monthly flows during the month of withdrawal at one potential location during withdrawal (duration about 6 to 11 days at each potential location) (Ambrose 2018). Within the range of SONCC coho salmon, there are three potential water sources—the Rogue River and Star Lake—and there are six potential discharge locations all of which occur within TEWA of the right-of-way. There are some other sites under consideration but these options have not been finalized. Final selection of intake rates and sites would be reviewed by ODFW and OWRD prior to testing, so that potential effects fish habitat from flow reductions would be unlikely.

Pacific Connector would minimize the potential effects of hydrostatic testing on these watersheds by adhering to the measures in its *Hydrostatic Test Plan* (see appendix U), including screening intake hoses to prevent the entrainment of fish and other aquatic organisms, meeting NMFS screening criteria, and regulating the rate of withdrawal to avoid adverse impact on aquatic resources or downstream flows. Where test water cannot be returned to its withdrawal source, the water would be treated with a mild chlorine treatment and discharged to an upland location (at least 150 feet from streams with no direct discharge features) through a dewatering structure at a rate to prevent scour and erosion and to promote infiltration. Pacific Connector would obtain all necessary appropriations, withdrawal, and discharge permits through the OWRD. With the implementation of the *Hydrostatic Test Plan* and BMPs, and obtaining required permits, adequate measures would be in place to prevent direct or indirect effects to SONCC coho salmon that may be in these stream systems.

One of the responsibilities of the EI is to ensure compliance with the requirements of FERC's *Plan* and *Procedures,* and all other environmental permits and approvals, including the multiple plans comprising the POD (see Section 4.0 in the ECRP in appendix F). This would include compliance with the OWRD water appropriation permit conditions, which would specify water withdrawal rates and volumes. The EI would ensure that these permit conditions are followed and ensure that water withdrawal pumps used to withdraw surface water would be screened according to NMFS screening criteria to prevent entrainment of aquatic species. When pumping water from a source, the pump head would be submerged and maintained on average at the center of the water column so as to prevent sucking in sediments and/or algae lying at the water level surface or sediments resting on the bed of the waterbody. The EI would also ensure that the targeted ramping rate would be managed such that there is no significant decrease of river flows.

Aquatic Nuisance Species

NAS are aquatic species that degrade aquatic ecosystem function and benefits, in some cases completely altering aquatic systems by displacing native species, degrading water quality, altering trophic dynamics, and restricting beneficial uses (Hanson and Sytsma 2001). Currently, there are 180 reported NAS in Oregon, of which 134 are documented within the USGS hydrologic basins that would be crossed by the Pipeline (USGS 2017).

In the riverine environments crossed by the Pipeline, largemouth and smallmouth bass, introduced as recreational species, prey on juvenile sockeye, coho, and Chinook salmon (Tabor et al. 2007). Management priorities in Oregon concentrate on the NAS whose current or potential impacts on native species and habitats, and economic and recreational activity in Oregon, are known to be significant (Hanson and Sytsma 2001). Some of the major potential freshwater invasive species are mussels, including the zebra and quagga mussels (*Dreissena polymorpha*, and *Dreissena rostriformis bugenisis*), as well as Chytrid fungus and other species of concern.

Pacific Connector has developed BMPs and guidelines to avoid the potential spread of the aquatic nuisance species and pathogens of concern (see *Hydrostatic Test Plan* in appendix U) in consultation with the BLM and Forest Service as well as the Center for Lakes and Reservoirs and Aquatic. If determined to be feasible for hydrostatic testing requirements, all water used in hydrostatic testing would be returned to its withdrawal source location after use; however, cascading water from one test section to another to minimize water withdrawal requirements may make it impractical to release water within the same watershed where the water was withdrawn. If it is not possible to return the water to the same water basin from where it was withdrawn, Pacific Connector would employ a water treatment method (chlorination, filtration, or other appropriate method) to disinfect the water that would be transferred across water basin boundaries. The hydrostatic test water would be treated after it is withdrawn and prior to hydrostatic testing.

As explained in the *Hydrostatic Test Plan* (see appendix U), Pacific Connector proposes to use a treatment of 2 ppm or 2 mg/l of free chlorine residual with a detention time of 30 minutes to treat all non-municipal surface waters that would be used as a water source for hydrostatic testing purposes. Chlorinated water would be released according to ODEQ criteria to prevent water quality impacts, potential effects to aquatic species, and to minimize potential impacts to sensitive areas. These plans would also be used for equipment used between waterbodies, and would include the inspection and cleaning of waterbody crossing equipment including flume pipes, pumps hoses, screens, or other materials and equipment that may be moved from waterbody to waterbody crossings to ensure it is free of dirt, grease, oil or other pollutants prior to installation and it would be steam-cleaned, if necessary. Additional supplemental invasive species protective actions for cleaning of equipment used among water bodies was developed by ODFW specifically for this Project and have been incorporated by Pacific Connector in their *Hydrostatic Test Plan*.

Some items in the *Hydrostatic Test Plan* that would aid in ensuring invasive aquatic species are not transported between streams, including preventing the spread of quagga and zebra mussels, New Zealand mudsnail, and aquatic plant invasion, are:

- Clean all aquatic plants, animals, and mud from vehicles, boats, motors or trailers and discarding the debris in the trash. Rinsing, scrubbing, or pressure washing should occur away from storm drains, ditches, or waterways.
- Drain live wells, bilge, and all internal compartments.
- Dry equipment including boats between uses, if possible (leaving compartments open and sponging out standing water).
- Scrub or pressure wash life jackets, waders, boats, landing nets, and other gear that comes in contact with the water.
- Clean and sanitize as needed which may include heated power wash before moving establishing sanitizing areas away from areas where it may enter surface water including use of bleach solution and run through portable pumps for 10 minutes
- Inspect everything for signs of aquatic invasive species before launching and before leaving.

Fuel and Chemical Spills

Fisheries habitats could be adversely affected if petroleum products of a substantial quantity were accidentally discharged into aquatic environments. Such materials are toxic to algae, invertebrates and fish. Of the products likely to be present during construction, data compiled from a wide range of sources indicate that diesel fuels and lubricating oils are considerably more toxic to aquatic organisms than other, more volatile products (gasoline) or heavier crude oil (Markarian et al. 1994). Release of diesel fuel in freshwater habitats significantly reduced aquatic invertebrate densities and species richness at least 3 miles downstream, but invertebrate densities recovered within a year (Lytle and Peckarsky 2001). Impacts to aquatic habitats that primarily affect aquatic substrates—spawning, incubating and rearing habitats—can remain for much longer periods (Markarian et al. 1994).

Equipment used for construction across waterbodies could potentially release hydraulic fluid comprised of a variety of compounds, the most common of which are mineral oil-based, organophosphate esters, and polyalphaolefins (HHS 1997). Release from machinery can occur through faulty seals, hoses, sumps and reservoirs, or general system failure. Components of mineral oil and polyalphaolefins do appear to bioaccumulate in animals whereas larger molecular constituents in organophosphate esters can concentrate in fish, primarily partitioning in fat tissue (HHS 1997). In general, toxicity of organophosphate esters is greater than either mineral oil or polyalphaolefin-based hydraulic fluids when inhaled, ingested, and in contact with the skin for humans. Toxicities have not been clearly described for aquatic invertebrates or fish and would be dependent on specific chemical components (HHS 1997).

To minimize the potential for spills and any impacts from such spills, Pacific Connector's SPCCP (see appendix L) would be implemented. In general, hazardous materials, chemicals, fuels, and lubricating oils would be not be stored, nor would refueling operations or concrete-coating activities be conducted within 100 feet (150 feet on BLM and NFS lands) of a wetland or waterbody in accordance with FERC's *Procedures* (see appendix C) and the SPCCP (see appendix L), except where no reasonable location is possible and additional containment steps have been taken. The SPCCP would be updated with site-specific information prior to construction. Adherence to these plans and procedures would prevent substantial adverse effects to the listed SONCC ESU coho salmon from Project-related oil product uses.

Effects to Hyporheic Exchange

The hyporheic zone is defined by the extent of surface-subsurface mixing, the hyporheic exchange that moves surface water into the surrounding alluvium and back to the river again through the porous sediment surrounding a river (Tonina and Buffington 2009). The downwelling flows of surface water supply the wetted hyporheic zone with dissolved oxygen, which sustains organisms in the aerobic environment but decomposition of organic materials in the hyporheic zone may deplete oxygen concentrations in return flows to the surface (Findlay et al. 1993; Tonina and Buffington 2009). Alternatively, nutrient enrichment to surface waters occurs with hyporheic exchange by upwelling flows (Valett et al. 1990). For example, hyporheic flow is important for surface water/groundwater interactions that influence bull trout spawning sites and use of other habitats (e.g., juvenile rearing, migration) (FWS 2005g) and presumably those of other salmonids.

GeoEngineers (2017j) developed a ranking procedure to qualitatively evaluate site conditions at waterbody crossings and the probable influence on hyporheic flow and whether a stream channel will have an active and functional hyporheic zone. The procedure assigns a value of 1 to 5 for different criteria: alluvial vs. bedrock substrate, substrate sediment size, stream flow period, presence of an upstream drainage basin, and channel gradient vs. percent drainage area contribution to the fifth-field HUC upstream from the pipeline crossing. The procedure includes weighting factors emphasizing importance of some criteria over the others. In the range of SONCC coho, there was a total of 62 stream crossing evaluated in the four fifth-field watersheds affected in the Upper Rogue River subbasin. Of those, four crossings (one in Big Butte Creek and three in Little Butte Creek watersheds) were evaluated as having high sensitivities to hyporheic zone alterations while 20 crossings (two in Trail Creek, one in Rogue River-Shady Cove, two in Big Butte Creek, and 15 in Little Butte Creek watersheds) had moderate sensitivities. The remaining 38 crossings scored low sensitivity to hyporheic zone alterations.

Construction of the pipeline using dry open cut construction would require removal of native stream bed and bank material from the stream. The subsequent burial of the pipeline would involve replacing those native materials back in the streambed and stream banks. At crossings with steep natural stream banks (e.g., slopes steeper than 3H:1V [horizontal to vertical]), additional stabilization measures such as compaction of backfill may be required that could locally alter stream bank permeability from pre-construction conditions. Removal and replacement of native stream material has the potential to locally disrupt the structure and organization of the hyporheic zone in the immediate area of the pipeline crossing. However, such alterations are expected to be minimal relative to adjacent unaffected streambed and stream banks and could either increase or decrease permeability over an extremely narrow segment of a stream channel, up to 12 feet in width at the maximum trench width. Local disruption of hyporheic function by construction and presence of the pipeline would not be expected to result in measurable effects to dissolved oxygen and/or nutrient enrichment and would not adversely affect coho.

BMPs that reduce the potential impacts to the hyporheic zone include the following:

- Native material that is removed from the pipeline trench during excavation across stream channels would be used to backfill once the pipe is in place in order to minimize potential changes to preconstruction permeability.
- Trench plugs would be installed at the base of slopes adjacent to wetlands and waterbodies and where needed to avoid draining of wetlands or affecting the original wetland or waterbody hydrology.

While the potential impact of pipeline construction on hyporheic exchange is considered to be low at all stream crossings considering the proposed construction methods, Pacific Connector proposes these additional measures to further reduce the potential for even localized impacts to water quality from hyporheic exchange at the stream crossings identified as having high hyporheic sensitivity (Appendix A to GeoEngineers 2017j):

- Document streambed stratigraphy prior to construction if possible, or if not possible, during construction to aid in site restoration. Such documentation would be conducted by staff trained in recognizing and observing river channel processes. If done during construction, this may be performed by the EI after receiving suitable training.
- Segregate active streambed gravels and cobbles from underlying streambed materials (including fractured bedrock) to their natural depth and replace gravels/cobbles to this natural pre-construction depth.

- Below active stream gravels, replace native material in a manner to match upstream and downstream stratigraphy and permeability to the maximum extent practicable.

Runoff from Permanent, Temporary, Existing Access Roads (PARs, TARs, EARs), TEWAs, and Culvert Installation

Runoff from PARs, TARs, EARs, TEWAs, and culvert installation can result in sediment delivery affecting streams supporting SONCC coho. Pacific Connector proposes to construct three new TARs and four new PARs within the range of SONCC coho (table 3.5.3-26). Potential for sediment delivery to streams following construction of the roads was evaluated by applying sediment and drainage assessment components of the Washington Road Surface Erosion Model or WARSEM (Dube et al. 2004) which has been previously applied in Oregon (Surfleet et al. 2011). Specific individual WARSEM modelling components have been used to evaluate levels of risk for delivery of sediment to streams nearest each TAR and PAR as well as nearest streams supporting ESA-species. Two TARs have low risks of sediment delivery to any stream but only one TAR has a low risk of delivery to an ESA stream: North Fork Little Butte Creek, which supports SONCC coho with designated critical habitat. None of the other proposed TARs and PARs have any risk of sediment delivery to streams closest to new road sites.

Similar risk analyses were conducted for portions of EARs that are known to occur within 1SPTH of streams with designated critical habitat for coho and other streams known or assumed to provide habitat for coho in the two ESUs. Finally, TEWAs that are proposed within 1SPTH of critical habitat for coho were evaluated for risks of sediment delivery to coho critical habitat. BMPs proposed by Pacific Connector that would be applied to PARs, TARs, EARs, and TEWAs to prevent sediment delivery in coho critical habitats and other coho-bearing streams are summarized from the ECRP (appendix F to the BA).

The risk analysis utilizes four modelling components required for sediment and drainage assessment as applied in WARSEM. The components that were evaluated for each TAR/PAR include:

- Dominant lithology – information source: Oregon Department of Geology and Mineral Industries, Oregon Geologic Data Compilation 6 (OGDC-6 geodatabase) available from http://www.oregongeology.org/sub/ogdc/index.htm. Dominant lithology coinciding with locations of each PAR or TAR was evaluated at each location.
- Road gradient – evaluated gradient at each PAR or TAR on topographic map using contour lines (rise divided by run) if road gradient is greater than 5 percent grade. If less than 5 percent, gradient was noted as zero to 5 percent.
- Annual rainfall – information source: Western Regional Climate Center, Western U.S. Climate Historical Summaries available from https://wrcc.dri.edu/Climsum.html. Annual rainfall at each location was evaluated by adjusting the average total precipitation for snowfall during the period of record for National Weather Station closest to each PAR or TAR.
- Delivery – evaluated closest distance of each PAR or TAR to any stream segment (perennial or intermittent, using National Hydrography Dataset, available at https://nhd.usgs.gov/data.html) and to each stream segment supporting ESA-listed fish

using ODFW Oregon Fish Habitat Distribution Data available at https://nrimp.dfw.state.or.us/nrimp/default.aspx?pn=fishdistdata. In addition, distances of nonforested and forested vegetation intervening between road and stream segment were measured using GIS.

Technical documentation (Appendix A) in Dube et al. (2004) was used to evaluate levels of risk for erosion and sediment delivery contributed by each of these four site-specific components at each proposed PAR or TAR.

In addition to site-specific conditions, Pacific Connector has specified road lengths and widths for each proposed PAR or TAR. Although road surfacing has not been specified, Pacific Connector has proposed surfacing enhancements as necessary in Section 2.3 of the Transportation Management Plan (see POD [appendix B to this BA]). Road length, width, and surfacing are required components for use in WARSEM as well as daily average traffic volume, which is currently unknown but may be hypothesized using categorical traffic levels in technical documentation for WARSEM (Appendix A, in Dube et al. 2004) and a road age factor which is irrelevant to the evaluation of risk for sediment production since none of the proposed roads have been constructed.

The following components required for WARSEM cannot be evaluated for the PARs and TARs and were not included in this risk analysis:

- Road prism geometry
- Cutslope height
- Cutslope cover
- Drainage ditch width
- Drainage ditch condition

WARSEM estimates the average annual amount of road surface erosion that is delivered to a stream from each road segment modeled by using calculations based on empirical relationships derived from road erosion research (Dube et al. 2004). The model uses the following formulas to calculate road surface erosion and sediment delivery to a stream:

Total Sediment Delivered to a Stream from each Road Segment (in tons/year) = (Tread & Ditch Sediment + Cutslope Sediment) x Road Age Factor

Tread & Ditch = Geologic Erosion Factor x Tread Surfacing Factor x Traffic Factor x Segment Length x Road (Tread + Ditch) Width x Road Gradient Factor x Rainfall Factor x Delivery Factor

Cutslope = Geologic Erosion Factor x Cutslope Cover Factor x Segment Length x Cutslope Height x Rainfall Factor x Delivery Factor

New TARs and PARs. Some of the relevant information used to derive various "Factors" necessary for WARSEM are provided in the tables, below. Percent gradient at locations of proposed TARs and PARs and the associated Road Slope Factor is provided in table 3.5.3-26. The gradient of a road segment influences the erosion rate. Three Road Slope Factors are used in WARSEM and apply to gradients estimated in table 3.5.3-26. The steepest gradient estimated for any proposed road was 9 percent for TAR-143.19, which corresponds to a Road Slope Factor of 1.0. Except for that road and TAR-141.10, the other the proposed road locations are on relatively flat terrain with gradients estimated from zero to 5 percent and Road Slope Factors of 0.2.

TABLE 3.5.3-26

Location and Physical Characteristics for Proposed TARs and PARs in Range of SONCC Coho

Road ID	Fifth Field Watershed	Latitude	Longitude	Length (feet)	Width (feet)	Surface Area (acres)	Gradient (Road Slope Factor) a/
TAR-141.10	Little Butte Creek	’42°29'6.129 N	’22°36”41.25"W	471	25	0.44	7% (1.0)
TAR 143.19	Little Butte Creek	’42°27’"0.095"N	’22°36’"4.968"W	146	20	0.07	9% (1.0)
TAR 145.60	Little Butte Creek	’42°25”36.74"N	’22°35’"1.543"W	391	20	0.18	0 to 5% (0.2)
PAR-113.66	Trail Creek	42°44’"3.236"N	’22°53”7.115"W’	73	25	0.04	0 to 5% (0.2)
PAR-122.18	Shady Cove-Rogue River	42°38’"3.179"N	’22°49”4.483"W’	181	25	0.10	0 to 5% (0.2)
PAR-132.46	Big Butte Creek	42°34’"8.274"N	’22°40’"1.653"W’	271	25	0.16	0 to 5% (0.2)
PAR-150.70	Little Butte Creek	42°22’"8.585"N	’22°32’"0.863"W’	282	25	0.16	0 to 5% (0.2)

a/ Road Slope Factors: 0.2 for gradients of <5%; 1.0 for gradients of 5-10%; 2.5 for gradients >10%. See Table A-6, Appendix A, Dube et al. (2004)

Erodibility of a road segment is related to soil characteristics at the site location which are related to the parent lithology and weathering. Relative erodibility for different rock types of different geologic ages that are associated with proposed TARs and PARs are provided in table 3.5.3-27 as the Geologic Erosion Factor corresponding to each lithology. The highest Geologic Erosion Factor (5) is associated with Quaternary and Tertiary volcanic ash and tuff as well as with weathered granite and other intrusive rocks. Deeply weathered sedimentary rocks that degrade to silt and sand also have the highest Geologic Erosion Factor. Weathered schist or gneiss from the Tertiary and older formations have moderate Geologic Erosion Factor (2), and others in table 3.5.3-27 have low Geologic Erosion Factor (1).

TABLE 3.5.3-27

Surface Lithology and Average Annual Total Rainfall Estimated at the National Weather Service Station (NWS) Closest to Each Proposed TAR and PAR in Range of SONCC Coho

Road Identification	Dominant Lithology a/	Geologic Erosion Factor b/	Closest NWS Station (NWS Number) c/	Period of Record	Station Distance to Road (miles)	Average Annual Rainfall d/ (inches)	Rainfall Factor e/
TAR-141.10	Oligocene/Miocene basaltic andesite	low (1)	Lake Creek 5 SE (354534)	1955-2009	8.7	23.84	1.9
TAR 143.19	Oligocene/Miocene basaltic andesite	low (1)	Lake Creek 5 SE (354534)	1955-2009	6.9	23.84	1.9
TAR 145.60	Oligocene/Miocene basaltic andesite	low (1)	Lake Creek 5 SE (354534)	1955-2009	5.0	23.84	1.9
PAR-113.66	Eocenet tuff volcaniclastic rocks	high (5)	Trail 12 NE (358588)	1951-1970	11.2	41.03	4.2
PAR-122.18	Eocene intermediate and silicic ash flow tuff	high (5)	Lost Creek Dam (355055)	1970-2016	6.8	32.98	3.0
PAR-132.46	Oligocene/Miocene basalt, basaltic andesite and andesite	low (1)	Lost Creek Dam (355055)	1970-2016	6.2	32.98	3.0
PAR-150.70	Miocene basaltic andesite	low (1)	Lake Creek (354634)	1955-2009	1.2	23.84	1.9

a/ Dominant Lithology evaluated from Oregon Department of Geology and Mineral Industries, Oregon Geologic Data Compilation 6. Available from http://www.oregongeology.org/sub/ogdc/index.htm.

b/ Geologic Erosion Factor surmised from Figure A-1 and Table A-1 in Appendix A, Dube et al. (2004).

c/ Closest NWS Station (with Cooperator Number) based on coordinates provided in individual station data, available from Western Regional Climate Center, Western U.S. Climate Historical Summaries (available from https://wrcc.dri.edu/Climsum.html).

d/ Average Annual Rainfall derived from average monthly precipitation adjusted for average monthly snowfall, described in Equation 6, Appendix A, Dube et al. (2004).

e/ Rainfall Factor derived from the average annual rainfall at the closest NWS station, computed using Equation 7, Appendix A, Dube et al. (2004).

Rainfall strongly influences erosion and sediment transport. Instead of using the PRISM climatic model as applied in WARSEM, data from National Weather Service (NWS) cooperating stations closest to each proposed TAR and PAR were used to evaluate average annual rainfall (average monthly precipitation adjusted for average monthly snowfall, described in Equation 6, Appendix A, Dube et al. 2004) for each station's period of record. That information is provided in table 3.5.3-27. A Rainfall Factor, derived from the average annual rainfall at the closest NWS station, is computed from Equation 7, Appendix A, Dube et al. (2004) and provided in table 3.5.3-27. In general, average annual rainfall and Rainfall Factors for proposed TARs and PARs decline with distance along the Pipeline route from west to east.

The Delivery Factor is a key component of WARSEM and subsequent estimation of risks by erosion and road-generated sediments to aquatic resources. Sediment transport is dependent on the slope of the hillside, infiltration capacity of the soils, volume and depth of runoff water, and obstructions on the hillside (e.g., effectiveness of vegetative buffers at trapping sediment) that would slow runoff water and trap the sediment (Dube et al. 2004). While roads farther than 200 feet from a stream are assumed not to deliver sediment to streams unless a gully exists that allows for transport of sediment from the road to the stream, roads within 100 to 200 feet of a stream are assumed to allow for delivery of 10 percent of produced sediment; roads less than 100 feet from a stream allow for delivery of 35 percent of produced sediment, and drainage from a road to a stream allows for 100 percent of produced sediment (see Table A-10, Appendix A, Dube et al. 2004).

This simplified scheme identifies four levels for the Road Delivery Factor in WARSEM: 0, 10, 35, and 100 (see table 3.5.3-28). Although vegetation characteristics are not factors in WARSEM, distances through nonforested and forested vegetation that intervene between each proposed road and the closest stream (and closest stream supporting ESA species) are included in table 3.5.3-28. The highest Road Delivery Factor in table 3.5.3-28 is 35 (indicating delivery of 35 percent of sediment produced by the new road) for PAR-122.18 which is 36 feet from Cricket Creek, a waterbody that does not support SONCC coho at the road location but is assumed to support SONCC coho 1,385 feet downstream from the road. TAR-145.60 is 111 feet from North Fork Little Butte Creek which provides critical habitat for SONCC coho but the Road Delivery Factor is 10, indicating delivery of 10 percent of sediment produced by the new PAR.

TABLE 3.5.3-28

Estimated Risks for Sediment Delivery to Any Closest Stream and Closest Stream with ESA Species from Each Proposed TAR and PAR in Range of SONCC Coho with Distances of Vegetation Intervening between Road and Stream

Road Identification	Closest Stream (distance)	Flow a/	Intervening Vegetation (distance)	Road Delivery Factor b/	Closest ESA Stream (distance)	Intervening Vegetation (distance)	Road Delivery Factor b/
TAR-141.10	Star Lake (210 ft)	pond	Nonforested (210 ft) Forested (0 ft)	0	Lick Creek (9,000 ft)	Nonforested (1,400 ft) Forested (7,600 ft)	0
TAR 143.19	Trib. to Salt Creek (290 ft)	I	Nonforested (210 ft) Forested (0 ft)	0	Salt Creek c/ (3,660 ft)	Nonforested (460 ft) Forested (3,200 ft)	0
TAR 145.60	N. Fk. Little Butte Ck. c/ (111 ft)	P	Nonforested (0 ft) Forested (111 ft)	10	N. Fk. Little Butte Ck. c/ (111 ft)	Nonforested (0 ft) Forested (111 ft)	10
PAR-113.66	Dead Horse Creek (2,500 ft)	P	Nonforested (1020 ft) Forested (1480 ft)	0	None	N/A	N/A
PAR-122.18	Cricket Creek (36 ft)	P	Nonforested (36 ft) Forested (0 ft)	35	Cricket Creek d/ (1085 ft)	Nonforested (525 ft) Forested (560 ft)	0
PAR-132.46	Trib. to Quartz Creek (270 ft)	I	Nonforested (270 ft) Forested (0 ft)	0	Quartz Creek c/ (830 ft)	Nonforested (830 ft) Forested (0 ft)	0
PAR-150.70	Trib. S. Fk. Little Butte Ck. (877 ft).	I	Nonforested (570 ft) Forested (307 ft)	0	S. Fk. Little Butte Ck c/ (6,800 ft)	Nonforested (3,680 ft) Forested (3,120 ft)	0

a/ Flow: P = Perennial, I = Intermittent/Ephemeral
b/ Road Delivery Factor: in WARSEM = 0, 10, 35, and 100 see Table A-10, Appendix A, Dube et al. (2004).
c/ Supporting SONCC ESU Coho and Critical Habitat
d/ Supporting summer steelhead with assumed presence of SONCC Coho

The products of three site-specific erodibility factors—Road Slope, Rainfall, and Geologic Erosion factors—are provided in table 3.5.3-29. The product of the three factors is assumed to represent a level of risk for erosion from each road's surface and has been ranked as Low (product <1), Moderate (product from 1 to 5), and High (product >5). The largest three factor product is 4.2 for PAR-113.66 due to a high Rainfall Factor and relatively high Geologic Erosion Factor. Table 3.5.3-29 also includes the Road Delivery Factor for any stream closest to each proposed road. The four factor products (including the three Site Erodibility Factors and Road Delivery factor for any closest stream) have been ranked as None (product of 0), Low (product >0 to 20), Moderate (product >20 to 50), and High (product >50).

The risk analysis indicates PAR-122.18 has a high risk of sediment delivery to any stream located near it but, because of distance, poses no risk to a stream with listed fish or designated habitat. TAR-145.60 has a low risk of sediment delivery to an ESA stream, to the North Fork Little Butte (nearest stream), which is designated critical habitat for SONCC coho. None of the other new TARs and PARs in table 3.5.3-29 pose any risk for sediment delivery to any stream.

TABLE 3.5.3-29

Summary of New Road Erosion Risks and Risks of Sediment Delivery to any Stream and ESA Stream Closest to Proposed TARs and PARs in Range of SONCC Coho

	New Road Site Erodibility Factors					Any Stream Closest to New Road			ESA Stream Closest to New Road		
Road Identification	Road Slope Factor a/	Rainfall Factor b/	Geologic Erosion Factor b/	Three Factor Product	Road Erosion Risk	Road Delivery Factor c/	Four Factor Product with Delivery	Risk of Sediment Delivery to Any Stream	Road Delivery Factor c/	Four Factor Product with Delivery	Risk of Sediment Delivery to ESA Stream
TAR-141.10	1.0	1.9	1	1.9	Moderate	0	0	None	0	0	None
TAR-143.19	1.0	1.9	1	1.9	Moderate	0	0	None	0	0	None
TAR-145.60	0.2	1.9	1	0.4	Low	35	13	Low	35	13	Low
PAR-113.66	0.2	4.2	5	4.2	Moderate	0	0	None	N/A	N/A	N/A
PAR-122.18	0.2	3.0	5	3.0	Moderate	35	105	High	0	0	None
PAR-132.46	0.2	3.0	1	0.6	Low	0	0	None	0	0	None
PAR-150.70	0.2	1.9	1	0.4	Low	0	0	None	0	0	None

a/ Slope Erosion Factors from table 3.5.3-26.
b/ Rainfall Factor and Geologic Erosion Factor from table 3.5.3-27.
c/ Road Delivery Factor from table 3.5.3-28.

EARs. A similar analysis was conducted for EARs that could potentially be utilized during Project construction, accessing the construction right-of-way and other project components. The following analysis is limited to segments of EARs that are within 1SPTH from streams within range SONCC coho, including designated critical habitats. EARs include federally-managed roads located on federally-managed lands and privately-owned lands that would be used/authorized during timber removal, construction, and operations to access the construction and operational right-of-way.

There are 65 EARs totaling 3.66 miles within 1SPTH of waterbodies within range of SONCC coho. Of those, 14 are paved, 13 are graveled, and 38 have dirt surfaces. Three EARs with dirt surfaces and two with gravel surfaces are within 1SPTH of waterbodies with critical habitat for SONCC coho and included in table 3.5.3-30. Risk estimates for sediment delivery from each of those EARs to four streams with critical habitat in range of SONCC Coho are summarized in table 3.5.3-30 utilizing the same data sets and factors (Road Slope Factor, Rainfall Factor, Geologic Erosion Factor, and Road Delivery Factor) described above for streams closest to new proposed TARs and PARs. In addition, the Road Surface Factor (1 for dirt, 0.5 for gravel) is included in a Five Factor Product is assumed to represent a level of risk for erosion from each road's surface and has been ranked as Low (product <10), Moderate (product from 10 to <100), and High (product >100) in table 3.5.3-30.

The largest five factor product in table 3.5.3-30 is 225 for the EAR within 1SPTH of Canyon Creek due to its dirt surface, relatively high Rainfall and Geologic Erosion factors, and direct delivery of sediment assumed since the road crosses Canyon Creek. The EAR within 1SPTH of Salt Creek also crosses the waterbody but five factor product is 28 with a moderate risk due to a lower Rainfall Factor and lower Geologic Erosion Factor due to Oligocene/Miocene basaltic andesite lithology even though the EAR has a dirt surface. However, unlike newly developed project roads (e.g., PARs and TARs), to varying degrees the sediment delivery risk from these roads to critical habitat already exists independent of Project actions.

TABLE 3.5.3-30

Summary of New Road Erosion Risks and Risks of Sediment Delivery to Streams with Coho Critical Habitat by Existing Dirt and Gravel Surfaced Roads within 1SPTH in Range of SONCC Coho

Watershed and Critical Habitat with EAR	Number of EARs	Road Surface	Total Road Length (miles)	Road Surface Factor a/	Road Slope Factor b/	Rainfall Factor c/	Geologic Erosion Factor d/	Road Delivery Factor e/	Five Factor Product	Risk of Sediment Delivery to Critical Habitat
Trail Creek										
Canyon Creek	2	Dirt	0.15	1	0.2	2.2	5	100	225	High
Shady Cove-Rogue River										
Rogue River	1	Gravel	0.01	0.5	0.2	2.2	5	10	11	Moderate
Little Butte Creek										
Salt Creek	1	Dirt	0.12	1	0.2	1.4	1	100	28	Moderate
North Fork Little Butte Creek	1	Gravel	0.03	0.5	0.2	1.4	1	35	5	Low

a/ Road Surface Factors: 0.5 for gravel, 1.0 for dirt. See Table A-3, Appendix A, Dube et al. (2004)

b/ Road Slope Factors: 0.2 for gradients of <5%; 1.0 for gradients of 5-10%; 2.5 for gradients >10%. See Table A-6, Appendix A, Dube et al. (2004)

c/ Rainfall Factor derived from the average annual rainfall at the closest NWS station, computed using Equation 7, Appendix A, Dube et al. (2004).

d/ Geologic Erosion Factor surmised from Figure A-1 and Table A-1 in Appendix A, Dube et al. 2004 based on Dominant Lithology evaluated from Oregon Department of Geology and Mineral Industries, Oregon Geologic Data Compilation 6. Available from http://www.oregongeology.org/sub/ogdc/index.htm.

e/ Road Delivery Factor: Distance from stream, >200 feet = 0, 100 to 200 feet = 10, <100 feet = 35, and direct delivery = 100. See Table A-10, Appendix A, Dube et al. (2004).

TEWAs. Distances of TEWAs to waterbodies within 1SPTH of designated critical habitat for SONCC Coho were measured using GIS and digitized waterbody streambanks and TEWA polygons. Consequently, distances could change once boundaries of TEWAs are surveyed on the ground. From these estimates, there are there are seven waterbodies with a total of 21 TEWAs within 1SPTH of critical habitat for SONCC coho, totaling 3.96 acres.

Risk estimates for sediment delivery from each of TEWAs similar to that described above for TARs, PARS, and EARs were not conducted since the procedures in WARSEM modeling is not applicable to TEWAs except for the road delivery factor (distance from a TEWA to a stream). All TEWAs in table 3.5.3-31 that are within 1SPTH of waterbodies with designated critical habitat are closer than 200 feet to streams, two TEWAs are less than 200 feet but more than 100 feet to streams, and 19 TEWAs within 1SPTH of waterbodies with designated critical habitat are less than 100 feet from the streams; 12 TEWAs are within 50 feet of designated critical habitat and sediment delivery to critical habitat has the greatest potential from those 12 TEWAs and a portion of TEWA 128.55-N overlaps critical habitat, potentially capable of direct sediment delivery based on the sediment delivery distance categories in WARSEM (Table A-10, Appendix A, Dube et al. 2004).

TABLE 3.5.3-31

Individual TEWAs within One Site-Potential Tree Height of Streams with Critical Habitats in Watersheds within Range of SONCC Coho

Watershed	Waterbody with Critical Habitat	TEWA ID	Distance (feet) to Critical Habitat	TEWA Area (acres) in 1SPTH
Trail Creek	West Fork Trail Creek	TEWA 118.70-N	25	0.05
		TEWA 118.83-W	10	0.25
		TEWA 118.89-W	17	0.16
	Canyon Creek	TEWA 120.29-W	31	0.18
		TEWA 120.48-W	64	0.10
Shady Cove-Rogue River	Rogue River	TEWA 122.62-W	10	0.77
	Indian Creek	TEWA 128.55-N	0	0.09
		TEWA 128.55-W	139	0.03
		TEWA 128.63-W	72	0.07
Big Butte Creek	Neil Creek	TEWA 131.88-N	10	0.07
	Quartz Creek	TEWA 132.72-W	130	0.08
		TEWA 132.79-W	76	0.07
Little Butte Creek	Salt Creek	TEWA 142.17-N	12	0.47
		TEWA 142.51-W	45	0.38
		TEWA 142.58-W	18	0.12
		TEWA 142.58-N	46	0.12
	Trib. to Long Branch Ck	TEWA 144.12-W	84	0.06
	NF Little Butte Creek	TEWA 145.58-N	40	0.14
		TEWA 145.58-W	50	0.16
		TEWA 145.70-W	85	0.31
		TEWA 145.70-N	65	0.28

Erosion of new road surfaces, existing road surfaces, and exposed surfaces of TEWAs within 1SPTH have the potential for sediment delivery to streams and could lead to adverse effects on fish and fresh water benthic invertebrates similar to those described above. As discussed in Section 2.3 of Pacific Connector's *Transportation Management Plan* (see POD [appendix B to this BA]), Pacific Connector would perform road surfacing structural capacity assessments and place additional road surfacing (aggregate or bituminous as appropriate) as needed for the planned use to minimize the potential for both road-related and off-road resource damage. In WARSEM modeling, the Road Tread Surfacing Factor is 1 for roads with native materials surface but is 0.2 for a gravel (aggregate) surface and 0.03 for an asphalt (bituminous) surface. Application of surfacing materials to any of the new TARs and PARs in table 3.5.3-29 with low to high risks of sediment delivery to streams would decrease levels of erosion and quantities of sediment delivered. Surfaces of all new PARs would be graveled thereby decreasing their erosion potential. Further, PARs and TARs would meet land-managing agencies' engineering design and road management standards consistent with the intended use of the road and all applicable agency BMPs; all applicable agency BMPs for erosion control would be implemented. In addition, Pacific Connector would install appropriate erosion and sediment control BMPs along the access roads as determined necessary by Pacific Connector's EI in cooperation with applicable agency officials. All land-managing agency roads are subject to short-term traffic restrictions and/or closures due to seasonal or unusual weather conditions, user safety or when necessary to prevent facility or resource damage.

Culvert Installation. Pacific Connector's ECRP also identifies mitigation measures that may be required to minimize potential impacts to existing culverts prior to access road use, to allow safe construction equipment travel and prevent damage to the culverts. Pacific Connector has completed an assessment to identify where proposed road improvements or where new permanent or temporary access roads would cross waterbodies and culvert installations would be required. The assessment used Pacific Connector's wetland survey data where access was available. Where access was not available, the assessment used FWS' National Wetland Inventory (NWI) data[39], USGS NHD data,[40] ODF statewide streams data,[41] LiDAR data, and aerial photography to interpret waterbody crossings. Identified waterbody crossings were also correlated with Pacific Connector's preliminary access road improvement plans that were completed to evaluate improvements necessary to accommodate trucks hauling pipe (Dyer Partnership 2015). The access road improvement plans (Dyer Partnership 2015) were based on field investigations and identified locations where new culverts or culvert extensions would be necessary.

The new culverts needed to cross waterbodies are located on small intermittent headwater streams where there is no fish presence. The measures outlined in Pacific Connector's Culvert Crossing BMPs (see Attachment F to the ECRP in appendix F) and appropriate erosion control and revegetation measures outlined in the ECRP would be implemented during any road improvement activities. As indicated in the Culvert Crossing BMP, prior to construction, existing culverts would be investigated along all private roads and federally authorized roads (i.e., BLM and Forest Service) identified for access to the construction right-of-way. These investigations would occur on access roads where Pacific Connector is authorized to be and/or where Pacific Connector has negotiated an access use agreement or easement. The investigation would determine the condition and integrity of existing culverts and identify any location that may require mitigative measures to ensure construction activities do not damage or impair the existing function of the culverts. Mitigative measures may be required prior to access road use to allow safe construction equipment travel and prevent damage to the culverts. In select locations, replacement and/or modification of a culvert may be necessary. As noted above, Pacific Connector has completed an assessment to identify where proposed road improvements would cross waterbodies and culvert installations would be required. The new culverts identified are located on small intermittent headwater streams where there is no fish presence.

Runoff from Facility Surfaces

There are three contractor and pipe storage yards, four rock source and disposal sites, three new TARs, two new PARs, and four aboveground facilities within the range of SONCC coho. One yard, Rogue Aggregates in the Gold Hill-Rogue River Watershed, is within 100 feet of the Rogue River. None of the rock source and disposal sites are near waterbodies inhabited by SONCC coho and no new PARs are near coho habitat.

Stored materials at the yards may include: construction mats, fencing materials, fuel and lubricants, stormwater control materials (straw bales, erosion control fabric, silt fence materials, etc.), and other construction materials. The yards would also be used for contractor office trailers and employee parking facilities. Although the yards are previously disturbed industrial sites, there is

[39] https://www.fws.gov/wetlands/nwi/overview.html
[40] https://nhd.usgs.gov/data.html
[41] http://www.oregon.gov/ODF/AboutODF/Pages/MapsData.aspx

some unknown level of risk that stored materials and surface runoff could enter SONCC coho critical habitat.

Pacific Connector has consulted with the BLM, the Forest Service, and the NRCS regarding erosion control and revegetation specifications. Other appropriate agencies have been consulted as well. The ODA Noxious Weed Control Program, as well as the BLM and the Forest Service, have been contacted regarding recommendations for the prevention and spread of noxious weeds with those incorporated into the Pipeline Project-specific ECRP. Pursuant to FERC's *Procedures* (see section IV.A), Pacific Connector has prepared an SPCCP (see appendix L). The SPCCP includes identifying all potential spill hazards at the facility (including oil) and lists the appropriate response actions and contacts for facility and emergency response personnel. All station technicians would be trained for proper handling, storage, disposal, and spill response of hazardous).

Operation and Maintenance Activities

Once installed, maintenance of the pipeline would include activities such as aerial inspections, gas flow monitoring, visual inspection of surrounding vegetation for signs of leaks, and integrity management, which includes smart pigging to investigate the interior surface of the pipe for any signs of stress cracking, pitting, and other anomalies (see the ECRP, appendix F). All of the proposed maintenance activities would be outlined in the Operations and Maintenance Plan that would be prepared according to operating regulations in USDOT 49 CFR Subpart L, Part 192 and would be completed prior to going in-service. These general maintenance activities would require only surface activities and usage of the existing right-of-way, such as insertion of the pig at one of the pig launching facilities.

Potential stream channel disturbance would occur if an integrity issue with the pipeline was found. If this were to occur, the pipeline would need to be unearthed within the right-of-way and repair work done in-water. Within stream sites, repair work could require isolated flow from the section of pipe that is to be exposed. Typically, repairs would be made to the pipe within the right-of-way (within the trench) or, depending on the site-specific conditions and nature of the repair needed, a reroute around the affected section may be considered.

Impacts would be similar to those discussed above for initial installation except on a much smaller scale, because they would only involve one crossing compared to many streams. However, should repairs be needed out of the standard stream crossing window (i.e. during periods of fish spawning or egg incubation) there would be additional adverse effects to key fish resources at the specific site. The actions would include all relevant BMPs and mitigation, dependent upon site conditions and land ownership. Any future repairs would require additional permit approval from appropriate state and federal agencies that would determine the acceptable parameters of these actions. Such pipeline integrity-based in-water projects are very infrequent.

Vegetation maintenance would be limited adjacent to waterbodies to allow a riparian strip to permanently revegetate with native plant species across the entire right-of-way. To facilitate periodic pipeline corrosion/leak surveys, a corridor centered on the pipeline and up to 30 feet wide would be maintained in an herbaceous state, with shrubs outside of this 30-foot corridor. In addition, trees that are located within 15 feet of the pipeline may be cut and removed from the right-of-way. No vegetation or tree limitations would occur beyond the 30-foot wide corridor in riparian areas (i.e., up to 100 feet of streams on federal lands, and 25 feet on non-federal lands).

Herbicide Application

Herbicides have the potential to cause toxic effects to different salmonid life stages and to other aquatic species, causing direct impacts, if used improperly. When herbicides are properly used according to label restrictions and BMPs to control noxious weeds, there is little to no chance of causing injury or mortality to fish or other aquatic organisms.

Pacific Connector would not use herbicides for routine vegetation maintenance. However, following construction, Pacific Connector would implement the IPM (see Appendix N to Pacific Connector's POD [appendix B in this BA]), which addresses control of noxious weeds and invasive plants across the Pipeline Project which would include the selective use of herbicides where necessary to control noxious weeds by limited application from the ground, where allowed by landowners. The plan was developed in consultation with the ODA, BLM, and Forest Service. Herbicides have the potential to cause toxic effects to different salmonid life stages and to other aquatic species, causing direct impacts, if used improperly

The BMPs would minimize the potential spread of invasive species and minimize the potential adverse effects of control treatments. Herbicides would not be applied by aerial or broadcast spraying. Noxious weeds would be removed only by manual methods in the riparian zone defined as one site-potential tree height and within Riparian Reserves that are defined as being greater than 150 feet in most areas along the route. Pacific Connector would not directly spray, or otherwise apply, herbicides in waterbodies or in riparian zones. The risk of drift would be avoided by selectively applying herbicides from the ground.

Where weed control is necessary along the construction right-of-way, Pacific Connector's first priority would be to employ hand and mechanical methods (pulling, mowing, biological, disking, etc.) applicable to the species to prevent the spread of potential weed infestations, where feasible. To determine if an herbicide is to be used over other control methods, Pacific Connector would base the decision on weed characteristics and integrated weed management principles (Forest Service 2005). If herbicides are used to control noxious weed infestations, they would be used when they are the most appropriate treatment method. Spot treatments and the use of selective herbicides would be utilized to minimize impact to native or non-target species. Permits or approvals for the use of herbicides and adjuvants on federal lands would be obtained prior to use/treatment, as detailed in the IPM (see Appendix N to the POD [appendix B to this BA]). Considering the potential for limited use of herbicides along the route, and precautions that would be in place to prevent entry into waters, meaningful negative effects to SONCC coho salmon from herbicides would be unlikely to occur.

Critical Habitat

Eight waterbodies known to support coho would be affected by construction of the Pipeline are within designated critical habitat for coho salmon in the SONCC ESU. Critical habitat is designated to include all river reaches accessible to listed coho within the range of the SONCC ESU. Critical habitat consists of the water, substrate, and adjacent riparian zone of estuarine and riverine reaches in hydrologic units and counties identified in NMFS (1999b), including the Upper Rogue HUC 1700307. Accessible reaches are those within historical range of the ESUs that can still be occupied by any life stage of coho salmon.

Riparian Zone Effects. Similar analyses to those above under *Riparian Vegetation Removal and Modification* were conducted for effects to riparian zones associated with each waterbody supporting coho critical habitat and waterbodies that are assumed to provided coho in each watershed. Areas of forested and non-forested habitats that would be affected within the riparian zones of each waterbody during construction are provided in table 3.5.3-32a and areas affected during operation are provided in table 3.5.3-32b and summarized in table 3.5.3-32c. The tables also include riparian zone areas affected by landowner, similar to tables 3.5.3-25a and 3.5.3-25b.

TABLE 3.5.3-32a

Total Terrestrial Habitat (acres) Affected/Removed (a/) by Construction within Riparian Zones (One Site-Potential Tree Height Wide) Associated with Waterbodies Supporting Critical Habitat or Assumed Coho Habitat within Range of SONCC Coho Crossed by the Pipeline

				Forest Habitat b/					Other Habitat b/						
Fifth-Field Watershed (Hydrologic Unit Code [HUC]) and Waterbody with Critical Habitat or Assumed Habitat	**MP**	**Coho Critical Habitat**	**Landowner**	**Late Successional Old Growth Forest**	**Mid-Seral Forest**	**Regenerating Forest**	**Clearcut, Forest**	**Forest Total**	**Forested Wetland**	**Nonforested Wetland**	**Unaltered Nonforested Habitat**	**Agriculture**	**Altered Habitat**	**Other Total**	**Total Riparian Zone Impact (acres)**
Trail Creek (HUC 1710030706)															
West Fork Trail Creek (ASP-202)	118.89	Yes	BLM-Medford District					**0**			0.20			**0.20**	**0.20**
			Non-Federal		0.02			**0.02**			1.31			**1.31**	**1.33**
			Riparian Zone Total	**0**	**0.02**	**0**	**0**	**0.02**	**0**	**0**	**1.51**	**0**	**0**	**1.51**	**1.53**
Canyon Creek (NSP-11)	120.45	Yes	BLM-Medford District	0.58				**0.58**						**0**	**0.58**
			Non-Federal	0.51				**0.51**			0.02			**0.02**	**0.53**
			Riparian Zone Total	**1.09**	**0**	**0**	**0**	**1.09**	**0**	**0**	**0.02**	**0**	**0**	**0.02**	**1.11**
Trib. to Trail Creek (ASI-206)	121.57	Yes	BLM-Medford District	0.31				**0.31**						**0**	**0.31**
			Non-Federal	0.10	0.52	0.02		**0.64**			0.02			**0.02**	**0.66**
			Riparian Zone Total	**0.41**	**0.52**	**0.02**	**0**	**0.95**	**0**	**0**	**0.02**	**0**	**0**	**0.02**	**0.97**
Shady Cove-Rogue River (HUC 1710030707)															
Rogue River (ASP-235)	122.57	Yes	Federal					**0**						**0**	**0**
			Non-Federal		0.32			**0.32**			0.82		0.03	**0.85**	**1.17**
			Riparian Zone Total	**0**	**0.32**	**0**	**0**	**0.32**	**0**	**0**	**0.82**	**0**	**0.03**	**0.85**	**1.17**
Indian Creek (AW-278)	128.60	No	Federal					**0**						**0**	**0**
			Non-Federal					**0**		0.32	0.70			**1.02**	**1.02**
			Riparian Zone Total	**0**	**0**	**0**	**0**	**0**	**0**	**0.32**	**0.70**	**0**	**0**	**1.02**	**1.02**
Big Butte Creek (HUC 1710030704)															
Neil Creek (ASP-252)	132.12	Yes	Federal					**0**						**0**	**0**
			Non-Federal		0.24			**0.24**		0.05			0.11	**0.16**	**0.40**
			Riparian Zone Total	**0**	**0.24**	**0**	**0**	**0.24**	**0**	**0.05**	**0**	**0**	**0.11**	**0.16**	**0.40**
Quartz Creek (ASI-265)	132.75	Yes	Federal					**0**						**0**	**0**
			Non-Federal		0.53			**0.53**	0.01					**0.01**	**0.54**
			Riparian Zone Total	**0**	**0.53**	**0**	**0**	**0.53**	**0.01**	**0**	**0**	**00**	**0**	**0.01**	**0.54**
Little Butte Creek (HUC 1710030708)															
Salt Creek (ESP-34)	142.57	Yes	Federal					**0**						**0**	**0**
			Non-Federal					**0**			0.90			**0.90**	**0.90**
			Riparian Zone Total	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0.90**	**0**	**0**	**0.90**	**0.90**

TABLE 3.5.3-32a (continued)

Total Terrestrial Habitat (acres) Affected/Removed (a/) by Construction within Riparian Zones (One Site-Potential Tree Height Wide) Associated with Waterbodies Supporting Critical Habitat or Assumed Coho Habitat within Range of SONCC Coho Crossed by the Pipeline

Fifth-Field Watershed (Hydrologic Unit Code [HUC]) and Waterbody with Critical Habitat or Assumed Habitat	MP	Coho Critical Habitat	Landowner	Forest Habitat b/: Late Successional Old Growth Forest	Forest Habitat b/: Mid-Seral Forest	Forest Habitat b/: Regenerating Forest	Forest Habitat b/: Clearcut, Forest	Forest Total	Other Habitat b/: Forested Wetland	Other Habitat b/: Nonforested Wetland	Other Habitat b/: Unaltered Nonforested Habitat	Other Habitat b/: Agriculture	Other Habitat b/: Altered Habitat	Other Total	Total Riparian Zone Impact (acres)
Trib. to Long Branch Creek (ESI-38)	143.51	No	Federal					**0**						**0**	**0**
			Non-Federal		2.09			**2.09**			0.55		0.13	**0.68**	**2.77**
			Riparian Zone Total	**0**	**2.09**	**0**	**0**	**2.09**	**0**	**0**	**0.55**	**0**	**0.13**	**0.68**	**2.77**
North Fork Little Butte Creek (ESP-66)	145.69	Yes	Federal					**0**						**0**	**0**
			Non-Federal		0.52			**0.52**		0.42	1.32		0.01	**1.75**	**2.27**
			Riparian Zone Total	**0**	**0.52**	**0**	**0**	**0.52**	**0**	**0.42**	**1.32**	**0**	**0.01**	**1.75**	**2.27**
Trib. to NF Little Butte Ck. (ESI-56)	146.05	No	Federal					**0**						**0**	**0**
			Non-Federal		3.16			**3.16**			0.55		0.13	**0.68**	**3.84**
			Riparian Zone Total	**0**	**3.16**	**0**	**0**	**3.16**	**0**	**0**	**0.55**	**0**	**0.13**	**0.68**	**3.84**
All Fifth-Field Watersheds and Jurisdictions															
			Federal Subtotal	**0.98**	**0**	**0**	**0**	**0.98**	**0**	**0**	**0.20**	**0**	**0**	**0.20**	**1.18**
			Non-Federal Subtotal	**0.61**	**7.33**	**0.02**	**0**	**7.96**	**0.01**	**1.69**	**5.28**	**0**	**0.41**	**7.39**	**15.35**
			Total	**1.59**	**7.33**	**0.02**	**0**	**8.94**	**0.01**	**1.69**	**5.48**	**0**	**0.41**	**7.59**	**16.53**

a/ Project components considered in calculation of habitat "Removed:" Pacific Connector construction right-of-way, temporary extra work areas, aboveground facilities, and permanent and temporary access roads (PAR, TAR).

b/ Habitat Types within Riparian Zones generally categorized as: Late Successional (Mature) or Old Growth Forest (coniferous, deciduous, mixed ≥80 years old); Mid-Seral Forests (coniferous, deciduous, mixed ≥40 but ≤80 years old); Regenerating Forest (coniferous, deciduous, mixed ≥5 but ≤40 years old); Clearcut Forests; Forested and Nonforested Wetland, Unaltered Nonforested Habitat (grasslands, sagebrush, shrublands), Agriculture, and Altered Habitats (urban, industrial, residential, roads, utility corridors, quarries).

TABLE 3.5.3-32b

Total Terrestrial Habitat (acres) a/ within the 30-foot-wide Corridor Maintained over the Pipeline within Riparian Zones (One Site-Potential Tree Height Wide) Associated with Waterbodies Supporting Critical Habitat or Assumed Coho Habitat within Range of SONCC Coho Crossed by the Pipeline

				Forest Habitat b/					Other Habitat b/						
Fifth-Field Watershed (Hydrologic Unit Code [HUC]) and Waterbody with Critical Habitat or Assumed Habitat	**MP**	**Coho Critical Habitat**	**Landowner**	**Late Successional Old Growth Forest**	**Mid-Seral Forest**	**Regenerating Forest**	**Clearcut, Forest**	**Forest Total**	**Forested Wetland**	**Nonforested Wetland**	**Unaltered Nonforested Habitat**	**Agriculture**	**Altered Habitat**	**Other Total**	**Total Riparian Zone Impact (acres)**
Trail Creek (HUC 1710030706)															
West Fork Trail Creek (ASP-202)	118.89	Yes	BLM-Medford District					**0**			0.06			**0.06**	**0.06**
			Non-Federal					**0**			0.26			**0.26**	**0.26**
			Riparian Zone Total	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0.32**	**0**	**0**	**0.32**	**0.32**
Canyon Creek (NSP-11)	120.45	Yes	BLM-Medford District	0.13				**0.13**						**0**	**0.13**
			Non-Federal	0.13				**0.13**			0.01			**0.01**	**0.14**
			Riparian Zone Total	**0.26**	**0**	**0**	**0**	**0.26**	**0**	**0**	**0.01**	**0**	**0**	**0.01**	**0.27**
Trib. to Trail Creek (ASI-206)	121.57	Yes	BLM-Medford District	0.14				**0.14**						**0**	**0.14**
			Non-Federal	0.04	0.15			**0.19**						**0**	**0.19**
			Riparian Zone Total	**0.18**	**0.15**	**0**	**0**	**0.33**	**0**	**0**	**0**	**0**	**0**	**0**	**0.33**
Shady Cove-Rogue River (HUC 1710030707)															
Rogue River (ASP-235)	122.57	Yes	Federal					**0**						**0**	**0**
			Non-Federal		0.07			**0.07**			0.07			**0.07**	**0.13**
			Riparian Zone Total	**0**	**0.07**	**0**	**0**	**0.07**	**0**	**0**	**0.07**	**0**	**0**	**0.07**	**0.13**
Indian Creek (AW-278)	128.60	No	Federal					**0**						**0**	**0**
			Non-Federal					**0**		0.09	0.18			**0.27**	**0.27**
			Riparian Zone Total	**0**	**0**	**0**	**0**	**0**	**0**	**0.19**	**0.18**	**0**	**0**	**0.27**	**0.27**
Big Butte Creek (HUC 1710030704)															
Neil Creek (ASP-252)	132.12	Yes	Federal					**0**						**0**	**0**
			Non-Federal		0.08			**0.08**		0.02			0.05	**0.07**	**0.15**
			Riparian Zone Total	**0**	**0.08**	**0**	**0**	**0.08**	**0**	**0.02**	**0**	**0**	**0.05**	**0.07**	**0.15**
Quartz Creek (ASI-265)	132.75	Yes	Federal					**0**						**0**	**0**
			Non-Federal		0.13			**0.13**						**0**	**0.13**
			Riparian Zone Total	**0**	**0.13**	**0**	**0**	**0.13**	**0**	**0**	**0**	**0**	**0**	**0**	**0.13**
Little Butte Creek (HUC 1710030708)															
Salt Creek (ESP-34)	142.57	Yes	Federal					**0**						**0**	**0**
			Non-Federal					**0**		0.19				**0.19**	**0.19**
			Riparian Zone Total	**0**	**0**	**0**	**0**	**0.**	**0**	**0.19**	**0**	**0**	**0**	**0.19**	**0.19**

TABLE 3.5.3-32b (continued)

Total Terrestrial Habitat (acres) a/ within the 30-foot-wide Corridor Maintained over the Pipeline within Riparian Zones (One Site-Potential Tree Height Wide) Associated with Waterbodies Supporting Critical Habitat or Assumed Coho Habitat within Range of SONCC Coho Crossed by the Pipeline

Fifth-Field Watershed (Hydrologic Unit Code [HUC]) and Waterbody with Critical Habitat or Assumed Habitat	MP	Coho Critical Habitat	Landowner	Forest Habitat b/: Late Successional Old Growth Forest	Forest Habitat b/: Mid-Seral Forest	Forest Habitat b/: Regenerating Forest	Forest Habitat b/: Clearcut, Forest	Forest Total	Other Habitat b/: Forested Wetland	Other Habitat b/: Nonforested Wetland	Other Habitat b/: Unaltered Nonforested Habitat	Other Habitat b/: Agriculture	Other Habitat b/: Altered Habitat	Other Total	Total Riparian Zone Impact (acres)
Trib. to Long Branch Creek (ESI-38)	143.51	No	Federal					**0**						**0**	**0**
			Non-Federal		0.48			**0.48**			0.13		0.02	**0.15**	**0.64**
			Riparian Zone Total	**0**	**0.48**	**0**	**0**	**0.48**	**0**	**0**	**0.13**	**0**	**0.07**	**0.15**	**0.64**
North Fork Little Butte Creek (ESP-66)	145.69	Yes	Federal					**0**						**0**	**0**
			Non-Federal		0.10			**0.10**		0.07	0.33			**0.39**	**0.49**
			Riparian Zone Total	**0**	**0.10**	**0**	**0**	**0.10**	**0**	**0.07**	**0.33**	**0**	**0**	**0.39**	**0.49**
Trib. to NF Little Butte Ck. (ESI-56)	146.05	No	Federal					**0**						**0**	**0**
			Non-Federal		0.27			**0.27**						**0**	**0.27**
			Riparian Zone Total	**0**	**0.27**	**0**	**0**	**0.27**	**0**	**0**	**0**	**0**	**0**	**0**	**0.27**
All Fifth-Field Watersheds and Jurisdictions															
			Federal Subtotal	**0.27**	**0**	**0**	**0**	**0.27**	**0**	**0**	**0.06**	**0**	**0**	**0.06**	**0.33**
			Non-Federal Subtotal	**0.17**	**1.28**	**0**	**0**	**1.45**	**0**	**0.37**	**0.98**	**0**	**0.07**	**1.41**	**2.86**
			Total	**0.44**	**1.28**	**0**	**0**	**1.72**	**0**	**0.37**	**1.04**	**0**	**0.07**	**1.47**	**3.19**

a/ Project components considered in calculation of habitat "Removed:" Pacific Connector construction right-of-way, temporary extra work areas, aboveground facilities, and permanent and temporary access roads (PAR, TAR).

b/ Habitat Types within Riparian Zones generally categorized as: Late Successional (Mature) or Old Growth Forest (coniferous, deciduous, mixed ≥80 years old); Mid-Seral Forests (coniferous, deciduous, mixed ≥40 but ≤80 years old); Regenerating Forest (coniferous, deciduous, mixed ≥5 but ≤40 years old); Clearcut Forests; Forested and Nonforested Wetland, Unaltered Nonforested Habitat (grasslands, sagebrush, shrublands), Agriculture, and Altered Habitats (urban, industrial, residential, roads, utility corridors, quarries).

Effects to water temperature (shade) during construction and operation within the riparian zone of each waterbody assumed to support coho or with coho critical habitat would be minor.

Table 3.5.3-32c below summarizes tables 3.5.3-32a and 3.5.3-32b. The greatest absolute impact to shade within riparian zones associated with critical habitats for SONCC coho would occur at Canyon Creek with removal of 1.09 acres of riparian forest. Riparian zones of Canyon Creek and Tributary to Trail Creek, both within the Trail Creek Watershed, and Quartz Creek within the Big Butte Creek watershed would have relatively large amounts of riparian forest affected during construction but relatively large areas of forest restoration following construction would partially offset the effects of construction. Absolute and relative impact to forests within riparian zones (with concomitant effects to water temperature and shade) associated with other affected waterbodies with critical habit for SONCC coho would be more modest (or nearly zero). The longest-term effects to riparian forest would occur at Canyon Creek and Tributary to Trail Creek (Trail Creek Watershed) where 1.09 acres and 0.50 acre of LSOG forest would be removed, respectively.

TABLE 3.5.3-32c

Summary Table for Effects to Riparian Zones (One Site Potential Tree Height Wide) Associated with Critical Habitats and Assumed Occupied Habitat for SONCC Coho

Fifth-Field Watershed and Waterbody with Critical Habitat	Coho Critical Habitat	Total Riparian Zone Affected (acres)	Riparian Forest Removed by Construction (acres) a/	Riparian Forest Not Restored During Operation (acres) b/,c/	Riparian Forest Restored After Construction (acres)	Percent Riparian Zone Originally Forested	Percent Riparian Forest Removed Permanently c/	Percent of Riparian Zone with Restored Forest
Trail Creek (HUC 1710030706)								
W. Fork Trail Creek	Yes	1.53	0.02	0.00	0.02	1%	0%	1%
Canyon Creek	Yes	1.11	1.09	0.26	0.83	98%	23%	75%
Trib. to Trail Creek	Yes	0.98	0.97	0.33	0.64	99%	34%	65%
Shady Cove-Rogue River (HUC 1710030707)								
Rogue River	Yes	1.17	0.32	0.07	0.25	27%	6%	21%
Indian Creek	No	1.02	0.00	0.00	0.00	0%	0%	0%
Big Butte Creek (HUC 1710030704)								
Neil Creek	Yes	0.50	0.24	0.08	0.16	60%	20%	40%
Quartz Creek	Yes	0.54	0.53	0.13	0.40	98%	24%	74%
Little Butte Creek (HUC 1710030708)								
Salt Creek	Yes	0.90	0.00	0.00	0.00	0%	0%	0%
Trib. to Long Branch Ck.	No	2.77	2.09	0.48	1.61	75%	17%	58%
NF Little Butte Ck.	Yes	2.27	0.52	0.10	0.42	23%	4%	19%
Trib. to NF Little Butte Ck.	No	3.84	3.16	0.27	2.89	82%	7%	74%

a/ Summarized from table 3.5.3-34a.
b/ Summarized from table 3.5.3-34b.
c/ Former forested area in 30-foot-wide corridor not re-forested during operation.

Effects to LW during construction and operation within the riparian zone of each waterbody assumed to support coho or with coho critical habitat are assumed to be directly related to areas of riparian forest removed during construction (riparian forest within the construction right-of-way, TEWAs, TARs, and PARs) and to areas of riparian forest that would be removed within the 30-foot wide operational easement for the life of the Pipeline. Riparian forest that is not in the operational easement would be restored over time, presumably attaining mid-seral status (40 to 80 years old) at the end of the 50-year life of the Pipeline. Magnitude of impact to LW recruitment associated with each waterbody with critical habitat and assumed to be occupied by coho is directly related to the absolute and relative amounts of riparian forest removed during construction, amounts removed permanently by the operational easement, and amounts of riparian forest that would be restored within affected riparian zones.

Summary. The Pipeline Project would result in adverse effects to freshwater critical habitat for the SONCC ESU of coho salmon. Most effects would be short term, but some would be intermediate to long term. Minor short-term effects would occur from sedimentation during construction actions. Minor intermediate-term effects would occur from a reduction in riparian habitat due to construction and operation. Sediment disturbance at stream crossings would affect food sources for rearing fish in the short-term, and riparian plant removal would reduce LW supply affecting habitat quality and quantity in the intermediate to long-term over small stream areas (i.e., within the less than 75- to 95-foot stream length clearing area per crossing).

Within the range of the SONCC ESU, the coho life cycle can be separated into five essential habitat types: 1) juvenile summer and winter rearing areas; 2) juvenile migration corridors; 3) areas for growth and development to adulthood; 4) adult migration corridors; and (5) spawning areas. Within these areas, essential features of coho salmon critical habitat include: adequate 1) substrate, 2) water quality, 3) water quantity, 4) water temperature, 5) water velocity, 6) cover/shelter, 7) food, 8) riparian vegetation, 9) space, and 10) safe passage conditions (NMFS 1999b). Each element or feature defined for critical habitat could be adversely affected by the proposed action. Those effects have been quantified to the extent possible in the foregoing analyses and summarized below in table 3.5.3-33.

Project effects to freshwater spawning sites would likely occur prior to coho spawning in the year of construction, and there would be no effects to spawning, incubation, and larval development by suspended sediment although Pipeline Project-generated sediment could increase gravel embeddedness downstream. Those effects would depend on precipitation and in-stream flow (potential freshets) following construction that would likely flush fines downstream. The Pipeline Project would remove small areas of riparian forest that would provide recruitment of LW. The Pipeline Project would temporarily decrease water quality downstream from construction sites by entrainment of sediments and temporarily limit in-stream migration during in-stream construction. In all instances, habitat suitability (HADD, Anderson et al. 1996) would temporarily decrease, though not necessarily to levels that would cause moderate habitat degradation (SEV = 7).

TABLE 3.5.3-33

Summary of Project Effects to Critical Habitat Designated for SONCC Coho within Watersheds Crossed by the Pipeline Project

Subbasins and Fifth-Field Watersheds	Total Waterbodies Crossed in Watershed	Waterbodies with Coho Affected a/			Riparian Zone Width (feet) b/	Areas (acres) of Riparian Vegetation Removed in Critical Habitat c/		
		Documented	Assumed	Total with Critical Habitat b/		Forested Habitat	Non-forested Habitat	Total
Upper Rogue Subbasin								
Trail Creek	6	3	0	3	159	2.08	1.34	3.42
Shady Cove-Rogue River	11	1	1	1	157	0.32	0.85	1.17
Big Butte Creek	9	2	0	2	187	1.06	1.02	2.09
Little Butte Creek d/	46	2	2	2	158	0.52	3.21	3.73
Total	**72**	**8**	**2**	**8**		**3.99**	**6.42**	**10.41**

a/ Data from ODFW GIS database (ODFW 2017f).
b/ Based on presence and potential presence (assumed) of SONCC coho.
c/ Riparian width of 1SPTH (one site-potential tree height).
d/ Includes the Key Watershed designated within the Little Butte Creek fifth-field watershed.

3.5.3.4 Conservation Measures

Appendices N and O include a complete list of conservation measures proposed by Jordan Cove and Pacific Connector. Conservation measures proposed by Pacific Connector to minimize construction and operation impacts to waterbodies and riparian zones within the riverine analysis area are listed in tables 1 and 2C in appendix N. Pacific Connector has also proposed measures to rectify, repair, rehabilitate, and otherwise reduce impact to waterbodies and riparian zones once construction of the Pipeline is complete. Those measures have been compiled in table 3C in appendix N. Details of some of the major conservation measures applicable to SONCC ESU to be implemented by Pacific Connector are summarized below.

The conservation measures details for the freshwater stream crossings are the same as those presented for Oregon Coast coho salmon ESU for the following items with the details of each found in the Appendix N tables noted above:

- Erosion Control
  - Temporary Slope Breakers
  - Sediment Barriers
  - Erosion Control Fabric
- Fish Salvage Plan
- OHV Barriers
- Streambank Stability
- Streambank Restoration
- In-Stream Gravel
- Stream Crossing Monitoring

The following conservation measures would also be implemented in or along streams affected by the route.

Revegetation

As required by FERC's *Plan*, Pacific Connector has identified procedures for the preparation and planting of live stakes or sprigs and for the planting bare root tree seedlings. Those procedures are included in appendix R. Within the range of SONCC coho salmon, construction of the Pipeline would remove 41.59 acres of riparian forested habitats of which 20.24 acres are late-successional (mature) old-growth, 17.97 acres are mid-seral forests, and 0.08 acres are forested wetlands. Within the Trail Creek watershed 6.17 acres of riparian forest would be removed; 8.01 acres within the Shady Cove-Rogue River watershed; 5.74 acres within the Big Butte Creek watershed; and 21.67 acres within the Little Butte Creek watershed (see table 3.5.3-25a).

Existing forested riparian zones in which forest would be removed during construction would be re-planted with conifers to within 15 feet of each side of the centerline. Permanent effects—persisting longer than the assumed 50-year life of the Pipeline—would occur by removing 16.86 acres of LSOG riparian forest. Even though the riparian zone would be replanted, the newly planted trees would not attain LSOG status within 50 years. Permanent effects would also last along the 30-foot-wide maintenance corridor centered on the Pipeline. Those effects to former LSOG riparian forest, mid-seral riparian forest and other existing riparian vegetation are included in table 3.5.3-25b. Due to a maintenance access route in the right-of-way that would not be allowed to grow trees for the life of the Pipeline Project, replanting conifers in the remaining affected forested riparian zone would still leave an estimated 10.02 acres of non-forested vegetation within former forested riparian zones over the long term or permanently (see table 3.5.3-25b).

Large Wood

As discussed in the Direct and Indirect Effects section above, mitigation would contribute to restoring an aquatic habitat indicator's functional level, such as placement of LW within and/or adjacent to streams and placing LW on floodplains, where appropriate, to provide microsites for riparian vegetation and/or vegetation protection during flood events. Placement of LW in streams and/or on streambanks has been one focal point of recent stream rehabilitation procedures (Slaney and Martin 1997; Cederholm et al. 1997; EPA 2001) and is further described in the *Large Woody Debris Plan* (appendix O.3).

As indicated in table 3.5.3-8, baseline watershed conditions crossed by the Pipeline are lacking in LW due to historical disturbance, and LW presence is typically below benchmark thresholds to be properly functioning. LW is an important habitat feature providing in-stream structure, channel and habitat complexity, among other benefits, and one that promotes salmonid productivity. If approved by land owners, Pacific Connector proposes to install LW on-site during construction as an appropriate habitat enhancement feature to mitigate for potential impacts and to benefit watershed conditions, which are generally lacking.

LW placement would be in addition to the conservation measures (see appendix N) that have been designed to minimize the potential effects, including utilizing dry open-cut crossing methods, applying in-stream construction timing restrictions, and implementing erosion control measures and revegetation methods. Because of the overall lack of LW in the affected watersheds, LW also provides an appropriate mitigation model for the potential waterbody crossing impacts that are temporary, short-term, and unavoidable (see the *Large Woody Debris Plan* in appendix O.3). The LW would also serve to mitigate for potential long-term impacts—impacts lasting for the 50-year life of the Pipeline—such as the loss of forested riparian vegetation within the 30-foot operational corridor (see table 3.5.3-25b). Even though the riparian zone would be replanted, the planted trees would not attain late-successional or old-growth status within 50 years. Placement of LW would, in some measure, reduce, though not eliminate, the impact due to the removal of LSOG riparian forest.

For low-gradient streams, Cederholm et al. (1997) suggest using logs with diameters at least 18 inches (less in areas of low velocity) placed by vertical angling into the stream channel. Logs could be used to create a stepped-channel profile with the rootwads and encourage woody debris accumulations in pool margins. For streams with steeper gradients, Cederholm et al. (1997) suggest that logs with smaller diameters might be used if larger logs are unavailable. Near headwaters, LW is often suspended over the channel so that it can become functional during periods of maximum runoff. Smaller debris may be retained during those periods and help develop pools that would be functional during summer (see Cederholm et al. 1997).

Guidelines for LW placement, provided by ODF and ODFW (1995), suggest using the following: 1) larger diameter wood pieces because they are more effective at creating pools and complex channels which improve fish populations (see table 3.5.3-34 for minimum diameter LW per bankfull width); 2) LW that are at least twice the length of the waterbody bankfull width (1.5 times the bankfull width if the rootwad is attached) to increase the likelihood that the LW would remain in place; and 3) conifer logs, especially western red cedars if available, because they are more durable. In larger waterbodies, smaller diameter, shorter LW could be used if bundled and anchored together to provide the same benefits of the longer, larger diameter LW (ODF and ODFW 1995).

TABLE 3.5.3-34

Minimum Diameter Large Wood for Placement in Waterbody Based on Bankfull Width

Bankfull Width (feet)	Minimum Diameter Large Wood (inches)
0 to 10	10
10 to 20	16
20 to 30	18
Over 30	22

Source: ODF and ODFW 1995.

Trees classified as late successional or old growth are assumed to have attained heights equal to the site-potential tree heights that are included above in table 3.5.3-33 as Riparian Zone Widths. Site-potential tree heights range from 157 feet (for example, the Shady Cove-Rogue River Watershed) to 187 feet (as in the Big Butte Creek Watershed). If Douglas-fir trees in the Oregon Cascades grow in height at the rate of 20 inches per year and in diameter by 0.25 inch per year (Cox 2008), a 20-inch-tall seedling planted the year after construction would be an estimated 85 feet tall and 12 to 13 inches in diameter (assumed diameter at breast height) after 50 years. Trees with those dimensions would provide suitable LW for streams with bankfull widths from zero to 10 feet but not larger streams (see table 3.5.3-34). Even in these streams recruitment of wood may be reduced as the rate for natural mortality of the young forest would be less relative to older trees. Although, recruitment of wood is not solely dependent on natural tree mortally and includes important contributing factors such as bank erosions, disease, fires, slides, and windthrow (Reeves et al. 2003; Martin and Benda 2001; Gregory et al. 2003). LW contribution would occur from these areas even though natural mortality contribution would be reduced.

The Pipeline would cross 13 perennial streams within the range of SONCC ESU coho salmon. Twelve of those perennial streams have existing riparian forest ranging from clear-cut forest to mid-seral stage (approximately 40 to 80 years old) and older late-successional and old-growth stages; 6.91 acres of existing riparian forest associated with perennial streams would be removed by construction. One additional perennial stream would also be crossed but construction would not affect riparian forest vegetation (see table 3.5.3-35). In addition, the Pipeline would cross 52 intermittent streams, 41 of which support riparian forest, and would affect riparian forest of 19 other intermittent streams; 41.68 acres, total, of riparian forest at perennial and intermittent streams would be removed. Seventeen intermittent streams with no riparian forest would also be crossed (see table 3.5.3-35).

To offset impact from removal of riparian trees (reducing LW recruitment potential) and to provide an overall benefit by enhancing stream habitat with no potential for LW recruitment, Pacific Connector proposes to place LW at the waterbody flow types identified by watershed in table 3.5.3-35 (see the *Large Woody Debris Plan* in appendix O.3), based on the following applications:

- Four pieces for each perennial stream crossed with riparian forest removed (two pieces in-stream and/or keyed into the streambank, two pieces within riparian zone on the bank);
- Two pieces for each intermittent stream and unknown stream crossed with riparian forest removed (one or both LW pieces placed in-stream, keyed into the bank, or placed on the bank);
- Two pieces for each perennial, intermittent, and unknown stream crossed but with no riparian forest removed (one or both LW pieces paced in-stream keyed into the bank, or placed on the bank); and
- One piece each for a perennial, intermittent, and unknown stream not crossed but adjacent to the construction right-of-way, with or without riparian forest removed (LW placed on bank).

Because the construction right-of-way at stream crossings would be 75 to 95 feet wide, Pacific Connector anticipates only enough space for two pieces of LW, preferably with rootwads attached, either placed in-stream or with stems keyed into streambanks. Unless site-specific conditions dictate otherwise, the preferable location for each in-stream LW is downstream from the pipeline to prevent scour of the pipe. LW would also be placed near or adjacent to streambanks within riparian zones to provide for and/or enhance microsites for riparian vegetation and/or vegetation protection during flood events.

The LW plan includes placing from 1 to 4 pieces of LW per stream crossed in the stream or on the bank, depending on forest conditions, stream flow, and landowner approval. This number of pieces, if no other LW were present in the stream reach affected by clearing, would be in the range of what is considered "desirable" by ODFW (Foster et al. 2001) for forested streams. Foster et al. (2001) noted that more than 20 LW pieces/100 meters of stream length (i.e., 4.6 pieces/75 feet of right-of-way clearing) with more than 3 "key" pieces/100 meters (i.e., 0.7 "key" pieces/75 feet right-of-way clearing) is considered "desirable" in forested streams in Oregon. The sizes of LW pieces to be installed are shown in table 3.5.3-34 above in streams to meet habitat needs for specific stream sizes and number of streams crossed.

In all, Pacific Connector proposes 173 pieces of LW for placement within the four fifth-field watersheds that coincide with SONCC ESU coho salmon and designated critical habitat. Placement of LW is subject to approval by each affected landowner. If a landowner rejects the proposed placement of LW, the number of pieces that would have been applied onsite would be reserved and provided to appropriate watershed councils for their use and placement, preferably elsewhere within the affected fifth-field watershed.

Pacific Connector anticipates that during construction, in some cases, the waterbody size, landowner restrictions, or construction constraints would limit LW placement according to the proposed LW schedule provided in table 3.5.3-35. Further, the overall benefit of installation of LW at some waterbody crossings (i.e., intermittent headwater streams) may not warrant LW placement. In these situations, Pacific Connector's EI would record the uninstalled LW as a deficit during construction. After construction is completed, unutilized LW would be provided to local watershed conservation organizations or agencies for use in local enhancement projects within the affected watersheds. (Also see the discussion on the use of LW for mitigation in appendix O.3)

TABLE 3.5.3-35

Proposed Application of Large Wood to Waterbodies and Riparian Zones Affected by Construction of the Pipeline within the Range of Southern Oregon Northern California Coast Coho Salmon

Fifth-Field Watershed	Watershed Parameter a/	Waterbody Type						Total in Watershed	Pieces of Large Wood Applied to Fifth-Field Watershed b/		
		Perennial		Intermittent		Unknown					
		Crossed	Adjacent	Crossed	Adjacent	Crossed	Adjacent		Crossed	Adjacent	Total
Trail Creek (HUC 1710030706)	Area (acres) of Riparian Forest	1.11	0	3.59	1.47	0	0	6.17			
	Total Number of Waterbodies	2	0	4	1	0	0	7			
	With Riparian Forest	2	0	4	1	0	0	7	16	1	17
	No Riparian Forest	0	0	0	0	0	0	0	0	0	0
Shady Cove-Rogue River (HUC 1710030707)	Area (acres) of Riparian Forest	0.91	0	4.13	3.13	0	0	8.17			
	Total Number of Waterbodies	4	0	6	9	0	0	19			
	With Riparian Forest	3	0	6	5	0	0	14	24	5	29
	No Riparian Forest	1	0	0	4	0	0	5	2	4	6
Big Butte Creek (HUC 1710030704)	Area (acres) of Riparian Forest	3.19	0	1.24	1.23	0	0	5.66			
	Total Number of Waterbodies	3	0	5	3	0	0	11			
	With Riparian Forest	3	0	4	3	0	0	10	20	3	23
	No Riparian Forest	0	0	1	0	0	0	1	2	0	2
Little Butte Creek (HUC 1710030708)	Area (acres) of Riparian Forest	1.71	0	17.84	2.13	0	0	21.68			
	Total Number of Waterbodies	4	0	37	6	0	0	47			
	With Riparian Forest	4	0	31	4	0	0	35	78	4	82
	No Riparian Forest	0	0	6	2	0	0	12	12	2	14
Total Fifth-Field Watersheds For SONCC Coho	Area (acres) of Riparian Forest	6.91	0	26.80	7.96	0	0	41.68			
	Total Number of Waterbodies	13	0	52	19	0	0	84			
	With Riparian Forest	12	0	41	13	0	0	66	138	13	151
	No Riparian Forest	1	0	11	6	0	0	18	16	6	22
								Total LW	**154**	**19**	**173**

a/ Riparian Forest assumed to be coniferous, deciduous, or mixed forest 40 years old and older.
b/ Proposed schedule for applying large wood (LW) to different waterbody types, subject to landowner approval:
– 4 pieces for each perennial stream crossed with riparian forest removed (2 pieces in-stream, 2 pieces within riparian zone on the bank);
– 2 pieces for each intermittent stream and unknown stream crossed with riparian forest removed (one or both pieces placed in-stream or on bank);
– 2 pieces for each perennial, intermittent, and unknown stream crossed but with no riparian forest removed (one or both pieces paced in-stream or on bank);
– 1 piece each for perennial, intermittent, and unknown stream not crossed but adjacent to ROW with or without riparian forest removed (placed on bank).

Mitigation

Appendix O.4 provides the draft of a suite of mitigation projects proposed by the Forest Service to address the effects of the Pipeline project on various resources on NFS lands and to ensure that construction and operation of the pipeline would be consistent with the objectives and goals of the respective Forest Service LRMP, including protections for ESA listed SONCC coho salmon ESU. These include proposed projects within watersheds in the Upper Rogue Subbasin. Additionally, mitigation to help maintain the ACS on NFS lands would have direct and indirect benefits to EFH habitat on these lands.

A summary of all Forest Service mitigation projects and their potential affects to all relevant species and habitats is provided in table 2.8-1. These include actions such as adding LW to selected areas to add to habitat complexity, trap fine sediment, and reduce temperature; improving fish passage at existing road crossing with related riparian habitat in crossing areas to aid in aquatic biota including coho movement and increased shading; and decommissioning, closing, and stormproofing roads to reduce fine sediment to streams, mitigate soil compaction, and increase fish passage associated with culvert removal as part of road decommissioning. Water source improvement would also be undertaken that would increase fire suppression helping to protect riparian habitat.

Currently, these projects lack the site-specific details needed for implementation; however, the Forest Service is seeking consultation at a programmatic level for these and other proposed Forest Service actions described in this BA. It is anticipated that these projects would require a secondary site-specific project-level ESA consultation prior to implementation.

3.5.3.5 Determination of Effects

Species

The Project **may affect** coho salmon in the SONCC ESU because:

- juvenile and subadult life stages of coho salmon are expected to occur within the marine analysis areas during construction and operation of the proposed action; and
- several life stages and activities of coho salmon (upstream adult migration, juvenile fry rearing, and juvenile smolt out-migration) are expected to occur at various locations in the riverine analysis area during construction and operation of the proposed action.

The Project is **likely to adversely affect** coho salmon in the SONCC ESU because:

- TSS could adversely affect juvenile coho salmon. Exposure of juvenile fry to TSS concentrations during dry open-cut construction (fluming or dam-and-pump) from 2 to 5 hours (see table 3.5.3-21) could potentially exceed SEV 3 (avoidance effects) or SEV 4 (effects to feeding rate) for an estimated 347 to 1,919 meters downstream (see table 3.5.3-23). Such an effect could cause minor physiological stress in juvenile coho salmon (SEV 3) or a short-term reduction in feeding rate and short-term reduction in feeding success (SEV 4).
- If a failure occurs while dry open-cut construction is underway, possible effects to juvenile coho (SEV = 7 and possibly SEV = 8) could include moderate habitat degradation and

impaired homing by fish and possibly major physiological stress and reduction in feeding success.

- Literature-based estimates of suspended sediment effects from pipeline construction on SEV effects suggest typical dry crossing methods could result in effects to coho salmon within a few hundred feet (e.g., 150 to 500 feet) below the crossing in the range of SEV of 4 to 6, which may include factors ranging from short term reduction in feeding to moderate physiological stress. If failure of sealing occurs effects to coho salmon could be SEV of 8 which may include habitat degradation, major physiological stress and long term reduction in feeding rate or success.
- Construction requiring blasting at 13 streams (4 at streams known to contain coho) could cause mortality to fish by rupturing swim bladders. Adult and juvenile coho fry salmon would be removed and/or prevented from being within 50 feet of blasting sites to the maximum extent possible. A worst-case estimate of 103 juvenile coho fry could potentially be salvaged from streams that require blasting but active fish removal from area prior to blasting would reduce risk of occurrence.
- Fish salvage would occur within isolated construction sites when adult and juvenile coho salmon are present. Coho salmon are considered vulnerable to electrofishing and could be subject to injury and mortality. Fish salvage would primarily rely on seining but may require electrofishing if other methods are ineffective (refer to the *Fish Salvage Plan* [appendix T]). Seining, electrofishing, and handling may adversely affect SONCC coho salmon. A worst-case estimate of 167 juvenile coho fry could potentially be salvaged from streams crossed by dry open-cut procedures that did not require blasting.
- Lack of LW is a limiting factor in most streams within range of SONCC coho salmon. Removal of mid-seral riparian forest (40 to 80 years old) would have long-term effects to recruitment of LW, and removal of LSOG forest (≥80 years old) would have permanent effects to recruitment of LW because planted conifers would not attain that age class within the 50-year life of the Project.

Critical Habitat

The Project **may affect** designated critical habitat for coho salmon in the SONCC ESU because:

- the Pipeline crosses designated critical habitat within waterbodies of the Upper Rogue hydrologic unit (HUC 17100307) below the Lost Creek, Willow Creek, and Fish Lake Dams.

Project components are **likely to adversely affect** designated critical habitat for coho salmon in the SONCC ESU because:

- approximately 16.5 acres of native riparian vegetation (forest, wetlands, and unaltered nonforested habitats) and of altered habitat would be removed during construction within riparian zones associated with designated critical habitat. Adverse effects to riparian zones associated with critical habitat would be long-term or permanent depending on whether mid-seral riparian forests (7.3 acres) or LSOG riparian forests (1.6 acres) are removed (provided in table 3.5.3-34a);
- food resources would potentially be affected over the short term by dry open-cut and diverted open-cut construction methods that would remove substrate and benthos at crossing sites;

- freshwater migration corridors would potentially be affected over the short term by dry open-cut and diverted open-cut construction methods that would create temporary barriers to in-stream movements; and
- a failure of crossing isolation structures lasting for 4 hours or more would cause an SEV score of 7 or higher (approximate SE value) for at least 132 meters downstream from dry open-cut crossings within three streams with critical habitat in the Trail Creek watershed (West Fork Trail Creek, Canyon Creek and tributary to Trail Creek, see table 3.5.3-23), at least 397 meters downstream within two streams with critical habitat in the Big Butte Creek watershed (Neil Creek and Quartz Creek, see table 3.5.3-23), and at least 554 meters downstream in two streams with critical habitat in the Little Butte Creek watershed (Salt Creek and North Fork Little Butte Creek). SEV of 7 would not occur within designated critical habitat in the Shady Cove-Rogue River watershed (Indian Creek) by a failure lasting for 4 hours but could occur if the duration lasted 5 hours or more.

3.5.4 Coho Salmon (Oregon Coast ESU)

3.5.4.1 Species Account and Critical Habitat

Status

The NMFS (1995) conducted a status review of coho salmon in 1995 that led to a proposed listing of several ESUs as threatened, including the Oregon Coast ESU, in 1995. The final listing was delayed due to disagreements about conclusions drawn from available information and the original proposal to list as threatened was withdrawn in 1997. In 1998, the District Court for Oregon determined that NMFS's 1997 withdrawal of the proposed listing status was arbitrary and capricious and vacated the determination. Following the Court decision, NMFS issued a final rule to list the Oregon Coast ESU as threatened in August 1998. That determination was based entirely on information collected prior to the proposed rule in 1997. However, the District Court set aside the 1998 final rule determining threatened status for the Oregon Coast ESU (a result of the Alsea ruling) and NMFS undertook an updated status review of 27 West Coast salmon ESUs in 2003, which included the coho salmon Oregon Coast ESU. During the status review, the Biological Review Team considered the uncertainty of the ESU becoming endangered. Nevertheless, NMFS again proposed listing the coho salmon Oregon Coast ESU as threatened in June 2004 based on the review (NMFS 2006d).

In December 2004, critical habitat was also proposed. NMFS designated critical habitats for several salmon ESUs in a final rule published in September 2005 but critical habitat for the coho salmon Oregon Coast ESU was not included because there had not been a final rule listing the ESU as threatened. In that new proposed rule, the ODFW was conducting an assessment of the population viability of Oregon Coast coho salmon. From that, ODFW concluded that Oregon Coast coho salmon are "inherently resilient at low abundance" and such response would prevent extinction. With that information and other products from the ODFW *Oregon Coastal Coho Assessment*, NMFS withdrew its proposals to list Oregon Coast coho salmon as threatened and to designate critical habitat in January 2006 (NMFS 2006d). In that decision to withdraw the proposed rules, NMFS declared that listing under ESA was not warranted at the time but the decision was challenged in Oregon District Court, which ruled that NMFS's withdrawal be invalidated and remanded to NMFS (Lohn 2007). The present listing status for the Oregon Coast coho salmon ESU is threatened, with corresponding critical habitat (NMFS 2008d). After proposing the ESU for listing, withdrawing the proposal, and re-proposing listing the ESU as threatened under scrutiny of Oregon federal district court, NMFS issued a final rule in 2011 (NMFS 2011d) retaining the threatened listing for the coho in the Oregon Coast ESU.

Threats

At the time the Oregon Coast ESU was first proposed for listing as threatened in 1995, threats to West Coast salmon populations were discussed in general but were not specific to the Oregon Coast ESU. The same factors noted above as threats to coho salmon in the SONCC ESU applied to coho salmon in the Oregon Coast ESU.

NMFS published a more recent status review in 2005 (Good et al. 2005). The U.S. District Court found NMFS's 1998 decision, listing the Oregon Coast coho salmon ESU, as unlawful because the ESU includes hatchery and naturally spawned coho salmon but NMFS only considered naturally spawned fish in their decision (Lawson 2005). Following the delisting, multiple parties petitioned NMFS to re-list all stocks within the Oregon Coast ESU as threatened based on new information about coho salmon abundance, variability in survival and abundance, threats to genetic integrity of stocks, and stochastic events including El Niño conditions and floods (Lawson 2005).

The short-term trend in escapement of adult spawners within the Oregon Coast ESU increased substantially in 2001 and 2002, including trends within the Umpqua, Coos, and Coquille subbasins due to increased marine survival and considerable restrictions on ocean harvests (Lawson 2005, and see discussion below). Alternatively, trends in short-term recruitment were less positive within the ESU, especially in the Coos and Coquille Rivers (Lawson 2005).

In 1994, most coho salmon harvest was prohibited and has been restricted since then, though mortalities still occur coincidentally with Chinook salmon fisheries for hatchery (marked) coho salmon (Lawson 2005). Subsequent analyses indicated that management for a proportional maximum harvest rate of 35 percent resulted in lower risk of extinction for the ESU than management for an escapement goal or quota of 200,000 spawners ESU-wide. As expected, a harvest of zero further reduces extinction risk (Lawson 2005).

Freshwater restoration projects to improve water quality and watershed conditions have been implemented throughout the Pacific Northwest since the late 1990s (e.g., the Coastal Salmon Restoration Initiative in 1997), though measurable results would take time (Lawson 2005). Poor marine survival for Oregon coho salmon began with climatological changes detected in the mid-1970s and worsening in the 1990s. Those conditions ameliorated in the late 1990s and extend into the early 2000s so that coho salmon marine survival improved. Such fluctuations have occurred in the past as variable cycles but future cycles would likely be within the context of global warming, which would likely prohibit predictions from past conditions (Lawson 2005).

Recently, NMFS (2016c) conducted a 5-year status review of Oregon Coast coho, concluding that there have been positive improvements to the Oregon Coast ESU including long-term abundance trends and escapement due, in part, to reduced harvest and hatchery releases coupled with high marine survival. In the Umpqua Stratum (defined by the Oregon and Northern California Coasts Technical Recovery Team to evaluate population recovery) that includes coho in the South Umpqua Sub-basin, there have been numerous efforts to acquire and restore conditions in watersheds including placement of large wood, road maintenance, improvements in fish passage, riparian plantings, and culvert replacements that reduce habitat degradations caused by human use and development (NMFS 2016c). In the Mid-South Coast Stratum, which includes coho in the

Coos and Coquille subbasins, there have been multiple projects similar to those in the Umpqua Stratum, as well as side channel reconnections implemented through watershed councils. In both strata, issues of continuing loss of beavers with concomitant loss of coho salmon rearing habitat, primary productivity, nutrient retention/cycling, floodplain connectivity, fish passage, and stream flow moderation remain ongoing habitat concerns for Oregon Coast coho (NMFS 2016c).

Compared to the Oregon Coast ESU as a whole, the proportion of escapements by coho salmon produced in hatcheries to wild spawners has been quite low in the Umpqua, Coos, and Coquille Rivers (Table 71 in Lawson 2005), though correct identification of hatchery and wild fish has been an issue in such surveys. As noted above, decreasing the proportion of hatchery spawners benefits wild stock.

NMFS (1996) developed an approach and criteria for evaluating human-related effects or threats to anadromous salmonid habitats which focuses on the following six pathways of potential impact: 1) water quality, 2) habitat access, 3) habitat elements, 4) channel condition and dynamics, 5) flow/hydrology, and 6) watershed condition. Actions that diminish the functioning of these parameters contribute to threating the production and survival of coho fish stocks. The BLM and Forest Service developed watershed analyses, in part to meet requirements of their respective land management plans, specifically to comply with the objectives of the ACS in the NWFP. In addition to federal agencies, watershed assessments have been developed by local watershed councils and Oregon's natural resource agencies and are available through the Oregon Watershed Enhancement Board. Watershed assessments provide evaluations of fish habitats and water quality and describe how natural process and human activities are affecting or threatening those resources (Governor's Watershed Enhancement Board 1999). Available watershed analyses developed by these sources are listed in table 3.5.4-1 for the fifth-field watersheds crossed by the Pipeline.

Summaries for three of the watershed analyses are provided in appendix AA. As a rule, streams lacked in-stream LW, fish access was limited, sedimentation was excessive, and habitats had been affected by high flows that degraded in-stream habitats. These reductions in watershed-level habitat conditions threaten achieving system potential production of this listed coho salmon ESU. NMFS's (2016c) review of habitat conditions within the range of the Oregon Coast coho ESU and the Coos, Coquille, and South Umpqua subbasins was discussed, above. The updated status review indicates that there has been improvement in the biological status of Oregon Coast coho in the last five years but factors related to persistence of coho in the ESU have not significantly changed since the former status review conducted in 2012 (NMFS 2016c).

TABLE 3.5.4-1

Watershed Assessments Conducted by Federal and State Agencies for Fifth-Field Watersheds Crossed by the Pipeline

Sub-basins and Fifth Field Watersheds	Watershed Analysis, BLM and/or Forest Service	Watershed Assessment, Oregon Watershed Enhancement Board
Coos Subbasin		
Coos Bay-Frontal Pacific Ocean	• Catching-Beaver Watershed Analysis (BLM 2010)	• Coos Bay Lowland Assessment and Restoration Plan (Coos Watershed Association 2006) • Catching Slough, Daniel's Creek and Heads of Tide Sub-basin Assessment and Restoration Opportunities (Coos Watershed Association 2008)
Coquille Subbasin		
North Fork Coquille River	• North Fork Coquille Watershed Analysis (BLM 2001a)	• Coquille River Sub-basin Plan (Coquille Indian Tribe 2007)
East Fork Coquille River	• East Fork Coquille Watershed Analysis (BLM 2000)	
Middle Fork Coquille River	• Upper Middle Fork Coquille Watershed Analysis (BLM 1999a) • Middle Fork Coquille Watershed Analysis (BLM 2007)	
South Umpqua Subbasin		
Olalla Creek-Lookingglass Creek	• Olalla-Lookingglass Watershed Analysis (BLM 1999b)	• Olalla/Lookingglass Watershed Assessment and Action Plan (DeVore and Geyer 2003).
Clark Branch-South Umpqua River	• Middle South Umpqua Watershed Analysis (BLM 1999c)	• Middle South Umpqua Watershed Assessment and Action Plan (Geyer 2003a).
Myrtle Creek	• Myrtle Creek Watershed Analysis and Water Quality Restoration Plan (BLM 2002)	• Myrtle Creek Watershed Assessment and Action Plan (Geyer 2003b)
Days Creek-South Umpqua River	• South Umpqua Watershed Analysis and Water Quality Restoration Plan (BLM 2001b)	• South Umpqua River Watershed Assessment and Action Plan (Geyer 2003c)
Upper Cow Creek	• Cow Creek Watershed Analysis. (Forest Service 1995)	• Upper Cow Creek Watershed Assessment and Action Plan (Geyer 2003d)
Little Butte Creek	• Little Butte Creek Watershed Analysis (BLM and Forest Service 1997).	• Little Butte Creek Watershed Assessment (Little Butte Creek Watershed Council 2003)

BLM and/or the Forest Service evaluated habitat conditions in the 10 fifth-field watersheds crossed by the Pipeline; most of the evaluations were conducted around 2000 (see table 3.5.4-1). More recently, various watershed associations, Native American tribes, and/or watershed councils conducted new assessments listed in table 3.5.4-1, including the Umpqua Basin Watershed Council (authored by Geyer 2003a–d). The watershed assessment of the larger South Umpqua Sub-basin (HUC 17100302) included the Days Creek–South Umpqua River and Elk Creek watersheds. These more recent watershed assessments use ODFW Aquatic Inventory and Analysis data, which were also summarized below in table 3.5.4-10a and table 3.5.4-10b.

Species Recovery

NMFS (2016b) released a final recovery plan that addressed limiting factors and threats to each coho population within the Oregon Coast ESU including those within the Coos, Coquille, and Umpqua River systems. Primary limiting factors in the Coos and Coquille populations include stream complexity; water quality is a secondary limiting factor. In the South Umpqua population, the primary limiting factor is water quantity; stream complexity and water quality are secondary limiting factors.

Among other actions, the plan calls for protection and restoration of tidally influenced habitats in the Coos estuary by reconnecting intertidal wetlands and tidal channels by removing dikes, levees, and tide gates. The plan also calls for monitoring predation by non-native fish in the Coquille and Coos River and reducing populations of predaceous non-native species in the Coquille River.

Recovery of Oregon Coast coho in those two population areas is also dependent on improving riparian forests to increase shade, reduce stream temperatures, and improve water quality. Additionally, the plan recommends increased habitat complexity that would restore winter habitat refuge areas in the floodplains in freshwater ecotones of upper tidal areas of the Coos estuary.

Key recovery strategies and potential actions that would improve coho populations and habitats in the Mid-South Coast Stratum, including the Coos and Coquille populations, include improvement of riparian conditions on state and private timber lands, improvement of water quality on rural (residential and agricultural) lands, maintenance of the ACS on federal lands, management of beavers to increase habitats associated with beaver ponds and dams, restoration of estuary and tidal lands, and evaluation of in-stream flows with focus on connectivity, water temperatures, and riparian protections to support salmon.

The recovery plan also addresses predation on Oregon Coast coho by non-native smallmouth bass and largemouth bass in the South Umpqua population. Recovery of the South Umpqua population is also dependent on restoration of watershed processes that promote winter and summer rearing habitats (e.g., wood recruitment, habitat complexity, floodplain connectivity). Key recovery strategies and potential actions that would improve coho populations and habitats in the Umpqua Stratum, including the South Umpqua population, include evaluation of in-stream flows with a focus on connectivity, water temperatures, and riparian protections to support salmon; improvement of riparian conditions on state and private timber lands; improvement of water quality on rural (residential and agricultural) lands; maintenance of the ACS on federal lands; management of beavers to increase habitats associated with beaver ponds and dams; and improvement of fish passage at dams, culverts, and other identified barriers.

Life History, Habitat Requirements, and Distribution

Miller and Sadro (2003) found that approximately one-half of each brood of coastal coho salmon in Winchester Creek/South Slough (which empties into Coos Bay approximately five miles south of the LNG Project) in 1999 and 2000 moved to the estuary as sub-yearlings (age zero). A portion of these juveniles lived in the ecotone between freshwater and saline portions of the estuary for up to 8 months and then moved back upstream to overwinter. Fish that moved to the ecotone in fall and winter had a mean residency of 48 days in 1999 and 64 days in 2000. Some of these fish resided in an off-channel beaver pond. In spring, age 1 smolts had a mean residence time in the ecotone of only 18 days and a mean residence time in the estuary of 5.8 days. Coastal coho salmon smolts would not be expected to utilize the more saline waters near the LNG Project area for the extended periods of time as they were shown to reside in the ecotone.

Radiotelemetry studies conducted by Oregon State University researchers (Schreck et al. 2002) in the Nehalem River estuary indicate that coho salmon smolts spend about 2 weeks in the estuary before moving into the ocean. Fish monitoring in Tillamook Bay (approximately 170 miles to the north) indicated that coho salmon smolts (age 1+) were rarely found in shallow edge habitat during their residency period in the bay (Ellis 1999, 2002a, 2002b). Most of the yearling smolts appear to move quickly through the estuarine environment to the ocean. ODFW seining surveys conducted at the McCullough Bridge and Trestle sampling sites in summer 2005 and 2006 did capture juvenile coho salmon (ODFW 2006b), but coho salmon smolts are not expected to rear within the estuarine analysis area in the estuary for significant periods of time. Coho salmon smolts resided in the stream-estuary ecotone of South Slough for a range of 12 to 40 days (Miller and Sadro 2003).

Figure 3.5.4-1 provides the typical timing of use for coho salmon in the estuarine analysis area and riverine analysis areas. Within the estuary, some coho salmon rearing occurs but most juvenile use is during migration to the ocean (Gray 2007). During the period between October 1 and February 15 when all in-water construction would occur, juvenile coho salmon are likely to be absent in the estuary and lower Coos River, but adult coho salmon would be holding and/or migrating upstream (see figure 3.5.4-1).

Life stage requirements of coho salmon within freshwater habitats in the Oregon Coast ESU are expected to be similar to those described above for coho salmon in the SONCC ESU (see section 3.5.3.1). Within the entire ESU, adults generally enter coastal streams in the fall and spawn from November through possibly March. Peak spawning is during December or January (NMFS 2004). After hatching in spring, parr inhabit areas of slow flows and spend a second winter in freshwater before outmigration to the ocean as smolts, generally March through June (NMFS 2004).

Specific timings of life history phases for Oregon Coast coho salmon are shown on figure 3.5.4-1 within the in-stream portion of the Pipeline Project area, and for individual rivers or tributaries in the vicinity of waterbodies crossed by the Pipeline. Smolt outmigration in the Umpqua River mainstem and tributaries lasts from March through June, with peak outmigration from April through mid-May. Similarly, peak outmigration in the Coquille River is from late March to early May, although the duration of outmigration is shown on figure 3.5.4-1 to extend from mid-February to mid-June.

Peak timing of river entry by adults to the Umpqua, Coos, and Coquille Rivers is early to mid-October although adults begin entrance to all three drainages in early September through January. Spawning in the Umpqua River begins in early October, and lasts through January, peaking in November and December (see figure 3.5.4-1). Though not shown on figure 3.5.4-1, spawning in the Coos River lasts from mid-November through late January, peaking in mid-December as well as in the Coquille River though spawning there lasts from mid-November through early February (Weitkamp et al. 1995, see Appendix Table C-4). In-stream construction within tributaries to the Coos, Coquille, and South Umpqua Rivers and within range of the Oregon Coast ESU would occur from July 1 through September 15. Coho salmon adult upstream migration would be occurring during the end of the in-stream construction window but spawning would not yet have started. Incubation and fry emergence from gravel, and juvenile smolt out-migration would not be occurring between July 1 and September 15, while juvenile rearing would occur during this period (see figure 3.5.4-1).

Based on genetic data and recoveries of tagged fish, the Oregon Coast coho ESU extends to Pacific Ocean tributaries from Cape Blanco north to the Columbia River. Coho in the ESU inhabit waterbodies in the following nine fifth-field watersheds that would be crossed by the Pipeline: Coos Bay-Frontal Pacific Ocean (HUC 1710030403), North Fork Coquille River (HUC 1710030504), East Fork Coquille River (HUC 1710030503), Middle Fork Coquille River (HUC 1710030501), Olalla Creek-Lookingglass Creek (HUC 1710030212), Clark Branch-South Umpqua River (HUC 1710030211), Myrtle Creek (HUC 1710030210), Days Creek-South Umpqua River (HUC 1710030205), and Upper Cow Creek (HUC 1710030206). Table 3.5.4-2 summarizes the number of waterbodies crossed within the Pipeline Project area that are known or assumed to support Oregon Coast coho.

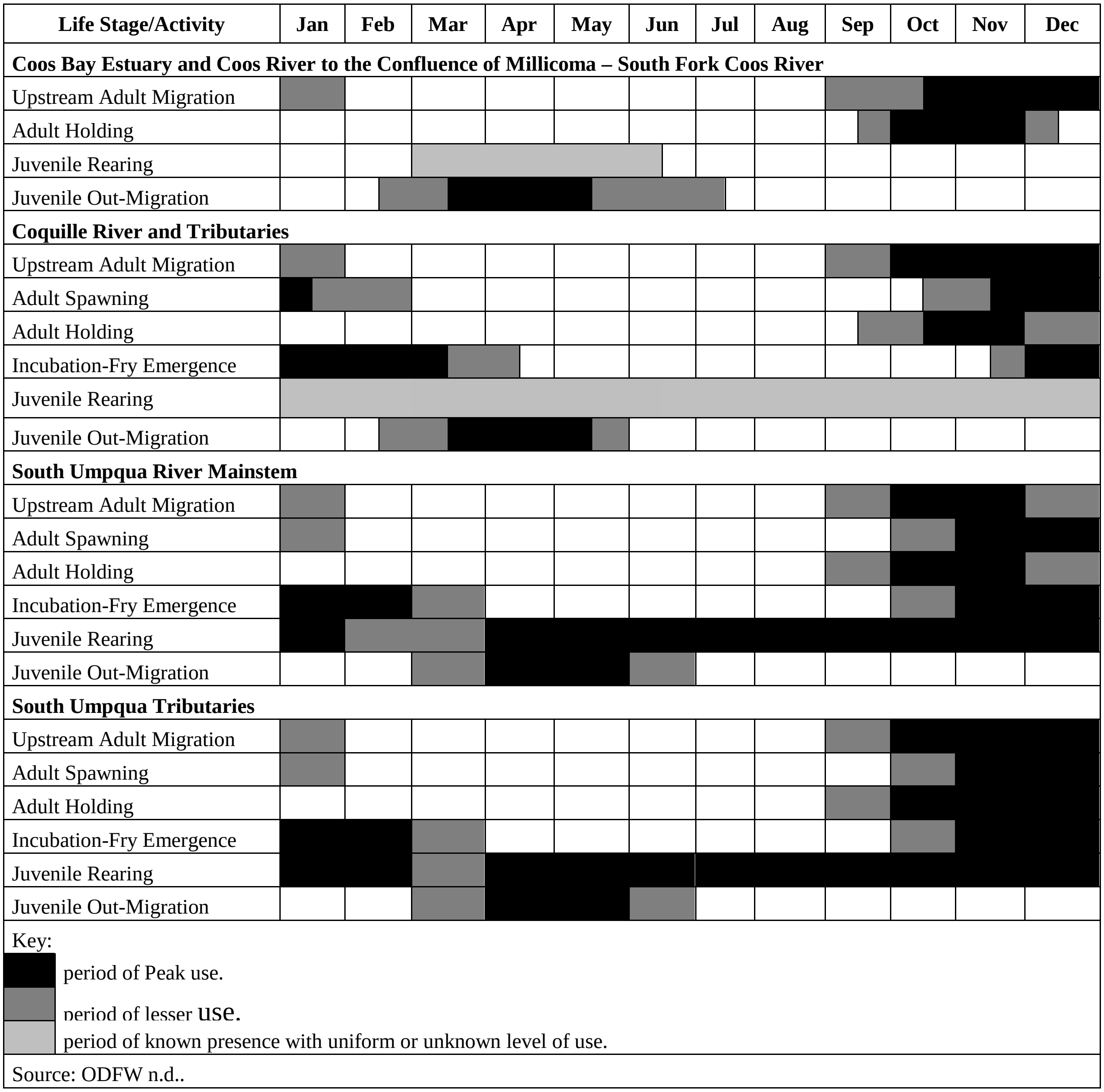


Figure 3.5.4-1 Approximate Timing of Oregon Coast ESU Coho Salmon Use of the Coos Bay Estuary, Coos River and Tributaries, Coquille River and Tributaries, and South Umpqua River and Tributaries

TABLE 3.5.4-2

Number of Waterbodies Crossed by the Pipeline Project within River Subbasins and Fifth-Field Watersheds with Oregon Coast Coho ESU Designated Critical Habitat and Coho Presence (Known or Assumed)

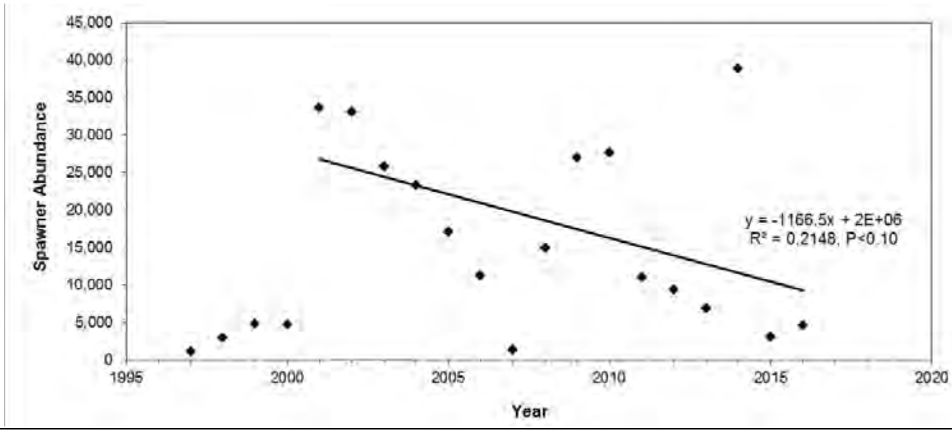
Subbasins and Fifth-Field Watersheds	Hydrologic Unit Code	Number of Waterbodies		
		Critical Habitat a/	Coho Known b/	Coho Assumed c/
Coos Subbasin	**17100304**			
Coos Bay-Frontal Pacific Ocean	1710030403	11	13	0
Coquille Subbasin	**17100305**			
North Fork Coquille River	1710030504	3	3	0
East Fork Coquille River	1710030503	2	2	6
Middle Fork Coquille River	1710030501	0	0	1
South Umpqua Subbasin	**17100302**			
Olalla Creek-Lookingglass Creek	1710030212	2	2	3
Clark Branch-South Umpqua River	1710030211	4	4	0
Myrtle Creek	1710030210	3	3	2
Days Creek-South Umpqua River	1710030205	4	4	0
Elk Creek d/	1710030204	0	0	0
Upper Cow Creek	1710030206	0	0	0
	Total	**29**	**31**	**12**

a/ NMFS 2008d
b/ ODFW 2017f
c/ Assumed presence based on connectivity to occupied stream reaches.
d/ Elk Creek Watershed would be crossed but no waterbodies would be affected within the watershed.

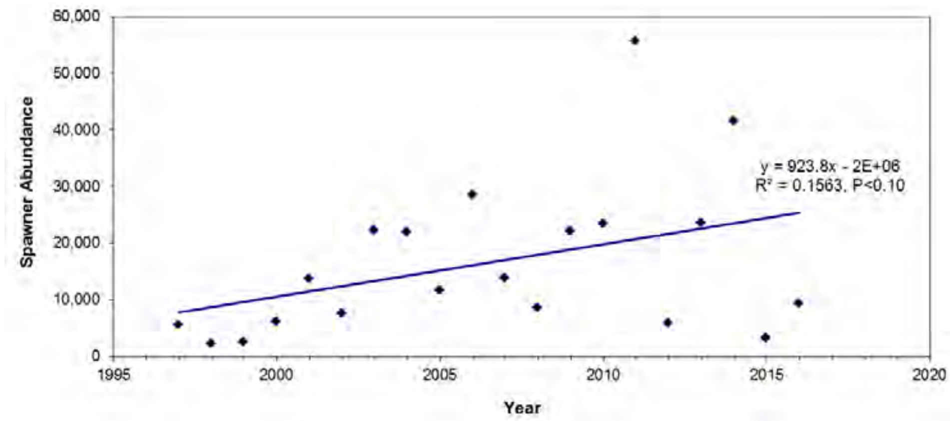
Population Status

Abundance of naturally producing coho within the Coos River subbasin peaked at 33,595 spawners in 2001 but has generally diminished since then to 11,000 spawners in 2011 and to 9,400 in 2012; the declining trend in spawner abundance since 2001 is significant (see figure 3.5.4-2A).

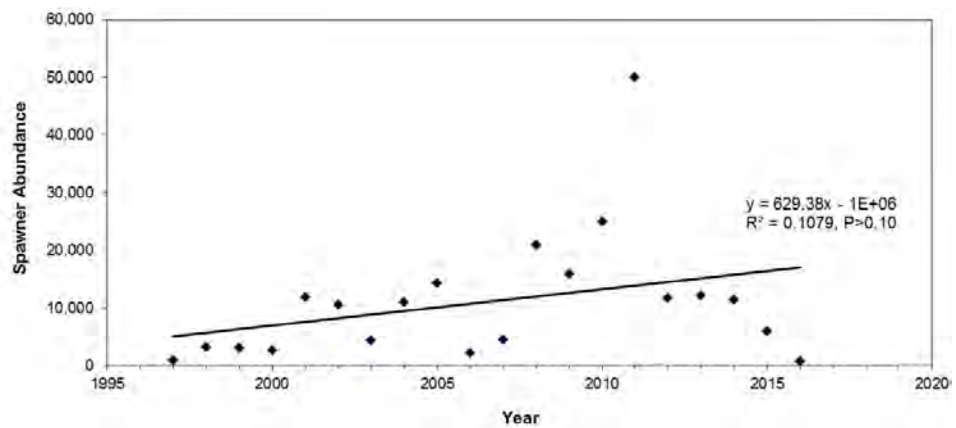
Coho spawner abundance in the Coquille River subbasin (see figure 3.5.4-2B) and South Umpqua Subbasin (see figure 3.5.4-2C) had both been increasing at significant rates between 1997 and 2011 but declined dramatically in 2012 through 2016, the fewest wild spawners since 2008 in the South Umpqua during 2016 and fewest since 1999 in the Coquille River subbasin during 2015. The overall trend in total number of spawners in all three subbasins, combined (see figure 3.5.4-2D) had likewise been increasing through 2011 but numbers of spawners in 2012 were the fewest since 2000 in the riverine analysis area for Oregon Coast coho salmon. Although the increasing trend through 2011 and decline in 2012 was apparent in all populations of the Oregon Coast ESU (ODFW 2013), the low spawner abundance since 2012 indicates there has been considerable variation but no overall trend, from 1997 through 2016 in the Oregon Coast ESU, similar to that shown on figure 3.5.4-2D.



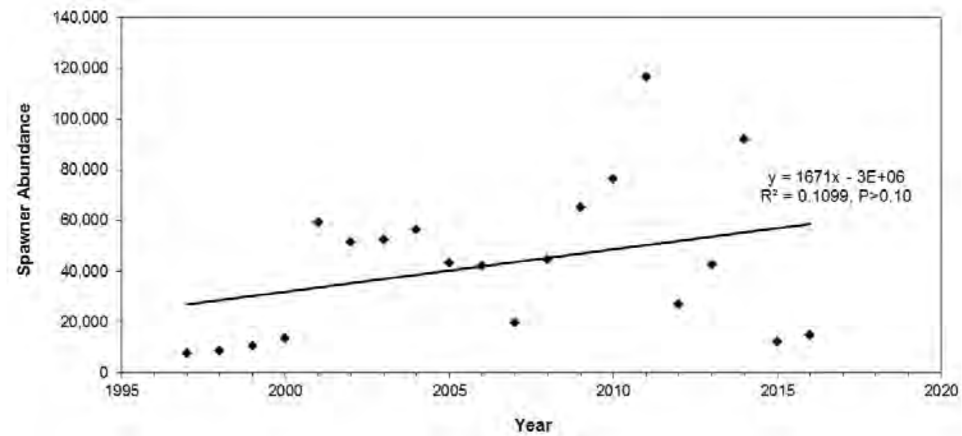
A. Coos Subbasin



B. Coquille Subbasin



C. South Umpqua Subbasin



D. All Subbasins in Analysis Area

Figure 3.5.4-2 Estimated Abundance of Wild Adult Coho Spawners in the Oregon Coast Coho ESU 1997 to 2016, within Three Subbasins Crossed by the Pipeline Project (Source: ODFW 2017d)

During the twentieth century, there had been a prolonged decline in numbers of recruits per spawner (Weitkamp et al. 1995; Good et al. 2005) wherein recruits from the return years 1997–1999 failed to replace parental spawners. Since 2000, increased marine survival rates and higher rainfall have likely contributed to a recent upswing in recruits (NMFS 2011d; Stout et al. 2012). That trend was interrupted during return years 2005, 2006, and 2007 as recruits again failed to replace parental spawners. Possible explanations for recent recruitment failures include the possibility that higher spawning abundance levels in recent years had reached the current carrying capacity of the degraded freshwater environment.

As total spawning abundance has been at the highest levels since the 1950s, the total numbers of recruits remain lower than in the 1950s–1970s (NMFS 2011d; Stout et al. 2012). These trends indicate that degraded freshwater habitat conditions may limit the Oregon Coast coho ESU from rebounding from another prolonged period of poor marine survival of recruits, should that occur in the future. The possibility that either of these factors (poor habitat and poor ocean conditions), individually or together, contributed to the extreme population declines observed in 2012 has not been reported.

Critical Habitat

Critical habitat has been designated (NMFS 2008d) in three CHUs that coincide with the Project components: Unit 9 – South Umpqua subbasin (HUC 17100302) affected by the Pipeline; Unit 11 – Coos subbasin (H–C 17100304 - includes the Coos Bay estuary) affected by the LNG Project and the Pipeline; and Unit 12 – Coquille subbasin (HUC 17100305) affected by the Pipeline.

Similar to critical habitat designated for coho salmon in the SONCC ESU, critical habitat for Oregon Coast coho includes stream channels to an extent laterally to the OHWM (or bankfull elevation or bankfull width). NMFS also defined critical habitat in estuarine and nearshore marine zones as areas contiguous with the shoreline from the extreme high water mark out to a depth no greater than 30 meters (98 feet) below the mean low water mark (NMFS 2004).

Within these areas, NMFS (2004) identified PCEs of critical habitat that include sites essential to support one or more coho life stages (spawning, rearing, migration, and foraging). Those sites each are associated with physical and biological features (or PCEs) essential to coho conservation (e.g., spawning gravels, water quality, water quantity, side channels, and food base). The following are PCEs for designated critical habitat for the Oregon Coast coho (NMFS 2008d):

1. Freshwater spawning sites with water quantity and quality conditions and substrate supporting spawning, incubation, and larval development.
2. Freshwater rearing sites with water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility; water quality and forage supporting juvenile development; and natural cover such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks.
3. Freshwater migration corridors free of obstruction with water quantity and quality conditions and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks a) supporting juvenile and adult mobility and survival, b) supporting juvenile use of various of habitats that allow them to avoid high flows, avoid predators, successfully compete, begin the behavioral and physiological changes needed for life in the ocean, and ability to reach the ocean, and c) essential for nonfeeding adults to successfully swim upstream, avoid predators, and reach spawning areas on limited energy stores.
4. Estuarine areas free of obstruction with water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between fresh- and

saltwater; natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels; and juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation.

5. Nearshore marine areas free of obstruction with water quality and quantity conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation; and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels.
6. Offshore marine areas with water quality conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation.

Designated critical habitat for the Oregon Coast coho does not include unoccupied areas. The lateral extent of critical habitat was defined as the width of the stream channel defined as the ordinary high-water line (NMFS 2008d).

3.5.4.2 Environmental Baseline

Analysis Area

There are three action area components that are applicable to coho salmon in the Oregon Coast coho salmon ESU: the marine analysis area, the estuarine analysis area, and the riverine analysis area.

The marine analysis area extends approximately 12 nmi offshore to the continental shelf (see figure 3.2.1-1, under section 3.2.1). Within this analysis area, effects to coho salmon within coastal marine waters would be associated with LNG carriers entering and exiting the Port from the Pacific Ocean that are assumed to transit the marine analysis area perpendicularly—east and west—as they approach and depart from Coos Bay (see the discussion above under section 3.2.1.2 for blue whales).

The estuarine analysis area was described above for MAMU (see figure 3.2.1-1). The estuarine analysis area includes: 1) the existing Federal Navigation Channel, which forms part of the waterway for LNG carrier traffic to and from the LNG Project; 2) the proposed access channel to the terminal slip; 3) the marine waterway modifications; 4) the area of North Slough adjacent to the Trans-Pacific Parkway/US-101 Intersection Widening; 5) the Eelgrass Mitigation site; 6) the Kentuck project site and sites temporarily occupied during construction activities; and 7) the HDDs of Coos Bay estuary and Coos River.

The riverine analysis area is similar to that described above for coho salmon in the SONCC ESU. The riverine analysis area includes two components: 1) the water column and substrate of all waterbodies crossed by the Pipeline from the point of crossing to the extent downstream where water quality is affected by turbidity generated during construction and sediment generated by runoff from the construction right-of-way, and 2) waterbodies' associated riparian zones affected in the short term during construction and in the long term by operation. For coho salmon in the Oregon Coast ESU, the riverine analysis area is limited to fresh waterbodies within Coos Subbasin (HUC 17100304 – figure 3.5.4-3A), Coquille Subbasin (HUC 17100305 – figure 3.5.4-3B) and South Umpqua Subbasin (HUC 17100302 – figure 3.5.4-3C); see table 3.5.4-3.

The downstream extent of the riverine analysis area was determined by estimating the likely distance downstream that suspended sediment concentrations generated during stream crossings could attenuate to ambient background levels within the Pipeline Project area. The methods used to estimate this distance are explained below.

Pipeline Project TSS concentrations generated during wet open-cut pipeline construction have been estimated from models developed by Reid et al. (2004). Amounts of TSS produced during dry open-cut construction (fluming, dam-and-pump) adjustments are fractions of the concentrations produced during wet-open cuts (Reid et al. 2004). Estimates of TSS produced during dry open-cut construction across waterbodies in fifth-field watersheds are presented below in section 3.5.4.3. Average sediment percentages (grain sizes including gravel, sand, silt, and organics) for streams within each fifth-field watershed (see table 3.5.4-10a and table 3.5.4-10b below in this section and table 3.5.4-17 in section 3.5.4.3) were assumed as fractions of the TSS generated during construction and concentrations of each grain class at various distances downstream were estimated using a simple sediment transport model (Ritter 1984). Downstream settling distances would be much greater for deeper waterbodies with high flow velocities than for shallow, slow flowing streams.

Using models noted above and data on the average sediment composition, stream depth, and average summer low flows for streams within range of Oregon Coast coho that would be crossed by the Pipeline, the average downstream distance expected to near a concentration of 2 mg/l for silt (0.0016 cm diameter, 0.023 cm/sec settling velocity) ranges from 34 meters (112 feet) in the Coos Bay watershed to 482 meters (1,581 feet) in the Upper Cow Creek watershed; the average downstream distance expected to near a concentration of 2 mg/l for clay (0.0004 cm diameter, 0.0014 cm/sec settling velocity) ranges from 595 meters (1,952 feet) in the Coos Bay watershed to 7,315 meters (23,993 feet) in the Upper Cow Creek watershed. These estimates are for average summer low flows likely to occur during construction within the ODFW (2008) allowed in-stream construction period.

While distances for fine clay settling to 2 mg/l would vary among sites, meaningful changes in suspended sediment concentrations at all sites should be much less than average distances of the estimated fine clay particle sizes downstream distance at average low summer flows. The estimated average downstream distance traveled of these very fine particles is a reasonable conservative limit to consider for the analysis area. The riverine analysis area used in this BA for Oregon Coast coho salmon has been limited to downstream distances ranging from 1,952 feet to 23,993 feet (0.4 mile to 4.5 miles) within the affected fifth-field watersheds in the range of Oregon Coast coho salmon (see figure 3.5.4-3).

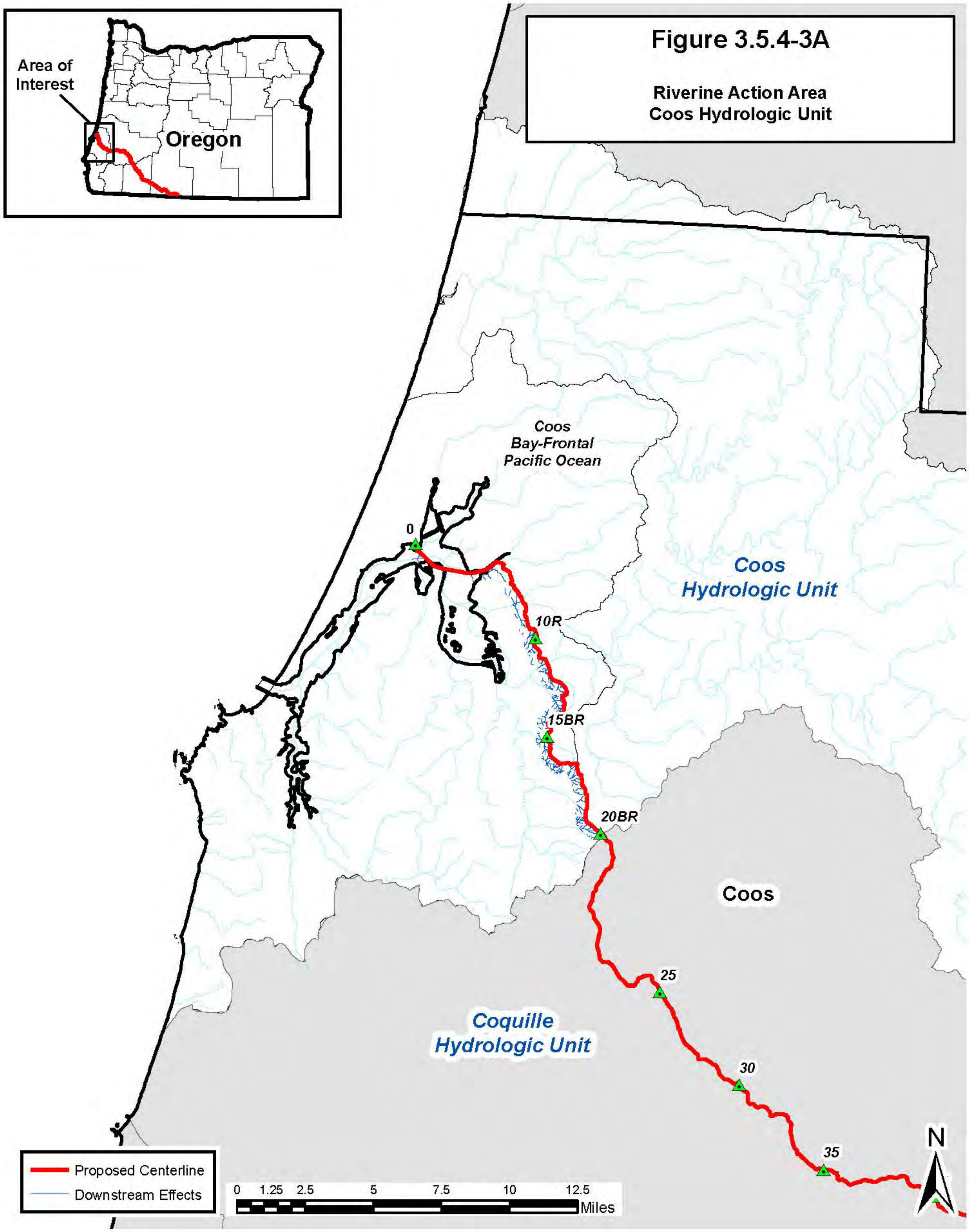


Figure 3.5.4-3A
Riverine Action Area
Coos Hydrologic Unit
Area of Interest
Oregon
Coos Bay-Frontal Pacific Ocean
Coos Hydrologic Unit
Coos
Coquille Hydrologic Unit
0
10R
15BR
20BR
25
30
35
Proposed Centerline
Downstream Effects
0 1.25 2.5 5 7.5 10 12.5
Miles
N

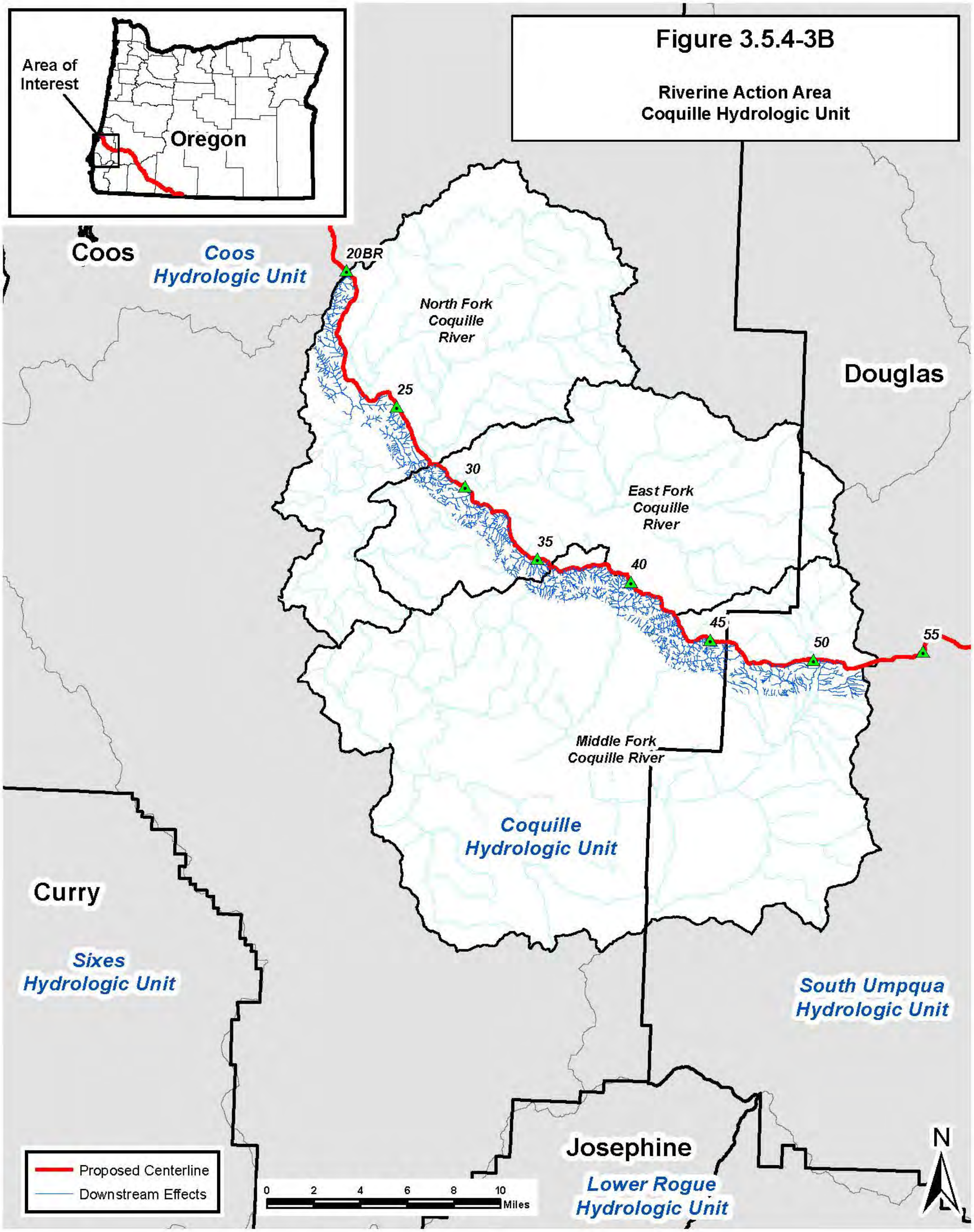


Figure 3.5.4-3B
Riverine Action Area
Coquille Hydrologic Unit
Area of Interest
Oregon
Coos
Coos Hydrologic Unit
20BR
25
30
35
40
45
50
55
North Fork Coquille River
East Fork Coquille River
Middle Fork Coquille River
Douglas
Coquille Hydrologic Unit
Curry
Sixes Hydrologic Unit
South Umpqua Hydrologic Unit
Josephine
Lower Rogue Hydrologic Unit
Proposed Centerline
Downstream Effects
0 2 4 6 8 10 Miles
N

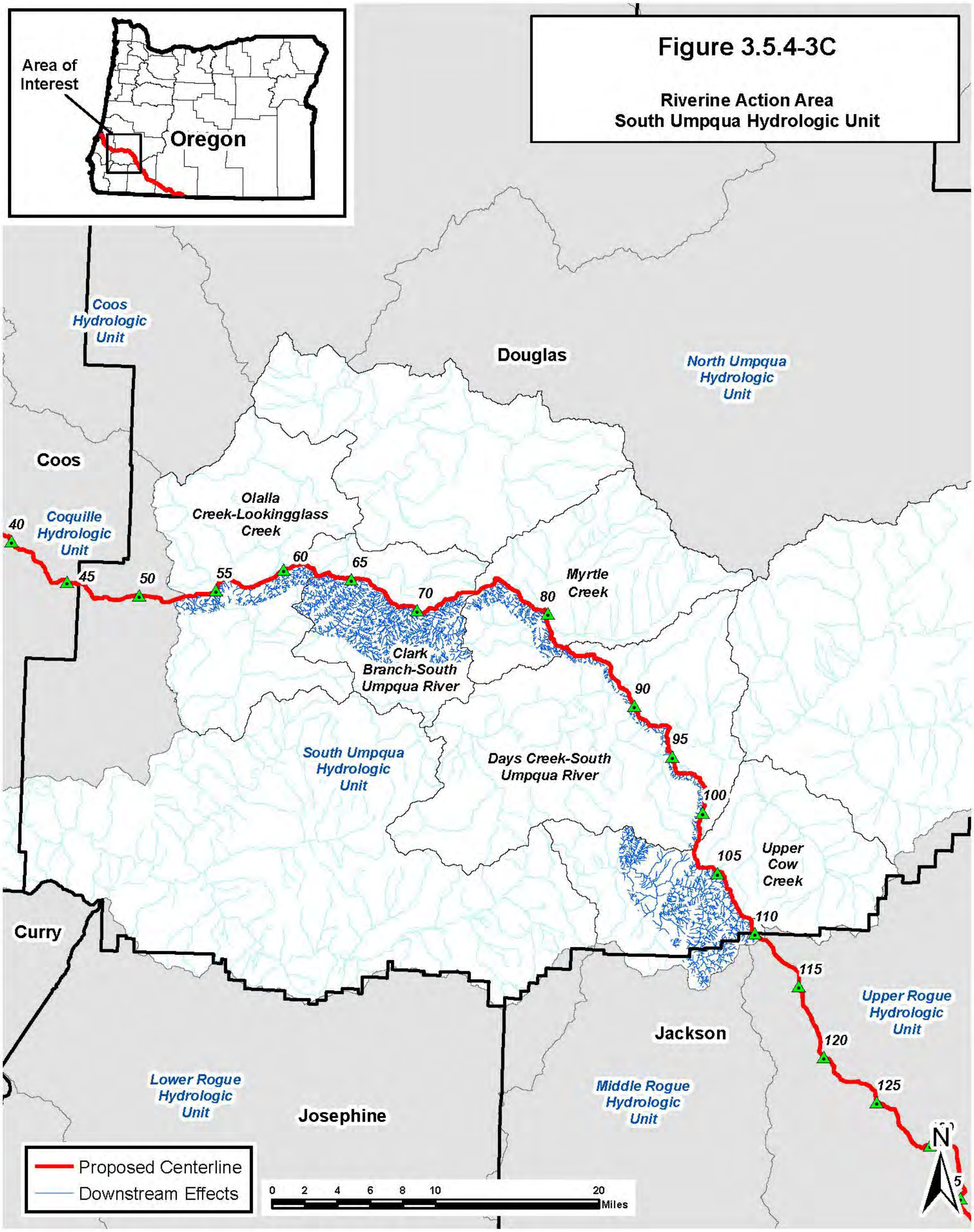


Figure 3.5.4-3C
Riverine Action Area
South Umpqua Hydrologic Unit
Area of Interest
Oregon
Coos Hydrologic Unit
Douglas
North Umpqua Hydrologic Unit
Coos
Coquille Hydrologic Unit
Olalla Creek-Lookingglass Creek
Myrtle Creek
Clark Branch-South Umpqua River
South Umpqua Hydrologic Unit
Days Creek-South Umpqua River
Upper Cow Creek
Curry
Jackson
Upper Rogue Hydrologic Unit
Lower Rogue Hydrologic Unit
Josephine
Middle Rogue Hydrologic Unit
40
45
50
55
60
65
70
80
90
95
100
105
110
115
120
125
Proposed Centerline
Downstream Effects
0 2 4 6 8 10 20
Miles
N

TABLE 3.5.4-3

Summary of River Subbasins and Fifth Field Watersheds Coinciding with the Pipeline Route, within Range of Oregon Coast Salmon ESU Encountered from West to East

Subbasins and fifth Field Watersheds	Hydrologic Unit Code	Number of Waterbodies a/				
		Estuary	Perennial	Intermittent	Pond b/	Total
Coos Subbasin	**17100304**					
Coos Bay-Frontal Pacific Ocean c/	1710030403	3	6	10	0	19
Coquille Subbasin	**17100305**					
North Fork Coquille River	1710030504		4	4		8
East Fork Coquille River	1710030503		9	15		14
Middle Fork Coquille River	1710030501		7	12		19
South Umpqua Subbasin	**17100302**					
Olalla Creek-Lookingglass Creek	1710030212		4	14		18
Clark Branch-South Umpqua River	1710030211		7	15		22
Myrtle Creek	1710030210		7	7		14
Days Creek-South Umpqua River	1710030205		6	10	3	19
Elk Creek d/	1710030204					0
Upper Cow Creek	1710030206		5	6		11
	TOTAL	**3**	**55**	**83**	**3**	**144**

a/ Includes waterbodies crossed and waterbodies not crossed but immediately adjacent to the pipeline and within the right-of-way.
b/ Includes stock ponds, industrial ponds.
c/ The Coos River is influenced by tides but it is included as a perennial waterbody in this watershed.
d/ Elk Creek watershed would be crossed but no waterbodies would be affected within the watershed.

Species Presence by Project Watershed

The Pipeline would cross the following watersheds that are inhabited by Oregon Coast coho: Coos Bay-Frontal Pacific Ocean (HUC 1710030403), North Fork Coquille River (1710030504), East Fork Coquille River (HUC 1710030503), Middle Fork Coquille River (HUC 1710030501), Olalla Creek-Lookingglass Creek (HUC 1710030212), Clark Branch-South Umpqua River (HUC 1710030211), Myrtle Creek (HUC 1710030210), Days Creek-South Umpqua River (HUC 1710030205), and Upper Cow Creek (HUC 1710030206). Upstream migrations by coho in the Middle Fork Coquille River are blocked (Bradford Falls) at RM 27.3, about 5.3 miles southwest of Camas Valley, Oregon.

The Pipeline would cross 116 of the waterbodies in table 3.5.4-4, 111 of them by dry open cutting (flume or dam-and-pump), while the South Umpqua River would be crossed twice, once by a DP crossing at MP 71.27 and again by a dry open cut at MP 94.73. Coos Bay would be crossed by two HDDs, one from MP 0.28 to MP 1.00, the other from MP 1.46 to MP 3.02. The Coos River (a reach of the estuary but categorized as a perennial waterbody) would be crossed using HDD at MP 11.13. Twenty-eight of the waterbodies listed in table 3.5.4-4 would not be crossed by the Pipeline but are adjacent to the centerline. Blasting may be necessary to construct across 22 streams that would be crossed by dry open-cut methods because the streambed of each is bedrock (see table 3.5.4-4).

All affected waterbodies within the three subbasins and nine fifth-field watersheds (Elk Creek HUC 1710030204, is crossed but no waterbodies are affected) that are within the range of Oregon Coast coho salmon ESU proximate to the Pipeline are included in table 3.5.4-4. There are 144 waterbodies included in the table, of which 55 are perennial, 83 are intermittent, one is an estuary (crossed twice), and three others are ponds. Coho salmon are known to occur in 31 of the waterbodies and are assumed to be present in 12 others based on connectivity to perennial streams known to support coho salmon, the presence of steelhead and/or resident salmonids, and/or information provided by fisheries biologists. Data in table 3.5.4-4 were revised based on ODFW (2017f) fish habitat distribution shapefiles and ODF (2018) Forest Practices statewide hydrography shapefiles that provide field evaluations for fish presence/absence in stream segments.

TABLE 3.5.4-4

Waterbodies Crossed or Adjacent to the Pipeline within the Coos Subbasin (HUC 17100304), Coquille Subbasin (HUC 17100305), and South Umpqua Subbasin (HUC 17100302) and in the Range of the Oregon Coast Coho Salmon ESU (updated May 2018)

Waterbodies Crossed and Waterbody ID	NHD Waterbody Reach Code and/or Jurisdiction	Pipeline Milepost (MP)	Waterbody Type	Proposed Crossing Method a/ (potential for blasting) d/	Species Present b/	Habitat Component Present b/	Fishery Construction Window c/
Coos Subbasin (HUC 17100304), Coos Bay-Frontal Pacific Ocean (HUC 1710030403) Fifth-Field Watershed, Coos County, Oregon							
Estuary Drain (Alt Wet NH (West))	17100304006491 State	0.00	Estuary	Pullback TEWA Adjacent to Pipeline	Coho	Coho, migration, rearing	Oct 1 to Feb 15
Coos Bay (NE-26)	17100304006491 State	0.28 to 1.00	Estuary	HDD	Coho	Coho, migration, rearing	Oct 1 to Feb 15
Coos Bay (NE-26)	171003040064961 State	1.46 to 3.02	Estuary	HDD	Coho	Coho, migration, rearing	Oct 1 to Feb 15
Kentuck Slough EE-SS-9004 (EE-6)	Not available	3.02 to 6.39R	Perennial	Adjacent riparian zone	Coho	Coho, spawning, rearing	Jul 1 to Sep 15
Trib to Coos Bay (NW-117/EE-6)	17100304000767 Private	6.39R	Perennial	Dry Open-Cut	Coho Assumed	Unknown	Jul 1 to Sep 15
Willanch Slough (EE-7)	17100304001393 Private	8.27R	Perennial	Dry Open-Cut	Coho	Coho, migration, rearing	Jul 1 to Sep 15
Johnston Creek S1-05 (GDX-29 / EE-8 (MOD))	17100304000413 17100304000409 Private	8.35R	Perennial	Adjacent riparian zone	Coho	Coho, spawning, rearing	Jul 1 to Sep 15
Trip to Willanch Slough (GDX030)	Private	8.48R	Intermittent	Dry Open-Cut	None	None	Jul 1 to Sep 15
Trib. to Cooston Channel (Echo Creek) (SS-100-002)	17100304005045 Private	10.21R	Intermittent	Dry Open-Cut	Coho	Coho Spawning, Rearing	Jul 1 to Sep 15
Coos River (BSP-119)	17100304005030 Private	11.13R	Perennial	HDD	Coho	Coho, migration, rearing	Oct 1 to Feb 15
Vogel Creek (SS-100-005)	17100304005031 Private	11.55BR	Perennial	Dry Open-Cut	Coho	Coho Spawning, Rearing	Jul 1 to Sep 15
Ditch Trib. to Vogel Creek (BR-S-04)	17100304000790 Private	11.88BR	Intermittent	Dry Open-Cut	None	None	Jul 1 to Sep 15
Ditch Trib. to Vogel Creek (BR-S-06)	17100304000798 Private	12.11BR	Intermittent	Dry Open-Cut	None	None	Jul 1 to Sep 15
Trib to Lillian Creek (EE-SS-9021)	17100304014424 Private	13.41BR	Intermittent	Adjacent to centerline within ROW	None	None	Jul 1 to Sep 15

TABLE 3.5.4-4 (continued)

Waterbodies Crossed or Adjacent to the Pipeline within the Coos Subbasin (HUC 17100304), Coquille Subbasin (HUC 17100305), and South Umpqua Subbasin (HUC 17100302) and in the Range of the Oregon Coast Coho Salmon ESU (updated May 2018)

Waterbodies Crossed and Waterbody ID	NHD Waterbody Reach Code and/or Jurisdiction	Pipeline Milepost (MP)	Waterbody Type	Proposed Crossing Method a/ (potential for blasting) d/	Species Present b/	Habitat Component Present b/	Fishery Construction Window c/
Trib. to Stock Slough (EE-SS-9026)	17100304015021 Private	13.92BR	Intermittent	Adjacent to centerline within TEWA	None	None	Jul 1 to Sep 15
Trib. to Stock Slough (BR-S-31)	17100304002068 Private	14.72BR	Intermittent	Dry Open-Cut	None	None	Jul 1 to Sep 15
Trib. to Stock Slough (Laxstrom Gulch) (BR-S-30)	17100304000493 Private	14.82BR	Intermittent	Adjacent riparian zone	Coho	Coho Spawning, Rearing	Jul 1 to Sep 15
Stock Slough (BR-S-36)	17100304000507 Private	15.11BR	Intermittent	Dry Open-Cut	Coho	Coho Spawning, Rearing	Jul 1 to Sep 15
Stock Slough (EE-SS-9068)	17100304000507 Private	15.32BR	Intermittent	Dry Open-Cut	Coho	Coho Spawning, Rearing	Jul 1 to Sep 15
Coquille Subbasin (HUC 17100305), North Fork Coquille River (HUC 1710030504) Fifth-Field Watershed, Coos County, Oregon							
Steinnon Creek (SS-500-003; BR-S-63)	17100305000361 BLM	20.20BR	Perennial	Dry Open-Cut	None	None	Jul 1 to Sep 15
Steinnon Creek (BR-S-63)	17100305000361 BLM	24.32BR	Perennial	Dry Open-Cut	Coho	Coho, spawning, rearing	Jul 1 to Sep 15
Ditch	17100305012102 Private	22.72	Intermittent	Dry Open-Cut	None	None	Jul 1 to Sep 15
North Fork Coquille River (BSP-207)	17100305000339 Private	23.06	Perennial	Dry Open-Cut	Coho	Coho, spawning, rearing	Jul 1 to Sep 15
Trib. to Middle Creek (BR-S-63)	17100305012832 Private	25.18	Intermittent	Dry Open-Cut	None	None	Jul 1 to Sep 15
Trib. to Middle Creek (BSI-137)	BLM- Coos Bay District	27.01	Intermittent	Dry Open-Cut	None	None	Jul 1 to Sep 15
Trib. to Middle Creek (BSI-135)	BLM- Coos Bay District	27.03	Intermittent	Adjacent to centerline within ROW	None	None	Jul 1 to Sep 15
Middle Creek (BSP-133)	17100305000323 BLM- Coos Bay District	27.04	Perennial	Dry Open-Cut	Coho	Coho, migration, rearing	Jul 1 to Sep 15
Coquille Subbasin (HUC 17100305), East Fork Coquille River (HUC 1710030503) Fifth-Field Watershed, Coos County, Oregon							
Trib. To E. Fork Coquille (BSP-77)	7100305002504 Private	28.86	Perennial	Dry Open-Cut (Streambed-bedrock)	Coho Assumed	Unknown	Jul 1 to Sep 15
Trib. To E. Fork Coquille (BSP-74)	17100305002598 Private	29.30	Intermittent	Dry Open-Cut	Coho Assumed	Unknown	Jul 1 to Sep 15
Trib. To E. Fork Coquille (BSI-76)	17100305002647 Private	29.47	Intermittent	Dry Open-Cut (Streambed-bedrock)	Coho Assumed	Unknown	Jul 1 to Sep 15
East Fork Coquille River (BSP-71)	17100305000286 Private	29.85	Perennial	Dry Open-Cut	Coho	Coho, spawning, rearing	Jul 1 to Sep 15
Trib. to E. Fork Coquille (SS-003-007A)	17100305002813 Private	30.22	Perennial	Dry Open-Cut	None	None	Jul 1 to Sep 15
Trib. to E. Fork Coquille (SS-003-007B)	17100305002813 Private	30.29	Perennial	Dry Open-Cut	Coho Assumed	Unknown	Jul 1 to Sep 15
Trib. To E. Fork Coquille (BSI-70)	17100305018097 BLM- Coos Bay District	31.64	Intermittent	Dry Open-Cut	None	None	Jul 1 to Sep 15

TABLE 3.5.4-4 (continued)

Waterbodies Crossed or Adjacent to the Pipeline within the Coos Subbasin (HUC 17100304), Coquille Subbasin (HUC 17100305), and South Umpqua Subbasin (HUC 17100302) and in the Range of the Oregon Coast Coho Salmon ESU (updated May 2018)

Waterbodies Crossed and Waterbody ID	NHD Waterbody Reach Code and/or Jurisdiction	Pipeline Milepost (MP)	Waterbody Type	Proposed Crossing Method a/ (potential for blasting) d/	Species Present b/	Habitat Component Present b/	Fishery Construction Window c/
Elk Creek (BSP-57)	1240218431116 Private	32.40	Perennial	Dry Open-Cut	Coho Assumed	Unknown	Jul 1 to Sep 15
Trib. To Elk Creek (BSP-55)	1239513431370 Private	32.44	Perennial	Dry Open-Cut (Streambed-bedrock)	Coho Assumed	Unknown	Jul 1 to Sep 15
Trib. To Elk Creek (SS-100-030)	7100305021871 Private	32.56	Intermittent	Dry Open-Cut	None	None	Jul 1 to Sep 15
Trib. To Elk Creek (SS-100-031)	17100305021865 Private	32.63	Intermittent	Dry Open-Cut	None	None	Jul 1 to Sep 15
Trib. To Elk Creek (BSP-49)	17100305003372 Private	33.00	Perennial	Dry Open-Cut	None	None	Jul 1 to Sep 15
Trib. To Elk Creek (BSP-50)	17100305003372 Private	33.02	Perennial	Adjacent to centerline within ROW	None	None	Jul 1 to Sep 15
South Fork Elk Creek (CSP-5)	17100305000591 Private	34.46	Perennial	Dry Open-Cut	Coho	Coho, spawning, rearing	Jul 1 to Sep 15
Trib. To S. Fork Elk Creek (BSI-251)	17100305021783 BLM-Coos Bay District	35.51	Intermittent	Dry Open-Cut	None	None	Jul 1 to Sep 15
Coquille Subbasin (HUC 17100305), Middle Fork Coquille River (HUC 1710030501) Fifth-Field Watershed, Coos County, Oregon							
Trib. to Big Creek (BLM 35.87)	17100305025781 BLM-Coos Bay District	35.87	Intermittent	Dry Open-Cut	None	None	Jul 1 to Sep 15
Trib. To Big Creek (BLM 36.48)	17100305026477 BLM-Coos Bay District	36.48	Intermittent	Dry Open-Cut	None	None	Jul 1 to Sep 15
Trib. To Big Creek (GSI-25/BSI-253)	17100305004068 BLM-Coos Bay District	36.54	Intermittent	Dry Open-Cut	None	None	Jul 1 to Sep 15
Trib. To Big Creek (BLM 36.85)	17100305025748 BLM-Coos Bay District	36.85	Intermittent	Dry Open-Cut	None	None	Jul 1 to Sep 15
Trib. To Big Creek (BSI-252)	17100305004061 BLM-Coos Bay District	36.92	Intermittent	Dry Open-Cut	None	None	Jul 1 to Sep 15
Trib. To Big Creek (ESI-19)	17100305026126 BLM-Coos Bay District	37.32	Intermittent	Dry Open-Cut	None	None	Jul 1 to Sep 15
Trib. To Big Creek (ESP-20)	17100305000606 BLM-Coos Bay District	37.35	Perennial	Dry Open-Cut	None	None	Jul 1 to Sep 15
Big Creek	17100305000272 BLM	37.41	Perennial	Adjacent riparian zone	Coho Assumed	Unknown	Jul 1 to Sep 15
Upper Rock Creek (BSP-41)	17100305000252 Private	44.21	Perennial	Dry Open-Cut	None	None	Jul 1 to Sep 15
Coquille Subbasin (HUC 17100305), Middle Fork Coquille River (HUC 1710030501) Fifth-Field Watershed, Douglas County, Oregon							
Trib. to Upper Rock Creek (S3-07 /BW-38)	17100305005585 Private	46.56	Perennial	Dry Open-Cut	None	None	Jul 1 to Sep 15
Ditch (S3-06)	Private	48.21	Intermittent	Dry Open-Cut	None	None	N/A
Deep Creek (BSP-257)	17100305005863 BLM-Roseburg District	48.27	Perennial	Dry Open-Cut	None	None	Jul 1 to Sep 15
Ditch (BDX-32)	Private	49.94	Intermittent	Adjacent to ROW	None	None	Jul 1 to Sep 15
Ditch (BDX-31)	Private	50.02	Intermittent	Dry Open-Cut	None	None	N/A

TABLE 3.5.4-4 (continued)

Waterbodies Crossed or Adjacent to the Pipeline within the Coos Subbasin (HUC 17100304), Coquille Subbasin (HUC 17100305), and South Umpqua Subbasin (HUC 17100302) and in the Range of the Oregon Coast Coho Salmon ESU (updated May 2018)

Waterbodies Crossed and Waterbody ID	NHD Waterbody Reach Code and/or Jurisdiction	Pipeline Milepost (MP)	Waterbody Type	Proposed Crossing Method a/ (potential for blasting) d/	Species Present b/	Habitat Component Present b/	Fishery Construction Window c/
Middle Fork Coquille River (BSP-30)	17100305000232 Private	50.28	Perennial	Dry Open-Cut (Streambed-bedrock)	None	None	Jul 1 to Sep 15
Trib. to Middle Fork Coquille (GDX-36/BSI-66)	17100305005874 Private	50.45	Intermittent	Dry Open-Cut	None	None	Jul 1 to Sep 15
Belieu Creek (BSP-61/GSI-37)	17100305000706 Private	50.71	Perennial	Dry Open-Cut	None	None	Jul 1 to Sep 15
Trib. to Middle Fork Coquille (GSI-38)	17100305022784 Private	51.02	Intermittent	Dry Open-Cut	None	None	Jul 1 to Sep 15
Unnamed Stream (SS-222-006)	Private	51.71	Intermittent	Adjacent to centerline within ROW	None	None	Jul 1 to Sep 15
South Umpqua (HUC 17100302) Subbasin, Olalla Creek-Lookingglass Creek (HUC 1710030212) Fifth-Field Watershed, Douglas County, Oregon							
Trib. to Shields Creek (BSI-202)	17100302001821 Private	55.90	Intermittent	Dry Open-Cut	Coho Assumed	Unknown	Jul 1 to Sep 15
Trib. to Shields Creek (BSI-203)	17100302001894 Private	55.94	Intermittent	Dry Open-Cut	None	None	Jul 1 to Sep 15
Trib. to Shields Creek (Denied Access 13)	17100302044091 Private	56.28	Intermittent	Dry Open-Cut	None	None	Jul 1 to Sep 15
Trib. to Shields Creek (Denied Access 14)	17100302044013 Private	56.34	Intermittent	Dry Open-Cut	None	None	Jul 1 to Sep 15
Trib. to Olalla Creek (BSI-140)	17100302048489 Private	57.11	Intermittent	Dry Open-Cut (Streambed – bedrock)	None	None	Jul 1 to Sep 15
Trib. to Olalla Creek (BSI-140)	17100302048489 Private	57.14	Intermittent	Dry Open-Cut (Streambed – bedrock)	None	None	Jul 1 to Sep 15
Trib. to Olalla Creek (BSI-138)	17100302002187 Private	57.31	Intermittent	Dry Open-Cut	Coho Assumed	Unknown	Jul 1 to Sep 15
Trib. to Olalla Creek (BSI-147/EE-12)	17100302002221 Private	57.84	Intermittent	Dry Open-Cut	None	None	Jul 1 to Sep 15
Irrigation Canal (BDX148)	Private	57.97	Intermittent	Dry Open-Cut	None	None	N/A
Trib. to Olalla Creek (BSI-151)	17100302002311 Private	58.20	Intermittent	Dry Open-Cut	None	None	Jul 1 to Sep 15
Ditch (BDX-157)	Private	58.30 58.51	Intermittent	Adjacent to centerline within ROW and TEWA	None	None	N/A
Trib. to Olalla Creek (BSP-159)	17100302002420 Private	58.55	Perennial	Dry Open-Cut	None	None	Jul 1 to Sep 15
Olalla Creek (BSP-155)	17100302000047 Private	58.78	Perennial	Dry Open-Cut	Coho	Coho Spawning, Rearing	Jul 1 to Se– 15
Ditch - Trib. to Olalla Creek (BDX-153)	17100302002576 Private	59.02	Intermittent	Dry Open-Cut	None	None	N/A
Trib. to Olalla Creek (BSI-132)	17100302002635 Private	59.29	Intermittent	Dry Open-Cut	None	None	Jul 1 to Sep 15
Trib. to Olalla Creek (BSI-129)	17100302000705 Private	59.65	Intermittent	Dry Open-Cut	Coho Assumed	Unknown	Jul 1 to Sep 15
Trib. to McNabb Creek (NSP-14)	17100302002838 Private	60.13	Perennial	Dry Open-Cut (Streambed-bedrock)	None	None	Jul 1 to Sep 15

TABLE 3.5.4-4 (continued)

Waterbodies Crossed or Adjacent to the Pipeline within the Coos Subbasin (HUC 17100304), Coquille Subbasin (HUC 17100305), and South Umpqua Subbasin (HUC 17100302) and in the Range of the Oregon Coast Coho Salmon ESU (updated May 2018)

Waterbodies Crossed and Waterbody ID	NHD Waterbody Reach Code and/or Jurisdiction	Pipeline Milepost (MP)	Waterbody Type	Proposed Crossing Method a/ (potential for blasting) d/	Species Present b/	Habitat Component Present b/	Fishery Construction Window c/
McNabb Creek (NSP-13)	17100302002924 Private	60.48	Perennial	Dry Open-Cut (Streambed-bedrock)	Coho	Coho Spawning, Rearing	Jul 1 to Sep 15
South Umpqua (HUC 17100302) Subbasin, Clark Branch-South Umpqua River (HUC 1710030211) Fifth-Field Watershed, Douglas County, Oregon							
Kent Creek (BSP-240)	17100302000075 Private	63.97	Perennial	Dry Open-Cut	Coho	Coho Spawning, Rearing	Jul 1 to Sep 15
Trib. to Kent Creek (BS-I241)	17100302003968 Private	63.97	Intermittent	Adjacent to centerline within ROW	None	None	Jul 1 to Sep 15
Rice Creek (S2-04; BSP-227)	17100302000079 Private	65.76	Perennial	Dry Open-Cut (Streambed-bedrock)	Coho	Coho Spawning, Rearing	Jul 1 to Sep 15
Trib to Rice Creek BSI-228	17100302044765 Private	65.83	Intermittent	Adjacent riparian zone	None	None	Jul 1 to Sep 15
Trib. to Willis Creek (BSI-230)	17100302004832 Private	66.87	Intermittent	Adjacent to centerline within ROW (Streambed-bedrock)	None	None	Jul 1 to Sep 15
Willis Creek (BSP-168)	17100302000083 Private	66.95	Perennial	Dry Open-Cut (Streambed-bedrock)	Coho	Coho Spawning, Rearing	Jul 1 to Sep 15
Trib. to Willis Creek (BSI-169)	17100302048422 Private	67.00	Intermittent	Dry Open-Cut (Streambed-bedrock)	None	None	Jul 1 to Sep 15
Trib. to South Umpqua River (SS-005-001 (SS-100-011)	17100302049984 Private	69.10	Intermittent	Adjacent to centerline within ROW	None	None	Jul 1 to Sep 15
Trib. to South Umpqua River SS-004-004 SS-100-012)	17100302005610 Private	69.29	Perennial	Dry Open-Cut	None	None	Jul 1 to Sep 15
Trib. to South Umpqua River (SS-004-005 SS-100-013)	17100302000727 Private	69.35	Perennial	Dry Open-Cut	None	None	Jul 1 to Sep 15
Trib. to South Umpqua River (SS-004-006 SS-100-014)	17100302005693 Private	69.57	Intermittent	Dry Open-Cut	None	None	Jul 1 to Sep 15
Trib. to South Umpqua River (SS-999-001)	17100302046930 Private	70.79	Intermittent	Adjacent riparian zone	None	None	Jul 1 to Sep 15
Trib. to South Umpqua River (SS-100-015)	17100302006216 Private	71.08	Intermittent	Adjacent In TEWA 71.01-N	None	None	Jul 1 to Sep 15
South Umpqua River (BSP-26)	17100302000086 Private	71.27	Perennial	Direct Pipe	Coho	Coho Migration	Jul 1 to Aug 31
Trib. to South Umpqua River (SS-005-007)	17100302035572 Private	71.34	Intermittent	Adjacent to potential Roth Pipe Yard	None	None	Jul 1 to Sep 15
Trib. to South Umpqua River (SS-005-008 SS-100-016)	17100302006366 Private	71.35 71.57	Intermittent	Direct Pipe	None	None	Jul 1 to Sep 15
Trib. to South Umpqua River (SS-100-017)	17100302047304 Private	71.69	Intermittent	Adjacent to centerline within ROW	None	None	Jul 1 to Sep 15

TABLE 3.5.4-4 (continued)

Waterbodies Crossed or Adjacent to the Pipeline within the Coos Subbasin (HUC 17100304), Coquille Subbasin (HUC 17100305), and South Umpqua Subbasin (HUC 17100302) and in the Range of the Oregon Coast Coho Salmon ESU (updated May 2018)

Waterbodies Crossed and Waterbody ID	NHD Waterbody Reach Code and/or Jurisdiction	Pipeline Milepost (MP)	Waterbody Type	Proposed Crossing Method a/ (potential for blasting) d/	Species Present b/	Habitat Component Present b/	Fishery Construction Window c/
Trib. to South Umpqua River (SS-005-009 SS-100-019)	17100302006590 Private	73.04	Intermittent	Dry Open-Cut	None	None	Jul 1 to Sep 15
Trib. to South Umpqua River (SS-005-013 SS-100-020)	17100302050160 Private	73.51	Intermittent	Dry Open-Cut	None	None	Jul 1 to Sep 15
Trib. to South Umpqua River (SS-005-011 & -12 SS-100-021)	17100302049674 Private	73.56	Intermittent	Dry Open-Cut	None	None	Jul 1 to Sep 15
Unnamed Stream (SS-005-010)	Private	73.73	Perennial	Dry Open-Cut	None	None	Jul 1 to Sep 15
South Umpqua (HUC 17100302) Subbasin, Myrtle Creek (HUC 1710030210) Fifth-Field Watershed, Douglas County, Oregon							
Rock Creek (EE-SS-9032)	17100302007335 Private	75.33	Perennial	Dry Open-Cut	Coho Assumed	Unknown	Jul 1 to Sep 15
Trib. to Rock Creek (EE-SS-9033)	17100302001061 Private	75.34	Perennial	Dry Open-Cut	Coho Assumed	Unknown	Jul 1 to Sep 15
Bilger Creek (BSP-1)	17100302000605 Private	76.38	Perennial	Dry Open-Cut	Coho	Coho Spawning, Rearing	Jul 1 to Sep 15
Little Lick (BSP-6)	17100302001073 Private	77.71	Perennial	Dry Open-Cut	None	None	Jul 1 to Sep 15
Trib. to Little Lick Creek (BSI-8)	17100302008039 Private	77.93	Intermittent	Dry Open-Cut	None	None	Jul 1 to Sep 15
Trib. to Little Lick Creek (BSI-10)	17100302008047 Private	78.02	Intermittent	Dry Open-Cut	None	None	Jul 1 to Sep 15
North Myrtle Creek (NSP-37)	17100302000541 Private	79.12	Perennial	Dry Open-Cut (Streambed-bedrock)	Coho	Coho Spawning, Rearing	Jul 1 to Sep 15
Trib. to North Myrtle Creek (NSP-38)	17100302008397 Private	79.15	Perennial	Dry Open-Cut	None	None	Jul 1 to Sep 15
Trib. to N. Myrtle Creek (EE-SS-9038)	17100302045565 Private	79.17	Intermittent	Dry Open-Cut	None	None	Jul 1 to Sep 15
Trib. to N. Myrtle Creek (EE-SS-9039)	17100302045117 Private	79.19	Intermittent	Dry Open-Cut	None	None	Jul 1 to Sep 15
South Myrtle Creek (BSP-172)	7100302000521 Private	81.19	Perennial	Dry Open-Cut (Streambed-bedrock)	Coho	Coho Spawning, Rearing	Jul 1 to Sep 15
Trib. to S. Myrtle Creek (BSP-259)	17100302008796 Private	81.38	Intermittent	Dry Open-Cut	None	None	Jul 1 to Sep 15
Trib. to S. Myrtle Creek (SS-100-023)	17100302008772 Private	81.45	Intermittent	Dry Open-Cut	None	None	Jul 1 to Sep 15
Trib. to S. Myrtle Creek (EE-SS-9074)	17100302008917 Private	81.93	Intermittent	Dry Open-Cut	None	None	Jul 1 to Sep 15
South Umpqua (HUC 17100302) Subbasin, Days Creek-South Umpqua River (HUC 1710030205) Fifth-Field Watershed, Douglas County, Oregon							
Wood Creek (BSP-226)	17100302001104 Private	84.17	Perennial	Dry Open-Cut (Streambed-bedrock)	None	None	Jul 1 to Sep 15
Trib. to Wood Creek (EE-SS-9040)	17100302009813 Private	85.38	Intermittent	Dry Open-Cut	None	None	Jul 1 to Sep 15

TABLE 3.5.4-4 (continued)

Waterbodies Crossed or Adjacent to the Pipeline within the Coos Subbasin (HUC 17100304), Coquille Subbasin (HUC 17100305), and South Umpqua Subbasin (HUC 17100302) and in the Range of the Oregon Coast Coho Salmon ESU (updated May 2018)

Waterbodies Crossed and Waterbody ID	NHD Waterbody Reach Code and/or Jurisdiction	Pipeline Milepost (MP)	Waterbody Type	Proposed Crossing Method a/ (potential for blasting) d/	Species Present b/	Habitat Component Present b/	Fishery Construction Window c/
Trib. to Wood Creek (EE-SS-9041)	17100302009881 Private	85.69	Intermittent	Dry Open-Cut	None	None	Jul 1 to Sep 15
Trib. to Wood Creek (EE-SS-9042)	17100302001103 Private	85.71	Perennial	Dry Open-Cut	None	None	Jul 1 to Sep 15
Trib. to Wood Creek (EE-SS-9043)	17100302036325 Private	85.88	Intermittent	Dry Open-Cut	None	None	Jul 1 to Sep 15
Trib. to Wood Creek (EE-SS-9044)	17100302036276 Private	86.07	Intermittent	Dry Open-Cut	None	None	Jul 1 to Sep 15
Trib. to Wood Creek (EE-SS-9045)	17100302036276 Private	86.10	Intermittent	Adjacent to centerline within ROW	None	None	Jul 1 to Sep 15
Trib. to Fate Creek (BSI-236)	17100302036007 Private	88.20	Intermittent	Dry Open-Cut (Streambed-bedrock)	None	None	Jul 1 to Sep 15
Trib. to Fate Creek (BSI-238 (MOD))	17100302036007 Private	88.23	Intermittent	Dry Open-Cut	None	None	Jul 1 to Sep 15
Fate Creek (BSP-232)	17100302001124 Private	88.48	Perennial	Dry Open-Cut (Streambed-bedrock)	Coho	Coho Spawning, Rearing	Jul 1 to Sep 15
Days Creek (BSP-233)	17100302000511 Private	88.60	Perennial	Dry Open-Cut (Streambed-bedrock)	Coho	Coho Spawning, Rearing	Jul 1 to Sep 15
Saint John Creek (ASP-303)	17100302011280 Private	92.62	Perennial	Dry Open-Cut	Coho	Coho Spawning, Rearing	Jul 1 to Sep 15
H3-01	Private	94.60	Pond	Not Crossed Pond adjacent to Milo Yard	None	None	None
H3-02	Private	94.60	Pond	Not Crossed Pond adjacent to Milo Yard	None	None	None
H3-03	Private	94.60	Pond	Not Crossed Pond in Milo Yard	None	None	None
South Umpqua River (ASP-196)	17100302011516 Private	94.73	Perennial	Diverted Open-Cut	Coho	Coho Spawning, Rearing, Migration	Jul 1 to Aug 31
Trib. to South Umpqua River (ASI-193)	17100302011517 Private	94.85	Intermittent	Dry Open-Cut	None	None	Jul 1 to Sep 15
Trib. to South Umpqua River (ASI-193)	17100302011517 Private	95.03	Intermittent	Dry Open-Cut	None	None	Jul 1 to Sep 15
Trib. to South Umpqua (ASI-190)	17100302038007 BLM-Roseburg District	98.46	Intermittent	Dry Open-Cut (Streambed-bedrock)	None	None	Jul 1 to Sep 15
South Umpqua (HUC 17100302) Subbasin, Upper Cow Creek (HUC 1710030206) Fifth-Field Watershed, Douglas County, Oregon							
Ditch (Beaver Creek) (CDX-50)	Forest Service – Umpqua NF	105.41	Intermittent	Dry Open-Cut	None	None	N/A
Ditch (CDX-49)	Forest Service – Umpqua NF	106.77	Intermittent	Adjacent to centerline within ROW	None	None	N/A
Roadside Ditch (CDX-47)	Forest Service – Umpqua NF	108.08	Intermittent	Dry Open-Cut	None	None	N/A
Roadside Ditch (CDX-48)	Forest Service – Umpqua NF	108.40	Intermittent	Dry Open-Cut	None	None	N/A
Trib. to East Fork Cow Creek (GDX-15)	17100302034497 Forest Service – Umpqua NF	109.13	Intermittent	Adjacent to centerline within TEWA	None	None	Jul 1 to Sep 15

TABLE 3.5.4-4 (continued)

Waterbodies Crossed or Adjacent to the Pipeline within the Coos Subbasin (HUC 17100304), Coquille Subbasin (HUC 17100305), and South Umpqua Subbasin (HUC 17100302) and in the Range of the Oregon Coast Coho Salmon ESU (updated May 2018)

Waterbodies Crossed and Waterbody ID	NHD Waterbody Reach Code and/or Jurisdiction	Pipeline Milepost (MP)	Waterbody Type	Proposed Crossing Method a/ (potential for blasting) d/	Species Present b/	Habitat Component Present b/	Fishery Construction Window c/
Trib. to East Fork Cow Creek (GSI-16/FS-HF-F)	17100302013838 Forest Service – Umpqua NF	109.33	Intermittent	Dry Open-Cut	None	None	Jul 1 to Sep 15
East Fork Cow Creek (GSP-19/FS-HF-G)	17100302013839 Forest Service – Umpqua NF	109.47	Perennial	Dry Open-Cut (Streambed-bedrock)	None	None	Jul 1 to Sep 15
East Fork Cow Creek (GSP-22/FS-HF-G ASP297)	17100302013839F orest Service – Umpqua NF	109.69	Perennial	Adjacent to centerline within TEWA	None	None	Jul 1 to Sep 15
Trib. to East Fork Cow Creek (FS-HF-J/AW298)	17100302013839F orest Service – Umpqua NF	109.69	Perennial	Dry Open-Cut	None	None	Jul 1 to Sep 15
Trib. to East Fork Cow Creek (FS-HF-K/AW-299)	17100302012765 Forest Service – Umpqua NF	109.78	Perennial	Dry Open-Cut	None	None	Jul 1 to Sep 15
South Umpqua (HUC 17100302) Subbasin, Upper Cow Creek (HUC 1710030206) Fifth-Field Watershed, Jackson County, Oregon							
Trib. to W. Fork Trail Creek (FS-HF-N /ESI-68)	17100302034587 Forest Service – Umpqua NF	110.96	Intermittent	Dry Open-Cut	None	None	Jul 1 to Sep 15

a/ Dry open cut crossing methods include flume or dam-and-pump procedures. Dam-and-pump methods would be utilized where streambed blasting is anticipated to eliminate blasting around the flume. The dam-and-pump crossing method is the preferred crossing procedure in steep incised drainage valleys where worker safety may be compromised when placing ("threading") the pipe string under the flume pipe and where there is a risk of upsetting the flume during this operation. The dam-and-pump crossing method is also the preferred crossing method on small streams under low flow conditions during the recommended ODFW-recommended in-water work period. Pacific Connector proposes temporary/short-term fish passage restriction when completing dam-and-pump crossings within the ODFW-recommended in-water work period. Appendix W provides details of stream crossings.

b/ ODFW 2017f; ODF 2018

c/ Assumes fisheries construction windows only apply to those waterbodies flowing at the time of construction and windows do not apply to HDD crossings.

d/ Streambed bedrock based on Pacific Connector's Wetland and Waterbody delineation surveys. Streambed bedrock may require special construction techniques to ensure pipeline design depth. Special construction techniques may include rock hammering, drilling and hammering, or blasting. The need for blasting would be determined by the construction contractor and would only be initiated after ODFW blasting permits are obtained.

In-stream construction of the Pipeline would occur before most Oregon Coast coho begin upstream migration and spawning by adults (see figure 3.5.4-1). However, juvenile coho are expected to be rearing in many of those streams. Although there are no data on numbers of juveniles expected to be present in streams crossed by the Pipeline, the following estimation procedure was developed after an estimate for numbers of juveniles present in streams crossed was requested by NMFS (2015e).

Total stream miles occupied by coho salmon within the fourth-field HUCs in table 3.5.4-5 and each of the fifth-field HUCs crossed by the Pipeline were derived with GIS by combining shapefiles of ODFW Fish Distribution data (ODFW 2017f) with watershed shapefiles from the NHD (USGS 2018). Stream miles with coho spawning habitats and coho rearing habitat in the range of Oregon Coast coho were similarly derived; stream miles in those habitats were added to provide Stream Miles for Juveniles' Presence in table 3.5.4-5.

TABLE 3.5.4-5

Total Stream Miles of Oregon Coast Coho Habitats in Fourth- and Fifth-Field Watersheds Crossed by the Pipeline Project and Estimates of Streams with Juvenile Coho Fry

Subbasin and Fifth-Field Watersheds	Total Stream Miles with Coho in HUC a/	Stream Miles with Spawning Habitat	Stream Miles with Rearing Habitat	Stream Miles for Juvenile Fry Presence b/
Coos Subbasin	**581.99**	**311.90**	**258.27**	**570.17**
Coos Bay-Frontal Pacific Ocean	206.88	70.02	132.34	202.36
Coquille Subbasin	**597.64**	**385.80**	**207.13**	**592.93**
North Fork Coquille River	147.92	106.77	39.30	146.07
East Fork Coquille River	54.31	42.84	11.47	54.31
Middle Fork Coquille River	91.67	75.06	16.61	91.67
South Umpqua Subbasin	**812.28**	**551.70**	**130.28**	**681.97**
Olalla Creek-Lookingglass Creek	88.36	66.12	14.90	81.02
Clark Branch-South Umpqua River	66.52	36.91	0.67	37.58
Myrtle Creek	92.91	88.50	1.93	90.43
Days Creek-South Umpqua River	102.93	70.84	28.62	99.46
Upper Cow Creek	29.24	0	0	0

a/ Total Stream Miles with Coho in HUC includes miles of Historical, Migration, Rearing, Spawning, and Unknown habitats.
b/ Stream Miles for Juvenile Fry Presence is the sum of Stream Miles for Spawning and Rearing Habitats in HUC
Source: StreamNet 2012; ODFW 2017f

Numbers of redds and spawning adult coho salmon counted in fourth-field watersheds over time are available on the StreamNet (2012) database accessed through the ODFW Natural Resources Information Management Program. The database provided only 15 records of redd surveys for Oregon Coast coho in the South Coast fourth-field HUC, all limited to streams within the South Umpqua River (HUC 17100302). The surveys were conducted during 1991 and 1992. With so few records available, numbers of adult coho salmon (not including jacks or subadults) reported as peak live or dead fish were used to estimate numbers of adult spawners in the stream which was used to derived juvenile fry present in streams that would be crossed by the Pipeline. Data for numbers of adults counted per mile from StreamNet database are summarized in table 3.5.4-6.

TABLE 3.5.4-6

Summary of Records for Spawning Adult Coho Within the Oregon Coast ESU in Fourth-Field Watersheds (HUCs) Crossed by the Pipeline Project

Subbasin	Number of Surveys	Year(s)	Average Adults (Live and Dead) per Mile Surveyed	90% Confidence Interval
Coos	706	1950 to 2010	87.58	± 8.01
Coquille	474	1950 to 2010	24.51	± 2.64
South Umpqua	153	1981 to 2004	3.47	± 0.85

Source: StreamNet 2012.

The following assumptions have been applied to the adult spawning data in each of the three watersheds coinciding with Oregon Coast coho and proposed for crossing by the Pipeline:

- The male:female ratio of live or dead spawners is 1:1 (Knudsen et al. 2003).

- At low to moderate densities of spawners, there is one redd for each female (Lestelle and Weller 2002).
- Redds are only present in stream reaches classified as spawning habitat by ODFW (2014c).
- The average number of eggs per redd is between 300 and 1,200 with 800 to 900 eggs being most frequent (Sandercock 1991).
- Under average conditions, 15 to 27 percent of all eggs will survive during incubation (mean of 27.1 percent survival was observed in Oregon coastal streams [Sandercock 1991]).
- Juveniles utilize spawning habitats during rearing as well as rearing habitats as classified by ODFW (2014c). Juveniles distribute themselves in uniformly spaced territories regardless of presence of pools, riffles or runs in the natal stream.

With these assumptions, the following are estimates of coho redd abundances in subbasins:

- average 43.79 redds per mile (± 4.01 redds per mile) within all spawning habitats in the Coos River fourth-field HUC;
- average 12.26 redds per mile (± 1.32 redds per mile) within all spawning habitats in the Coquille River fourth-field HUC; and
- average 1.74 redds per mile (± 0.43 redds per mile) within all spawning habitats in the South Umpqua River fourth-field HUC.

Average values for redds per mile in fourth-field HUCs, stream miles of spawning and rearing habitats in HUCs, and the assumptions above for eggs per redd and egg survival rates were used to estimate juveniles per mile of habitat in table 3.5.4-5 for each of the fifth-field HUCs crossed within range of the Oregon Coast ESU. Values for redds per mile within 90 percent confidence intervals were not carried through the analyses in table 3.5.4-7. In reality, estimates of juvenile fry per mile of habitat would vary from year to year showing at least as much variability as the estimated abundance of wild adult coho spawners reported within the three subbasins of the analysis area from 1997 to 2016, shown on figure 3.5.4-2 above.

There would be some natural mortality between juvenile fry and smolt stages and during the period from fry emergence (through the end of May) before pipeline construction (beginning July 1). Therefore, estimates are very conservative. Waterbodies within the Coos, Coquille, and South Umpqua subbasins would be crossed between July 1 and September 15. Based on figure 3.5.4-1, in-stream construction would likely avoid the juvenile coho out-migration periods during June; there would be few or no post-winter pre-smolt juvenile coho present during construction. Very few are expected because reported over-winter survival rates of juvenile coho are less than 40 percent, at least in waterbodies studied within the Coos Bay Frontal-Pacific Ocean fifth-field watershed (Weybright and Giannico 2017), and peak smolt outmigration occurs well before any potential stream crossings would occur.

TABLE 3.5.4-7

Estimates of Juvenile Coho Fry in the Oregon Coast ESU Present in Fourth-Field and Fifth-Field Watersheds Crossed by the Pipeline Project

Subbasin and Fifth-Field Watersheds	Total Redds in HUC a/	Total Eggs in HUC b/	Total Juvenile Fry in HUC c/	Juvenile Fry per Mile of Habitat d/
Coos Subbasin	**13,658**	**11,609,268**	**3,146,112**	**5,518**
Coos Bay-Frontal Pacific Ocean	3,066	26,06,216	706,285	3,490
Coquille Subbasin	**4,730**	**4,020,409**	**1,089,531**	**1,838**
North Fork Coquille River	1,309	1,112,612	301,518	2,064
East Fork Coquille River	525	446,469	120,993	2,228
Middle Fork Coquille River	920	782,225	211,983	2,312
South Umpqua Subbasin	**960**	**815,958**	**221,125**	**324**
Olalla Creek-Lookingglass Creek	115	97,793	26,502	327
Clark Branch-South Umpqua River	64	54,587	14,793	394
Myrtle Creek	154	130,889	35,471	392
Days Creek-South Umpqua River	123	104,776	28,394	285
Upper Cow Creek	0	0	0	0

a/ Total Redds in HUC = the Average Redds per Mile in Fourth-Field HUC multiplied by Stream Miles of Spawning Habitat in table 3.5.4-5.
b/ Total Eggs in HUC = average of 850 eggs per red (see assumptions) multiplied by Total Redds in HUC.
c/ Total Juvenile Fry in HUC = 27.1 percent average survival rate of eggs to fry (see assumptions in text) multiplied by Total Eggs in HUC.
d/ Juvenile Fry per Mile of Habitat = Total Juvenile Fry in HUC divided by Stream Miles of Juvenile Fry Presence in table 3.5.4-5.

Habitat

Estuarine Habitats

The estuarine habitat along the Pipeline route is located in mostly shallow regions of Coos Bay and in the Coos River. Tidally influenced waters extend over seven miles upstream in Catching Slough and Coos River. Tidal gates at the mouths of Kentuck Slough and Willanch Slough have changed salt water inundation and flow regimes in the lower reaches of those waterbodies.

Substrates within the estuary include subtidal (continuously submerged) and intertidal (periodically submerged by tidal action) zones. Both zones support various habitats that have been classified by type of bottom material (including rock, sand, mud, and wood/organic debris) and relative position within the estuary (aquatic bed, shore, flat, beach/bar, and tidal marsh) by the Oregon Department of Land Conservation and Development (ODLCD) (1987). Sub-tidal and intertidal habitats within the Coos Bay estuary were mapped in 1987 as a pilot project for the ODLCD Coastal Management Program Dynamic Estuary Management Information System, or DEMIS (ODLCD 1998). The Pipeline route coincides with shallow intertidal and subtidal fine bottom and unconsolidated bottom habitat, with a few regions of mixed seabeds of eelgrass, attached algae, and tidal marsh.

Tidal mudflats and eelgrass beds are found on the west shore of Coos Bay; both habitats are utilized by most fish species within the bay at some time during the year (Cummings and Schwartz 1971). Eelgrass densities in Coos Bay are greatest at relatively shallow depths, slightly above and below the mean low water level (Thom et al. 2001). Distribution of eelgrass within the estuary has apparently changed slightly since 1987 (ODLCD 1998). Preliminary distribution of eelgrass (interpreted from infrared imagery, with some field verification) was evaluated in the vicinity of the project area during 2005 (Clinton 2007). Eelgrass on intertidal mud flats between Glasgow

Point (Kentuck Inlet) and Russell Point (Haynes Inlet) decreased since 1987 while eelgrass beds on intertidal mud and mud/sand flats extending outward from Kentuck Inlet had apparently increased.

Natural turbidity in the estuary was judged to be higher at upper bay locations, away from water influx from the ocean (Moffatt & Nichol 2006). Turbidity (measured in NTUs) was evaluated at the Charleston Bridge, near the entrance to Coos Bay, and estimated as TSS (measured in mg/l) for modeling dredge-generated turbidity during construction of the LNG Project (Moffatt & Nichol 2006). At that location, turbidity varied from 3.7 to 18.1 NTUs (5.7 to 45.7 mg/l) but sometimes exceeded 200 NTU.

Summaries of watershed health indicators have been reported by the Coos Watershed Association for tideland habitats accessible by Oregon Coast coho salmon (Oregon Watershed Enhancement Board 2007). Table 3.5.4-8 provides conditions in the following three estuarine zones:

- **Tidal wetlands**: Marshes and swamps; a vegetated wetland that is periodically inundated by tidal waters. Tidal wetlands include emergent, scrub-shrub, and forested wetland types.
- **Tidal flat**: An area inundated by all high tides and exposed only at low tide. Some tidal flats have extensive growth of algae or seagrass; others are bare mud.
- **Subtidal zone**: Subtidal estuarine habitats include channel bottoms, slope bottoms, and the open water above them.

Wetland functions within the estuary have been affected by dikes, tide gates, roads and railroads, ditches, and dams that restrict tidal flows and/or have changed tidal flow patterns. Agricultural land uses have contributed to erosion of channels and, along with channel armoring, has affected vegetation diversity in wetlands, channel shading, and salmonid habitat function; tidal wetlands have also been affected excavations and disposal of dredged materials (Oregon Watershed Enhancement Board 2007).

TABLE 3.5.4-8

Watershed Health Indicators for Three Tidal Habitat Zones in the Coos Bay Estuary

Tideland Habitat Zone	Hydro-Modification	Sediment Regime	Water Quality	Vegetation Modification	Invasive Species	Habitat Loss
Tidal Wetlands	Limiting >40% historic wetlands modified	Limiting >40% wetlands affected by major change in sediment regime	Moderate DEQ water quality criteria met <90% of samples	Limiting 40% wetland vegetation altered by land use	Moderate Limited Invasive species impact on tidal wetland function	Limiting >40% zone with complete fill or conversion
Tidal Flat Zone	Limiting >40% historic tidal flats modified	Moderate 20-40% tidal flats affected by major change in sediment regime	Moderate DEQ water quality criteria met <90% of samples	N/A	Moderate Limited Invasive species impact on tidal flat function	Moderate 20-40% zone with complete fill or conversion
Sub-Tidal Zone	Moderate 20-40% historic zone modified	Moderate 20-40% sub-tidal zone affected by major change in sediment regime	Moderate DEQ water quality criteria met <90% of samples	N/A	Moderate Limited Invasive species impact on sub-tidal zone function	Moderate 20-40% zone with complete fill or conversion

Source: Oregon Watershed Enhancement Board 2007.

NMFS performed a preliminary survey of benthic invertebrates in the vicinity of the Federal Navigation Channel in 1989 (Miller et al. 1990). The study characterized the macroinvertebrate community at 20 sites in and adjacent to the navigation channel in support of channel deepening in Coos Bay. There were 121 different invertebrate taxa identified with a mean density of 2,617 individuals/square meter (m^2). The highest invertebrate densities were observed in the lower bay, downstream from the LNG Terminal site (CM 2 to CM 5). One of the sites (Station 11) was located in the navigation channel, immediately adjacent to the LNG Terminal site where 16 different taxa were identified and the mean density was 552 individuals/m^2. The polychaete worm, *Glycera tenuis*, dominated the taxa at this location (n=23). Nearby sampling stations also were found to support high numbers of polychaetes, including *Glycera tenuis* and *Heteropodarke heteromorpha*. *Corophium salmonis*, an amphipod important as juvenile salmonid prey, was rarely found in the study area. Total benthic invertebrate densities in Coos Bay ranged from 375 to 13,546/m^2 and were found to be lower than densities observed in the Umpqua River estuary (range from less than 200 to over 50,000/m^2) and the Columbia River estuary (range from less than 1,000 to over 60,000/m^2) (Bottom et al. 1985; Miller et al. 1989; Durkin and Emmett 1980).

Previous studies by ODFW have shown that benthic macroinvertebrates in Coos Bay may not comprise a major portion of the diet for juvenile salmonids. Stomach contents of wild Chinook salmon and hatchery coho salmon juveniles were analyzed from July to September 1980 (Nicholas and Lorz 1984). The survey was performed during the outmigration period for juvenile salmonids, when juveniles are expected to be abundant within the estuary. The major prey species consumed by juvenile Chinook salmon (in order of abundance) were Pacific sand lance (n=89), terrestrial insects (n=59), and decapods (e.g., crab zoea and shrimp larvae) (n=27) (Nicholas and Lorz 1984). Only five amphipods (likely *Corophium* spp.) were identified in 143 Chinook salmon stomach samples. However, amphipods were the major prey species identified in juvenile coho salmon stomach samples (n=105). Other prey species found included terrestrial insects (n=27) and Pacific sand lance (n=25). Previous studies in Coos Bay have found that *Corophium* spp. are abundant in intertidal areas and constitute an important diet element for juvenile Chinook salmon and striped bass (BLM 1971). Shallow water habitats near the LNG Terminal have been mapped as habitat for *Corophium* spp. (Coos County Planning Department 1979).

Based on the presence of juvenile salmonids at nearby ODFW sampling sites, it is likely that juvenile coho and other fish species utilize the shallow water areas near the LNG Terminal site for foraging during periods of the year. The shoreline has been mapped as potential habitat for the amphipod *Corophium* spp., which is considered an important prey species (Coos County Planning Department 1979) and was shown to be consumed in large numbers by coho salmon (Nicholas and Lorz 1984). Shanks et al. (2011) sampled zooplankton in Coos Bay near the LNG Terminal site. A variety of zooplankton were found to be present within the bay, with potential salmonid forage items such as copepod adults, larvaceans, harpacticoid copepods, and Daphnia noted in abundance.

However, benthic studies conducted by NMFS within and in the vicinity of the Federal Navigation Channel found that *Corophium salmonis* occurred in much lower densities than other Oregon estuaries (Miller et al. 1990; Bottom et al. 1985; Miller et al. 1989; Durkin and Emmett 1980). Based on site observations made in November 2006, it appears that shallower habitats at the LNG Terminal site contain a higher percentage of fine substrates, and thus could support a greater abundance of benthic macroinvertebrates than had been observed within the navigation channel, which is dominated by coarser sand.

Freshwater Habitats

Conditions of aquatic habitats within the fifth-field watersheds in the Coos, Coquille, and South Umpqua subbasins that would be crossed by the Pipeline were evaluated with data collected by ODFW in their Aquatic Inventories Project (ODFW 2014c). In cooperation with other agencies, ODFW has conducted stream surveys throughout the state including streams within watersheds crossed by the Pipeline. Four types of habitat information provide quantitative evaluations of the fish habitat condition within the various watersheds: 1) pool habitat condition, 2) riffle habitat condition, 3) shade conditions, 4) woody debris habitat condition, and 4) riparian habitat condition. ODFW (Foster et al. 2001) has developed benchmark criteria for each of these habitat conditions that would represent undesirable and desirable habitat conditions. The benchmarks are provided in table 3.5.4-9 along with the various aquatic habitat conditions to which they apply.

TABLE 3.5.4-9

Oregon Department of Fish and Wildlife Aquatic Inventory and Analysis Project Criteria for Aquatic Habitat Conditions and Benchmarks

Aquatic Habitat Condition	Benchmark Level for Condition	
	Undesirable	Desirable
Pools		
Pool Area (% total stream area)	<10	>35
Pool Frequency (channel widths between pools)	>20	5-8
Residual Pool Depth (meters [m])		
Small Streams (<7 meters [m] wide)	<0.2	>0.5
Medium Streams (≥7 m and <15 m width)		
Low Gradient (slope <3%)	<0.3	>0.6
High Gradient (slope >3%)	<0.5	>1.0
Large Streams (≥15 m width)	<0.8	>1.5
Complex Pools (pools with ≥3 LW pieces / kilometer of reach length)	<1	>2.5
Riffles		
Width/Depth Ratio (active channel based)		
East Side	>30	<10
West Side	>30	<15
Gravel (% area)	<15	≥35
Silt-Sand-Organics (% area)	>20	<10
Volcanic Parent Material	>15	<8
Sedimentary Parent Material	>20	<10
Channel Gradient <1.5%	>25	<12
Shade (Reach Average, Percent)		
Stream Width <12 m		
West Side	<60	>70
Northeast	<50	>60
Central-Southeast	<40	>50
Stream Width >12 m		
West Side	<50	>60
Northeast	<40	>50
Central-Southeast	<30	>40
Large Wood		
Pieces/100 m Stream Length	<10	>20
Volume (m^3)/100 m Stream Length	<20	>30
"Key" Pieces (>60 centimeters and 10 m long)/100 m	<1	>3
Riparian Conifers (30 m From Both Sides of Channel)		
Number >20 inches dbh/1,000 feet Stream Length	<150	>300
Number >35 inches dbh/1,000 feet Stream Length	<75	>200

Source: Foster et al. 2001
dbh = diameter at breast height; LW = large wood

Benchmark conditions are not absolute but they provide a method for comparing values of key aquatic habitat components (Foster et al. 2001) that are used to establish baseline conditions within watersheds to be crossed by the Pipeline. Pools provide refuges for fish during high and low stream flows. Pools provide slow water habitats for adults and juveniles, provide over-wintering habitat for some fish species, provide habitat during periods of low summer flows, and pools associated with large wood provide habitat complexity.

Riffles provide spawning habitats for various salmonid species that construct nests or redds in gravels of various sizes, specific to salmonid species. Sand, silt, and organic debris can reduce suitability of spawning habitats by filling pores between gravel particles that are necessary for intergravel stream flows, availability of oxygen, and for development of embryos; high percentages of sand, silt, and organic material in riffles indicate poor conditions as spawning habitat.

Riparian trees provide shade over stream channels, which reduces deleterious effects of high summer water temperatures. Roots of riparian vegetation stabilize stream banks, contribute to development of bank undercutting (thermal and hiding cover), limit erosion and sedimentation from stream banks, and provide LW as an important component of the aquatic habitat. LW, especially contributed by riparian conifers, provides cover for fish, physical habitat complexity that influences stream flows and channel diversity, and biological complexity as substrate for macroinvertebrate communities that provide food for salmonids during different life stages (Foster et al. 2001).

Data used to evaluate aquatic habitat conditions, reported by ODFW (2014c), are provided in appendix X for each stream reach included in the inventories and evaluations of benchmark conditions are summarized in tables 3.5.4-10a and 3.5.4-10b, below.

Coos Subbasin - HUC 17100304. Data available from the ODFW (2014c) Aquatic Inventories Project provided aquatic habitat conditions for 33 stream reaches within the Coos Bay-Frontal Pacific Ocean fifth-field watershed (HUC 710030403) surveyed between 1992 and 1999. The sampled reaches were of first, second or third order (Strahler numbers 1, 2, 3) streams with active channel widths (bankfull widths) averaging 5.8 meters and active channel heights averaging 0.5 meter.

Desirable conditions for pool habitat in surveyed reaches ranged from only 11 percent for pool frequency to 35 percent for residual pool depth (see table 3.5.4-10a). In general, pool habitat conditions were undesirable or less than desirable (moderate) for most streams within the watershed. Riffle habitats were relatively abundant (68 percent of stream reach areas) but degraded by high levels of silt, sand and organic materials and width to depth ratios of sampled reaches tended to be high, indicative of relatively shallow wide stream channels that provide less suitable habitat than deep, narrow channels (see benchmarks in table 3.5.4-9).

Riparian conditions in streams surveyed within the Coos Bay Frontal-Pacific Ocean watershed are mostly undesirable. Trees in less than half of the reaches provide adequate shade of stream channels and the numbers of large conifer trees within surveyed riparian zones were undesirable; large conifers were absent in many of the surveyed reaches. It is not surprising that the amount of LW, including key pieces (pieces of large wood ≥0.6 meter diameter and ≥12 meters long), is undesirable, less than benchmark. Low estimates of riparian shade is indicative of lower gradient streams and floodplains that have been altered by past land uses in the watershed. As one consequence, summer stream temperatures in lower reaches exceed levels suitable as juvenile salmonid summer rearing habitats (Coos Watershed Association 2006). The ODFW (2008) in-stream construction window for coastal tributaries is July 1 to September 15 although work in the Coos Bay estuary and Coos River mainstem is allowed from October 1 to February 15.

TABLE 3.5.4-10a

Aquatic Habitat Conditions from Samples Taken by ODFW in Stream Reaches within Fifth-Field Watersheds of the Coos and Coquille Subbasins Crossed by the Pipeline Project

	Mean Values (with Standard Errors) in Relation to Benchmark Conditions in Surveyed Reaches (by %) of Watersheds a/							
	Coos Bay-Frontal HUC 1710030403		North Fork Coquille HUC 1710030504		East Fork Coquille HUC 1710030503		Middle Fork Coquille HUC 1710030501	
Aquatic Habitat Condition	**Mean (Standard Error)**	**Undesirable Desirable Conditions**	**Mean (Standard Error)**	**Undesirable Desirable Conditions**	**Mean (Standard Error)**	**Undesirable Desirable Conditions**	**Mean (Standard Error)**	**Undesirable Desirable Conditions**
Pools								
Pool Area (% total stream area)	36.6 (6.5)	35.7% 39.3%	43.4 (3.5)	13.8% 55.4%	37.8 (2.2)	8.1% 54.1%	34.4 (2.1)	13.1% 50.5%
Pool Frequency (channel widths between pools)	72.6 (18.3)	60.7% 10.7%	22.3 (4.5)	26.2% 18.5%	12.8 (1.6)	17.6% 27.0%	30.6 (8.2)	25.3% 28.3%
Residual Pool Depth (m) by stream size and gradient	0.5 (0.1)	10.7% 35.7%	0.5 (0.03)	1.5% 35.4%	0.6 (0.03)	0.0% 52.7%	0.6 (0.02)	1.0% 43.4%
Complex Pools (pools with ≥3 LW pieces ≥3 per km of reach length	0.3 (0.2)	92.9% 7.1%	4.7 (0.7)	43.1% 44.6%	4.6 (0.6)	36.5% 52.7%	3.3 (0.5)	53.5% 37.4%
Riffles								
Width/Depth Ratio (active channel based)	22.2 (3.1)	30.4% 34.8%	17.2 (1.3)	8.6% 47.1%	16.0 (0.9)	5.4% 50.0%	22.9 (1.8)	18.2% 39.4%
Gravel (% of area)	28.4 (5.4)	40.9% 45.5%	36.1 (2.0)	9.0% 59.7%	42.0 (2.6)	9.5% 54.1%	50.0 (2.2)	5.1% 72.7%
Silt-Sand-Organics (% of area) by parent material and gradient b/	48.5 (8.6)	59.1% 27.3%	29.2 (3.4)	43.3% 19.4%	21.9 (2.2)	39.2% 21.6%	15.1 (1.3)	26.3% 41.4%
Shade								
Reach Average, % by stream width	67.1 (4.5)	30.3% 48.5%	87.5 (1.9)	4.1% 95.9%	91.1 (1.0)	1.4% 97.3%	81.4 (2.3)	11.1% 80.6%
Large Wood								
LWD Pieces/100 m of Stream Length	14.8 (3.2)	57.6% 21.2%	15.9 (1.3)	35.1% 23.0%	22.0 (1.6)	16.2% 41.9%	13.0 (1.2)	48.1% 22.2%
LWD Volume (m^3)/100 m of Stream Length	23.8 (6.3)	72.7% 24.2%	25.7 (3.4)	59.5% 24.3%	61.9 (9.2)	31.1% 51.4%	21.2 (2.6)	67.6% 24.1%
Key Pieces (≥60cm D by ≥12 m L)/100 m of Stream Length c/	0.9 (0.3)	75.8% 9.1%	1.2 (0.3)	70.3% 8.1%	1.9 (0.3)	47.3% 17.6%	0.7 (0.1)	76.9% 5.6%
Riparian Conifers								
Number >20in dbh/1000 ft of Stream Length	21.4 (11.0)	97.0% 3.0%	23.4 (6.1)	98.6% 1.4%	47.3 (13.3)	90.5% 1.4%	25.6 (4.5)	94.4% 0.0%
Number >35in dbh/1000 ft of Stream Length	1.3 (0.9)	100.0% 0.0%	7.2 (2.8)	98.6% 0.0%	11.6 (3.1)	95.9% 0.0%	7.3 (2.3)	98.1% 0.0%

a/ Values unweighted by surveyed reach length. Stream reach specific data in appendix X.
b/ Assumes sedimentary parent material in all surveyed reaches.
c/ D= diameter, L = length
dbh = diameter at breast height; HUC = hydrologic unit code; LW = large wood; m = meter

TABLE 3.5.4-10b

Aquatic Habitat Conditions from Samples Taken by ODFW in Stream Reaches within Fifth-Field Watersheds of the South Umpqua Subbasin Crossed by the Pipeline Project

	Mean Values (with Standard Errors) in Relation to Benchmark Conditions in Surveyed Reaches (by %) of Watersheds a/									
	Olalla Creek-Lookingglass Creek HUC 1710030212		Clark Branch-South Umpqua River HUC 1710030211		Myrtle Creek HUC 1710030210		Days Creek-South Umpqua River HUC 1710030205		Upper Cow Creek HUC 1710030206	
Aquatic Habitat Condition	**Mean (Standard Error)**	**Undesirable Desirable Conditions**	**Mean (Standard Error)**	**Undesirable Desirable Conditions**	**Mean (Standard Error)**	**Undesirable Desirable Conditions**	**Mean (Standard Error)**	**Undesirable Desirable Conditions**	**Mean (Standard Error)**	**Undesirable Desirable Conditions**
Pools										
Pool Area (% total stream area)	49.5 (3.1)	5.6% 75.9%	22.9 (4.0)	46.9% 28.1%	35.6 3.3	19.0% 44.8%	27.5 (2.3)	24.2% 28.6%	25.3 (3.1)	21.4% 17.9%
Pool Frequency (channel widths between pools)	15.7 (6.1)	11.1% 33.3%	85.1 (33.8)	50.0% 12.5%	51.3 19.6	24.1% 24.1%	34.6 (7.5)	37.4% 15.4%	47.3 (18.1)	46.4% 14.3%
Residual Pool Depth (m) by stream size and gradient	0.4 (0.02)	0.0% 13.0%	0.4 (0.02)	6.3% 3.1%	0.4 0.03	0.0% 22.4%	0.4 (0.02)	3.3% 12.1%	0.4 (0.03)	0.0% 21.4%
Complex Pools (pools with ≥3 LW pieces ≥3 per km of reach length	2.6 (0.6)	63.0% 31.5%	0.03 (0.03)	96.9% 0.0%	1.1 0.3	75.9% 17.2%	2.3 (0.5)	64.8% 24.2%	0.1 (0.0)	96.4% 0.0%
Riffles										
Width/Depth Ratio (active channel based)	16.5 (1.2)	11.1% 50.0%	22.2 (2.5)	20.0% 23.3%	24.2 1.8	27.6% 29.3%	15.4 (0.9)	4.2% 53.7%	15.5 (2.5)	7.1% 39.3%
Gravel (% of area)	40.7 (2.0)	2.1% 70.2%	55.1 (3.2)	0.0% 86.7%	42.4 2.2	3.5% 66.7%	46.5 (1.9)	0.0% 69.2%	46.5 (3.5)	3.6% 75.0%
Silt-Sand-Organics (% of area) by parent material and gradient b/	15.8 (1.9)	31.9% 44.7%	9.2 (1.2)	6.7% 43.3%	30.8 2.3	66.7% 8.8%	17.7 (1.8)	29.7% 31.9%	29.9 (3.0)	71.4% 0.0%
Shade										
Reach Average, % by stream width	78.2 (1.6)	7.4% 77.8%	91.7 (6.2)	11.4% 80.0%	66.3 5.8	31.8% 60.6%	82.4 (1.8)	7.8% 85.3%	79.8 (4.4)	7.1% 85.7%
Large Wood										
LWD Pieces/100 m of Stream Length	13.6 (1.3)	46.3% 24.1%	4.2 (0.9)	85.7% 2.9%	11.3 4.8	80.3% 6.1%	10.8 (1.0)	54.9% 13.7%	10.1 (1.1)	57.1% 3.6%
LWD Volume (m^3)/100 m of Stream Length	21.0 (2.5)	57.4% 24.1%	6.3 (2.0)	91.4% 2.9%	14.1 3.2	77.3% 10.6%	14.8 (1.7)	74.5% 14.7%	17.4 (2.1)	60.7% 17.9%
Key Pieces (≥60cm D by ≥12m L)/100m of Stream Length c/	0.6 (0.1)	74.1% 0.0%	0.2 (0.1)	94.3% 0.0%	0.4 0.1	84.8% 1.5%	0.4 (0.1)	85.3% 2.0%	0.7 (0.1)	82.1% 3.6%
Riparian Conifers										
Number >20in dbh/1000 ft of Stream Length	60.8 (11.3)	83.3% 3.7%	13.4 (5.9)	100.0% 0.0%	29.8 7.6	93.9% 1.5%	30.1 (6.4)	95.1% 1.0%	74.9 (16.2)	82.1% 3.6%
Number >35in dbh/1000 ft of Stream Length	3.3 (1.6)	100.0% 0.0%	2.4 (1.3)	100.0% 0.0%	4.9 1.5	100.0% 0.0%	10.3 (4.2)	97.1% 1.0%	16.7 (4.8)	92.9% 0.0%

a/ Values unweighted by surveyed reach length. Stream reach specific data in appendix X.
b/ Assumes sedimentary parent material in all surveyed reaches.
c/ D= diameter, L = length
dbh = diameter at breast height; HUC = hydrologic unit code; LW = large wood; m = meter

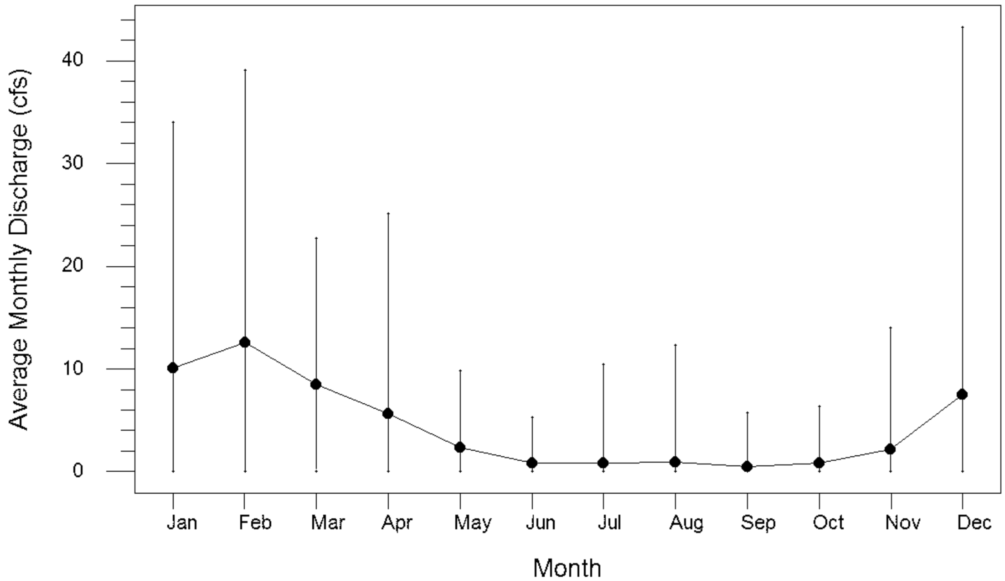
The Pipeline would be adjacent to Kentuck Slough and would cross Willanch Slough upstream from tide gates, in low gradient reaches with associated low gradient floodplains. Echo Creek would be crossed upstream from the confluence with the Coos Bay estuary, a reach that is not tidally influenced. Specific aquatic habitat conditions in those streams (Coos Watershed Association 2006) are consistent with conditions reported for stream reaches surveyed by ODFW Aquatic Inventories Project and summarized in table 3.5.4-10a.

Stream discharges over the annual cycle are provided in figure 3.5.4-4 for two streams within the Coos Subbasin: Pony Creek—a small, tidally influenced stream and tributary to Coos Bay draining a watershed 3.88 square miles—and West Fork Millacoma River—a large tributary to the Coos River, draining a 46.90-square-mile watershed. Seasonal discharges in West Fork Millacoma River are representative of large and small waterbodies crossed by the Pipeline within the Coos Subbasin. However, flows in Pony Creek have been influenced by releases from Upper Pony Creek Reservoir since construction of the new dam, completed in 2001 (Sol Coast Consulting & Design, LLC and Parsons Brinckerhoff 2009).

Highest monthly discharges occur between December and April in both waterbodies along with the largest range in variability (maximum and minimum discharge for a given month). Lowest discharges occur between June and October. In all months, minimum discharges in Pony Creek were zero (see figure 3.5.4-4A) and minimum discharges in West Fork Millicoma River were less than 10 cubic feet per second (cfs) during July, August, September and October in some years (see figure 3.5.4-4B). The ODFW (2008) in-stream construction window for coastal tributaries is July 1 to September 15.

Coquille Subbasin - HUC 17100305. ODFW, BLM, and Oregon Forest Industry Council surveyed 336 stream reaches in the four fifth-field watersheds within the Coquille Subbasin that would be crossed by the Pipeline: 18 in the Coquille HUC 1710030505, 76 in the North Fork Coquille River HUC 1710030504, 95 in the East Fork Coquille River HUC 1710030503, and 147 in the Middle Fork Coquille River HUC 1710030501. Surveys were conducted during summers in different watersheds between 1992 and 2005. Conditions for aquatic habitats in the four watersheds are included in table 3.5.4-10a. Sampled reaches of first through fifth order (Strahler numbers 1 through 5) streams had active channel widths averaging less than 3 meters and active channel heights averaging less than 0.6 meter.

Conditions associated with riparian vegetation are generally undesirable in each of the watersheds: there are too few large conifers along most stream reaches and LW numbers, volume, and presence of key pieces tend to be below benchmark levels, especially for reaches in the Middle Fork Coquille River watershed. Pool conditions tend to more desirable than in the Coos Bay-Frontal Pacific Ocean watershed except for pool complexity formed by LW, not surprising given the overall undesirable condition for LW in surveyed streams. Overall, amounts of shade for reaches in the North Fork, East Fork, and Middle Fork Coquille watersheds are at desirable levels (see table 3.5.4-10a), covering more than 80 percent of stream channels.



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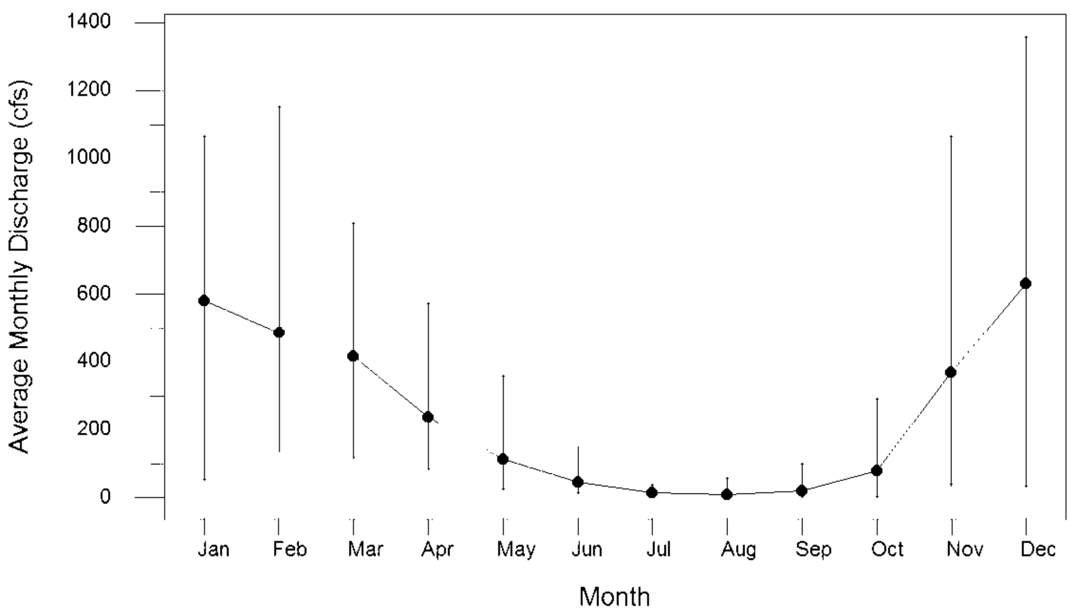


B

Figure 3.5.4-4 Average Monthly Discharge (cfs) in (A) Pony Creek (USGS Gage 14324580) from 1975 to 2008, and (B) West Fork Millicoma River (USGS Gage 14324500) from 1954 to 1981. Vertical lines show maximum and minimum discharges during the periods of record.

Streams in the four watersheds are mostly deeper and narrower (low width/depth ratios) than in the Coos Bay Frontal watershed. Gravel substrates appear to be less limited in reaches within the three watersheds compared to the Coos Bay Frontal. Fine sediments (silt, sand, and organic materials) are present at undesirable levels within many riffle habitat units. These conditions are consistent with summaries of watershed health indicators reported by the Coquille Watershed Association for aquatic/in-stream habitats accessible by Oregon Coast coho salmon (Oregon Watershed Enhancement Board 2007) in lower Coquille River, North Fork Coquille River, East Fork Coquille River, and Middle Fork Coquille River. Conditions for aquatic habitats in the watersheds are included in table 3.5.4-10a. Likewise, BLM (1999a) evaluated habitat conditions in the Upper Middle Fork Coquille Watershed in table AA-2 in appendix AA, noting major problems with erosion and sedimentation due to proliferation of roads during the previous 40 years. Access to upstream habitats was limited by various types of barriers, principally culverts associated with forest roads.

The Coquille Sub-basin was included in NMFS's (2016b) recent evaluation of habitat conditions within Oregon's Mid-south Coast Stratum. Although not specifically addressing the three 5th field watersheds in the sub-basin that would be crossed by the Pipeline, many of the same habitat limiting factors that were described by BLM (1999a) and Oregon Watershed Enhancement Board (2007) persist as habitat concerns. The same issues that were discussed above for the Coos Subbasin apply: habitat complexity, fine sediments, stream flows, suitable rearing habitats, refugia, and limited fish passage.

Juvenile salmonid habitat complexity in low gradient streams requires some form(s) of shelter as large wood, pools, connected off-channel alcoves, beaver ponds, lakes, interconnected floodplains and wetlands that provide refugia and shelter from extreme water temperatures and hiding cover from predators (Oregon Watershed Enhancement Board 2007). Spawning gravel quantities, measured by percent of riffle areas covered with gravel and gravel quality depends on embeddedness (percent of riffle areas in silt, sand, and organic fines). Waterbodies in the three watersheds within the Coquille Subbasin that would be crossed by the Pipeline are primarily limited in these and most other aquatic habitat health indicators (see table 3.5.4-11).

Stream discharges over the annual cycle are provided in figure 3.5.4-5 and tributary to Coquille River draining a watershed 73.90 square miles, and Middle Fork Coquille River – a larger tributary to the Coquille River, draining a 305-square-mile watershed.

The highest monthly discharges occur between November and April in both waterbodies along with the largest range in variability (maximum and minimum discharge for a given month); the lowest discharges occur between June and October. Minimum discharges in North Fork Coquille River were less than 10 cfs during August, September, and October in some years (see figure 3.5.4-5A) and were less than 20 cfs during August, September, October, and November in some years in the Middle Fork (see figure 3.5.4-5B). The ODFW (2008) in-stream construction window for the Coquille River and tributaries is July 1 to September 15.

TABLE 3.5.4-11

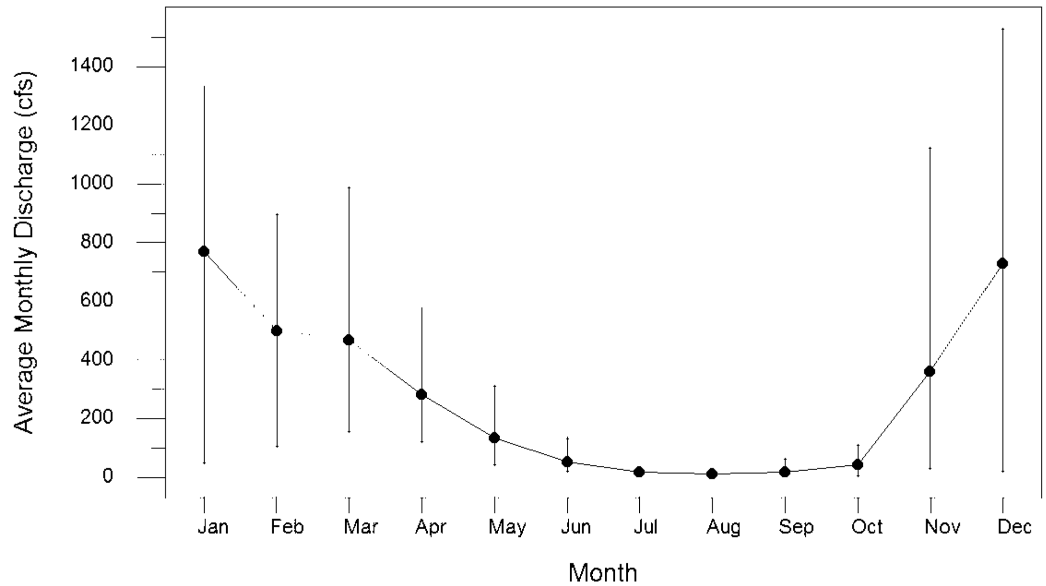
Comparisons of Aquatic Habitat Watershed Indicators in Fifth-Field Watersheds within the Coquille Sub-Basin that Would Be Crossed by the Pipeline Project from West to East

5th Field Watershed (HUC)	Winter Rearing Habitat Complexity	Summer Rearing Habitat Complexity	Spawning Gravel Quantity	Spawning Gravel Quality	Channel Modification	Large Wood	Water Quality	Water Temperature
North Fork Coquille River (1710030504)	Limiting	Limiting	Moderate	Limiting	Limiting	Limiting	Moderate	Limiting
East Fork Coquille River (1710030503)	Limiting	Limiting	Limiting	Limiting	Limiting	Limiting	Limiting	Limiting
Middle Fork Coquille River (1710030501)	Limiting	Limiting	Moderate	Limiting	Limiting	Limiting	Limiting	Limiting

Source: Oregon Watershed Enhancement Board 2007.
Aquatic habitat categories:
Limiting: indication of degraded watershed health and a significant amount of restoration action is needed to improve watershed conditions.
Moderate: indication of less than desirable watershed health and moderate to significant levels of restoration action is needed to improve watershed conditions.
Adequate: indication of functional watershed health and minimal restoration activities are needed to maintain exiting watershed conditions.

South Umpqua Subbasin – HUC 17100302. The Pipeline would cross five fifth-field watersheds in the South Umpqua subbasin. Between 1992 and 2010, the BLM and Umpqua Basin Fisheries Restoration Initiative surveyed 57 stream reaches in the Olalla-Lookingglass Creek watershed (HUC 1710030212), 97 reaches within the Clark Branch-South Umpqua River watershed (HUC 1710030211), 52 reaches within the Myrtle Creek watershed (HUC 1710030210), 34 reaches within the Days Creek-South Umpqua River watershed (HUC 1710030205), and 28 reaches within the Upper Cow Creek watershed (HUC 1710030206). Conditions for aquatic habitats in the five watersheds are included in table 3.5.4-10b.

Stream reaches sampled in the Olalla-Lookingglass Creek watershed had significantly ($P<0.05$) more area of pool habitats than reaches in the other watersheds of the South Umpqua subbasin (see table 3.5.4-10b). However, complex pools associated with LW were undesirably limited (too few pieces per reach length) in most stream reaches for all six watersheds. Conditions for residual pool depths and pool frequencies were mostly intermediate (moderate), neither undesirable nor desirable for most of the sampled reaches in watersheds to be crossed by the Pipeline. Ratios of stream widths to depths in most stream reaches in the six watersheds were generally low, more narrow and deep than wide and shallow. Areas of gravel in riffle habitats were mostly desirable or moderate conditions. Areas of fine sediments in riffles would be undesirable for the majority of stream reaches in the Upper Cow Creek watershed but at moderate or desirable conditions in reaches sampled in the other five watersheds (see table 3.5.4-10b).



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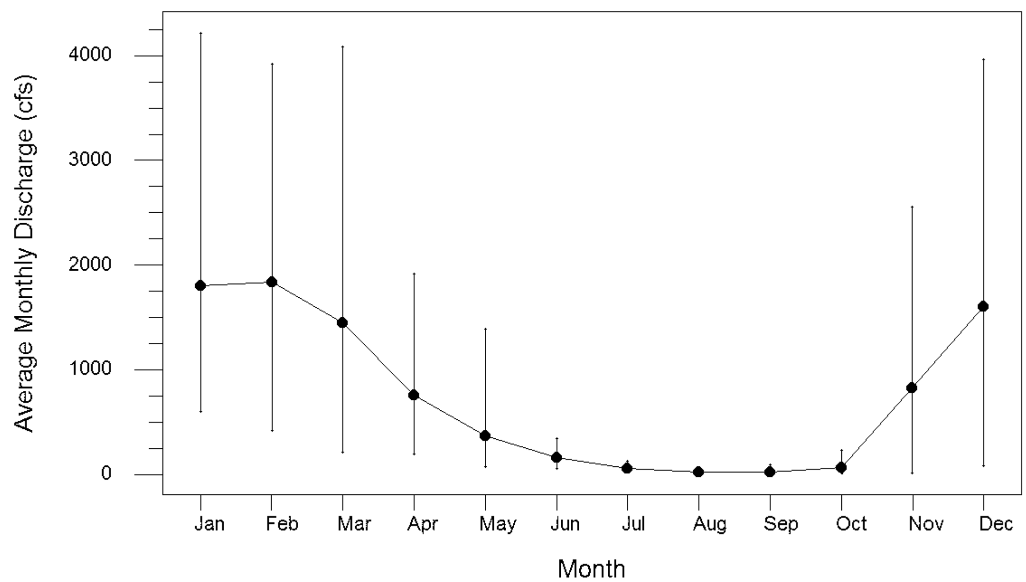


B

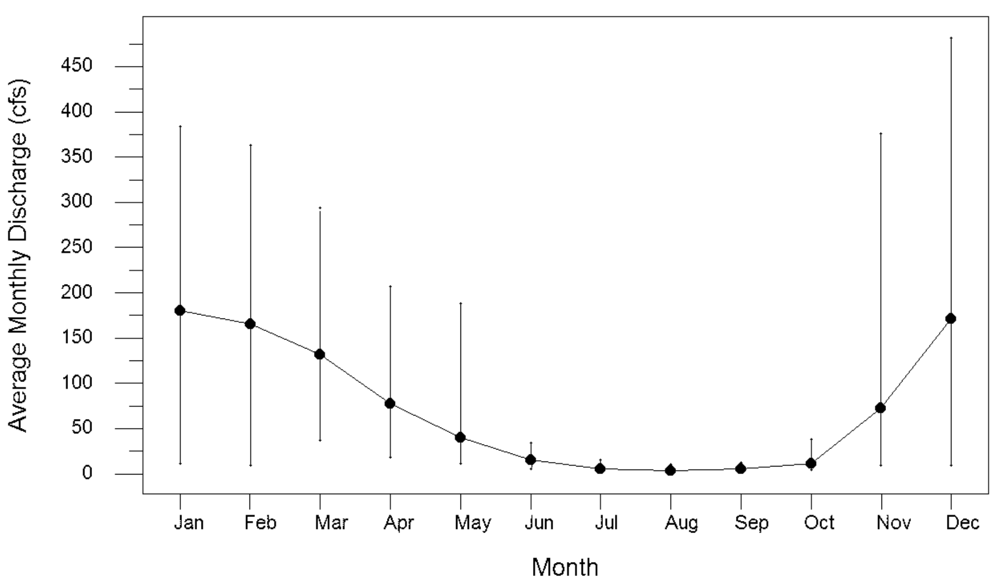
Figure 3.5.4-5 Average Monthly Discharge (cfs) in (A) North Fork Coquille Fiver (USGS Gage 14326800) from 1963 to 1981, and (B) Middle Fork Coquille River (USGS Gage 14326500) from 1930 to 1946. Vertical lines show maximum and minimum discharges during the periods of record

Shade conditions would be considered desirable for the majority of stream reaches in all six watersheds but numbers of large conifers in riparian zones were below desirable benchmark levels. LW conditions in most stream reaches were also below desirable benchmark conditions (see table 3.5.4-10) for all of the watersheds to be crossed by the Pipeline. Likewise, BLM evaluated habitat conditions in the five fifth-field watersheds crossed by the Pipeline (see table 3.5.4-1). Summaries of the watershed analyses are provided in tables AA-3, AA-4, AA-5, AA-6, and AA-7 in appendix AA. As a rule, streams lacked in-stream LW, fish access was limited, sedimentation was excessive, and habitats had been affected by high flows that degraded in-stream habitats.

The South Umpqua subbasin was included in NMFS's (2016b) recent evaluation of habitat conditions within Oregon's Umpqua Stratum. Although not specifically addressing the five fifth-field watersheds in the subbasin that would be crossed by the Pipeline, many of the same habitat limiting factors that were described by BLM nearly 30 years ago persist as habitat concerns. The same issues that were present in the past persist in the South Umpqua subbasin: water quantity and quality and stream complexity are the main limiting factors.

Stream discharges over the annual cycle are provided on figure 3.5.4-6 for two waterbodies within the South Umpqua subbasin, North Myrtle Creek—a small tributary to Myrtle Creek and the South Umpqua River with a 54.2-square-mile watershed—and the mainstem South Umpqua River with a watershed area of 1,670 square miles.

The highest monthly discharges occur between November and April in both waterbodies along with the largest range in variability (maximum and minimum discharge for a given month); the lowest discharges occur between June and October. Minimum discharges in North Myrtle Creek were less than 5 cfs during July, August, September, and October in some years (see figure 3.5.4-6A) and were less than 100 cfs during July, August, and September in some years in the South Umpqua River mainstem (see figure 3.5.4-6B). The ODFW (2008) in-stream construction window for tributaries to the South Umpqua River is July 1 to September 15 and from July 1 to August 31 for the South Umpqua River.



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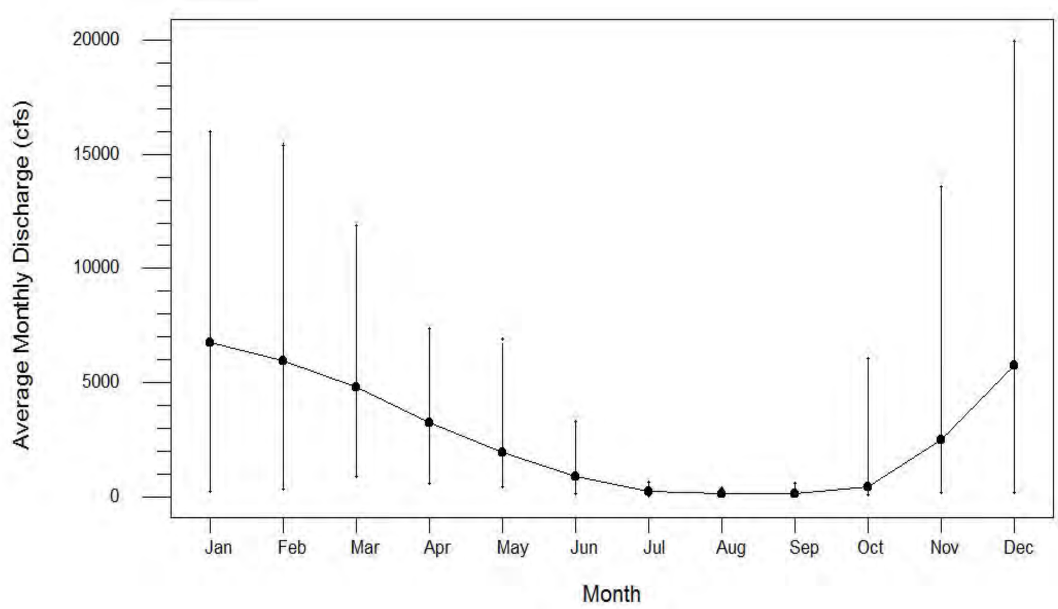


B

Figure 3.5.4-6 Average Monthly Discharge (cfs) in (A) North Myrtle Creek (USGS Gage 14311000) from 1955 to 1986, and (B) South Umpqua River (USGS Gage 14312000) from 1906 to 2016. Vertical lines show maximum and minimum discharges during the periods of record

The only watershed known to be affected by recent wildfire (i.e., the Stouts Creek Fire) is the Days Creek–South Umpqua Watershed. No information comparable to data collected by ODFW Aquatic Inventory and Analysis and reviews prepared by BLM, Forest Service, and/or Oregon Watershed Enhancement Board has been available for the Days Creek–South Umpqua Watershed since the Stouts Creek fire and no documented update of watershed conditions is available.

The Stouts Creek Fire started on June 26 and was contained on July 30, 2015 and burned 12,719 acres in the Days Creek–South Umpqua watershed (approximately 9.0 percent of the total watershed area), 13,494 acres in the Elk Creek watershed (approximately 24.8 percent of the total watershed area), and 239 acres in two subwatersheds within the Upper Cow Creek fifth-field watershed (HUC 1710030206), amounting to 0.5 percent of the total watershed area. The three watersheds are within the South Umpqua subbasin (HUC 17100302).

The fire burned 26,452 acres (41.3 square miles), of which 14,251 acres were on National Forest Service land (Umpqua National Forest); 5,544 acres were on BLM Medford District land; and 6,658 acres were on private land. The fire affected from 84 percent to 99 percent of two sub-watersheds in the Elk Creek fifth-field watershed (HUC 1710030204): 4,509 acres in Callahan Creek (Lower Elk Creek HUC 171003020404) and 8,024 acres in Drew Creek (Drew Creek HUC 171003020403). The fire also burned 4,008 acres within Hatchet Creek subwatershed (Corn Creek-South Umpqua HUC 171003020502) and portions of the Stouts Creek subwatershed (HUC 171003020503) within the Days Creek–South Umpqua fifth-field watershed.

The Days Creek–South Umpqua and Elk Creek watersheds were assessed most recently in 2003 by the Umpqua Basin Watershed Council (Geyer 2003c). The 2003 assessment utilizes ODFW habitat benchmarks and measurements to interpret conditions of fish habitat, showing habitat conditions for streams in different fifth-field watersheds within the South Umpqua Sub-basin. Specific values for those habitat conditions for streams in the Days Creek–South Umpqua Watershed were provided below in table 3.5.4-10b, and generally coincide with the summary provided in Map 3-3 through Map 3-6 in Geyer (pages 65-68, 2003), especially in categories for conditions of pools and LW:

> *Of the 84 surveyed stream reaches, only five rate as fair or good in all four categories (6.0%). Sixty-four stream reaches (76.2%) have at least two categories rate as poor. Looking at Map 3-3, it is striking that three-fourths of all reaches rate as poor for large woody material. Over 90% of pools rate as poor or fair (see Map 3-4), and almost half of riffles rate as poor (see Map 3-5). Finally, approximately one third of riparian areas rate as poor (see Map 3-6).*

Key findings for stream functions within the Subbasin focus on stream morphology (most streams have low gradients with few stream miles in source areas where most LW is recruited; lack of LW, poor riffle and pool conditions limit fish habitat), stream connectivity (dams and culverts are barriers or impede connectivity and fish access to stream habitats), and channel modifications (many channels have been modified without permits) (Geyer 2003c). Likewise, key findings for riparian zone conditions include riparian tree components (predominant hardwoods and brush/blackberry), riparian vegetation widths or buffers (almost half of potential anadromous salmonid streams have riparian zones that are two trees wide or greater), and riparian shade (potential salmonid streams are predominantly shaded by vegetation or infrastructure, but over a third are less than half covered). Further, water temperatures in reaches of multiple streams in the Sub-basin were found to be limited by ODEQ (in years 1998 and 2002) water quality standards based on salmonid tolerance levels. Alternatively, no streams in the subbasin were on the ODEQ 303(d) list for sedimentation (TSS) or for turbidity (as NTUs) at the time the watershed assessment was prepared (Geyer 2003c).

Data provided by the Umpqua National Forest (Forest Service 2015) on modeled effects of the Stouts Creek fire (e.g., Cannon et al. 2010) and reviews of scientific studies related to post-fire stream discharge, surface erosion, and effects to water quality (Hallema et al. 2017) and salvage logging effects on sediment transport (Silins et al. 2009) were combined with the most recent Oregon Watershed Enhancement Board 2003 watershed assessment for the South Umpqua Subbasin (Geyer 2003c), which includes the Days Creek-South Umpqua Watershed. That investigation estimated that debris-flow volumes would increase with basin size and distance along the drainage network, but some smaller drainages were also predicted to produce substantial volumes of material. The predicted probabilities and some of the volumes predicted for the modeled storms indicate a potential for substantial debris-flow delivery to coho salmon-bearing streams and designated critical habitats downstream in Stouts Creek, lower East Fork Stouts Creek, Hatchet Creek, Callahan Creek, and Drew Creek. All are tributaries to the South Umpqua River for which water quality is likely to decline due to increased delivery of sediment because of the Stouts Creek Fire.

According to geographic data developed by the Umpqua National Forest and GIS shapefiles provided to Edge Environmental, Inc., 9.14 square miles in the Stouts Creek Fire perimeter were unburned or burned with very low intensity (22.1 percent), 11.55 square miles (28.0 percent) burned with low intensity, 13.70 square miles (33.2 percent) were moderate, and 6.90 square miles (16.7 percent) burned with high intensity. Areas of high severity burn were extensive in headwaters of Hatchet and Callahan Creeks and smaller drainage areas in Drew Creek. Those drainages support Oregon Coast coho and designated critical habitat (0.7 mile in Hatchet Creek, 3.6 miles in Callahan Creek, and 2.6 miles in Drew Creek). According to the Umpqua National Forest (Forest Service 2015), post-fire runoff, erosion, and debris flows risks would increase in Hatchet and Callahan creeks along with increasing risks of spawning and rearing habitat degradation. Roads are also likely to be impacted from higher runoff and debris flows, scouring roadbeds and increasing sedimentation to coho habitat (Forest Service 2015).

Forest fires can lead to increased peak in-stream discharge and surface erosion; effects to water quality and aquatic habitats are exacerbated by increased wildfire severity over larger areas of slopes that lead to increased overland flow of eroded materials (Hallema et al. 2017). In addition, soil texture, litter cover, soil moisture and organic matter are affected by wildfire duration and fire temperature which can lead to soil water repellency and decreased water infiltration (Hallema et al. 2017). Further, research has shown that post-fire salvage logging increases mass wasting by creating more effective terrestrial sediment transport networks to stream channels, thus delivering more sediment than burned watersheds without salvage logging (Silins et al. 2009). Wildfire has also been found to increase concentrations of phosphorous in burned and post-fire, log-salvaged streams which elevated algal production and increased stream primary productivity, levels of secondary invertebrate consumers, and increased size and growth rates of fish as tertiary consumers (Silins et al. 2014).

USGS has developed empirical models to estimate probabilities for the occurrence and volume of post wildfire debris flows (Cannon et al. 2010). The models describe debris-flow probability as a function of readily obtained measures of areal burned extent, soil properties, basin morphology, and rainfall from short-duration and low recurrence-interval rainstorms and describe debris-flow volume as a function of drainage basin gradient, extent of area burned, and storm rainfall. The models have been applied to burned watersheds in the Intermountain West and the Pacific Coast by the USGS Landslide Hazards Program and include modeling predicted debris flows after the Stouts Creek Fire. USGS conducted a post-fire debris-flow hazard assessment for the Stouts Creek Fire using geospatial data related to basin morphometry, burn severity, soil properties, and rainfall characteristics to estimate the probability and volume of debris flows that may occur in response to a design storm (the model results are available online at https://landslides.usgs.gov/hazards/postfire_debrisflow/).

For model applications, the Stouts Creek Fire area was divided into 324 discrete drainage mini-basins with areas averaging 0.57 km^2 (ranging from 0.02 km^2 to 7.43 km^2). Estimated debris-flow probabilities in the drainage mini-basins ranged from 0 to >80 percent in response to the rainfall intensity for a 2-year recurrence interval rainstorm measured for 1-hour duration along with rainstorm interval recurrences of 5 years, 10 years, 25 years, 50 years, and 100 years.

Basins and drainage networks with the highest volumes of debris flows following 2-year, 5-year, and 10-year recurrence interval rainstorms tended to be in the center of the fire area, centered on Hatchet Creek in the Corn Creek subwatershed (HUC 171003020502), in the eastern portion of the Stouts Creek subwatershed (HUC 171003020503), and the headwaters of Callahan Creek (Lower Elk Creek subwatershed, HUC 171003020404) and Drew Creek (Drew Creek subwatershed, HUC 171003020403). Highest volumes for predicted debris flows averaged 180,303 m^3 (ranging from 82,574 m^3 up to 445,238 m^3 in 12 mini-watersheds where probabilities were 0 to 20 percent for 9 of the 12 watersheds following a 2-year recurrence interval rainstorm).

Estimated debris-flow volumes increase with basin size and distance along the drainage network, but some smaller drainages were also predicted to produce substantial volumes of material. The predicted probabilities and some of the volumes predicted for the modeled storms indicate a potential for substantial debris-flow delivery to coho salmon-bearing streams and designated critical habitats downstream in Stouts Creek, lower East Fork Stouts Creek, Hatchet Creek, Callahan Creek, and Drew Creek. All are tributaries to the South Umpqua River for which water quality is likely to decline due to increased delivery of sediment because of the Stouts Creek Fire. Consequently, post-fire effects to water quality and streambed substrates in this portion of the South Umpqua Subbasin are expected.

Critical Habitat

Using available spatial data from ODFW on specific occupied stream reaches (ODFW 2014c), NMFS developed critical habitat information based on fifth-field watersheds to designate specific streams as critical habitat within watersheds, including the 10 watersheds that would be crossed by the Pipeline. Included in the designation of critical habitat for the Oregon Coast coho are estuaries associated with the watersheds, beginning at the estuary mouth, including the entrance to the Coos Bay estuary at the land end of North Jetty and South Jetty. Critical habitats for Oregon Coast coho in specific waterbodies crossed by the Pipeline are compiled in appendix M and are summarized in table 3.5.4-12. Critical habitat includes the Coos Bay estuary and 25 freshwater streams in which critical habitat for Oregon Coast coho salmon has been designated (NMFS 2008d). Critical habitat is designated within 6,568 stream miles in 81 fifth-field watersheds covering a total of 10,751 square miles with 7,342 stream miles of current and/or historically occupied habitat. Approximately 27 percent of critical habitat for the Oregon Coast coho ESU is within the three subbasins in table 3.5.4-12: 2.9 percent is in the Coos Bay Frontal-Pacific Ocean; 4.0 percent is within the three fifth-field watersheds crossed in the Coquille subbasin; and 4.9 percent is within the five fifth-field watersheds crossed in the South Umpqua subbasin.

TABLE 3.5.4-12

Critical Habitat – Stream Miles and Riparian Zones – Designated for Oregon Coast Coho within Watersheds Crossed by the Pipeline Project

	Waterbodies with Coho Presence a/				Areas (acres) of Riparian area within Riparian Zone (1 SPTH)	
Subbasins and Fifth-Field Watersheds	**Number of Waterbodies with Critical Habitat b/**	**Total Stream Miles with Critical Habitat**	**Proportion of Total Critical Habitat Stream Miles in Project Area Watersheds b/**	**Riparian Zone Width (feet) (1 SPTH) c/**	**Within Subbasin or Watershed**	**Within 1 SPTH of Waterbodies with Critical Habitat b/**
Coos Subbasin	**157**	**540.9**	**0.082**	**216**	**471,867**	**29,611**
Coos Bay-Frontal Pacific Ocean	62	191.7	0.029	225	151,585	10,925
Coquille Subbasin	**164**	**544.5**	**0.083**	**196**	**676,291**	**26,575**
North Fork Coquille River	33	136.9	0.021	224	98,407	7,656
East Fork Coquille River	11	43.9	0.007	204	85,963	2,231
Middle Fork Coquille River	24	81.7	0.012	189	197,314	3,839
South Umpqua Subbasin	**214**	**688.1**	**0.105**	**165**	**1,152,662**	**27,901**
Olalla Creek-Lookingglass Creek	20	76.8	0.012	169	103,212	3,186
Clark Branch-South Umpqua River	17	64.3	0.010	149	59,577	2,347

TABLE 3.5.4-12 (continued)

Critical Habitat – Stream Miles and Riparian Zones – Designated for Oregon Coast Coho within Watersheds Crossed by the Pipeline Project

Subbasins and Fifth-Field Watersheds	Waterbodies with Coho Presence a/			Riparian Zone Width (feet) (1 SPTH) c/	Areas (acres) of Riparian area within Riparian Zone (1 SPTH)	
	Number of Waterbodies with Critical Habitat b/	Total Stream Miles with Critical Habitat	Proportion of Total Critical Habitat Stream Miles in Project Area Watersheds b/		Within Subbasin or Watershed	Within 1 SPTH of Waterbodies with Critical Habitat b/
Myrtle Creek	23	89.3	0.014	168	76,250	3,684
Days Creek-South Umpqua River	32	92.9	0.014	164	141,569	3,752
Upper Cow Creek	0	0.0	0.000	187	47,499	0
TOTAL	**535**	**1,773.5**	**0.270**		**2,300,820**	**84,087**

a/ Data from ODFW GIS database (ODFW 2017f)
b/ NMFS 2008d
c/ 1 SPTH, one site-potential tree height

3.5.4.3 Effects of the Proposed Action

Analyses of effects for coho salmon in the Oregon Coast ESU are addressed separately for the marine analysis area, estuarine analysis area, and riverine analysis area.

Direct and Indirect Effects – Marine Analysis Area

Potential project-related effects to Oregon Coast coho within the marine analysis area include 1) acoustic effects to coho from LNG carriers transiting the marine analysis area, and 2) the inadvertent release of fuel and equipment fluids from LNG carriers at sea.

Acoustic Effects

Underwater noise may affect coho salmon in the Oregon Coast ESU. LNG carriers transiting the marine analysis area would produce underwater noise. Underwater noise levels are expected to vary by ship type and also by carrier length, gross tonnage, carrier speed, and, to some extent, carrier age—older carriers tended to be louder than newer carriers. Based on the general trend for higher underwater noise generated by larger carriers (McKenna et al. 2012), it is possible for some of the LNG carriers that would utilize the LNG Project to generate more noise than the LNG tanker built in 2003 with 138,028 m^3 capacity reported by Hatch et al. (2008) that produced sound levels (with 1 standard error) of 182 ± 2 dB re: 1 µPa @ 1 meter.

State agencies in Washington, Oregon, and California, along with federal agencies have developed interim noise exposure threshold criteria for pile driving effects on fish (WSDOT 2019; Fisheries Hydroacoustic Working Group 2008; Popper et al. 2006). These threshold criteria are considered levels below which injury effects would not occur to fish, including salmonids, from in-water noise. As a result, these thresholds should be suitable for all forms of in-water noise. Interim noise exposure threshold criteria for pile driving effects on fish (WSDOT 2019) include 1) a SEL_{cum} of 187 dB re 1 µPa^2 s for fishes more than two grams, 2) a SEL_{cum} of 183 dB re 1 µPa^2 s for fishes less than two grams, and 3) an SPL_{peak} of 206 dB re 1 µPa for all sizes of fishes (WSDOT 2019).

The LNG tanker in the Hatch et al. (2008) study produced sound levels (with 1 standard error) of 182 ± 2 dB re: 1 µPa @ 1 meter that attenuated to 160 dB at 35 ± 11 meters and to 120 dB at 16,185 ± 5,359 meters. All values are less than those noted above as causing direct harm to fish, with the possible exception of very small fish within one meter (three feet) of the hull for an extended period. Additionally, since carriers are in transit and fish can easily move away from carriers, fish exposure would be very brief, further reducing the chance for noise exposure that would result in adverse effects.

It is likely that any LNG carrier noise generated in the marine analysis area would be below thresholds for adverse effects to fish with the possible exception of those fish very near the hull for extended periods, which would be an unlikely event. The criteria for noise levels considered harmful to fish are presented above in the green sturgeon discussion (see section 3.5.1), but generally values less than 183 dB are not considered harmful to fish. As a result, only fish within about one meter (three feet) of the vessel would be in danger of direct noise harm. Noise from LNG carriers would likely increase the background noise within the marine analysis area, which is occurring globally (Slabbekoorn et al. 2010). While background levels are not specifically known in the marine analysis area, analyses of more recent vessel-traffic related noise shows that such levels along the U.S. West Coast are holding steady or increasing slightly offshore from southern California but decreasing in the area off Oregon and Washington (Andrew et al. 2011). Oregon Coast coho in the marine analysis area might detect noise from LNG carriers but would be highly unlikely to be within three feet of these vessels especially for extended periods, and thus are not expected to be adversely affected.

Fuel or Oil Spills at Sea

The LNG carriers use either a steam or DFDE propulsion system that is primarily fueled by natural boil-off gas. Fuel (e.g., diesel) used for back-up generation for LNG carrier propulsion and oil or hydraulic fluids used for mechanical equipment could possibly leak or be inadvertently spilled while the carriers are in transit. The low volume of petroleum oils and fuel on LNG carriers greatly reduces chance of impacts in the marine environment from petroleum spills. The Federal Water Pollution Control Act, as amended by the CWA (33 U.S.C. 1251–1387), prohibits the discharge of oil upon the navigable waters of the U.S. LNG carriers calling on the LNG Project would also be required by the Coast Guard to have a vessel response plan in order to be adequately prepared for accidental spills. Therefore, neither fuel nor oil leaks from LNG carriers transiting in the waterway to and from the LNG Project are likely to have adverse effects on aquatic resources including coho salmon.

Direct and Indirect Effects – Estuarine Analysis Area

Potential Project-related effects to coho salmon in the Oregon Coast ESU within the estuarine analysis area include:

- Interference with key life history functions,
- turbidity effects from dredging the slip and access channel, marine waterway modifications, and the Eelgrass Mitigation Site,
- contamination effects from dredging,
- turbidity effects from temporary in-water construction,
- turbidity effects from LNG carrier propwash and ship wake,
- erosion runoff from Coos bay upland facility,

- stormwater discharge,
- stranding Oregon Coast coho by LNG carrier ship wake,
- introduction of exotic, invasive species from ballast water,
- entrainment from dredging,
- entrainment and impingement of Oregon Coast coho in LNG carriers' intake port,
- food organism entrainment from cooling water intake,
- temperature effects from estuary water cooling discharge during LNG carrier cargo loading,
- effects from facility lighting,
- acoustic effects to coho during LNG Project construction and in-water pile installation for other project related activities,
- habitat and food source effects related to the slip, access channel, marine waterway modifications, and pile dike rock apron developments,
- shading effects,
- restoration activities at the Kentuck and Eelgrass Mitigation sites, and
- suspended sediment potentially released during HDD construction across Coos Bay Estuary and Coos River.

Timing to Life History Functions

In-water construction of the Jordan Cove LNG Project within the Coos Bay estuary is planned from October 1 through February 15 following ODFW's recommendation (ODFW 2008). This work window applies to Coos Bay estuary and estuarine portion of the Coos River (upstream to Millicoma-South Coos River confluence), which coincides with adult upstream migrations of coho (see figure 3.5.4-1, above).

Approximately one-half of each brood of coastal coho salmon in Winchester Creek/South Slough (tributaries to Coos Bay) moved to the estuary as sub-yearlings (Miller and Sadro 2003). The estuary provides feeding and migratory habitat for adult and maturation habitat for juvenile coho that inhabit the ecotones between freshwater and saline portions of the estuary for up to 8 months and then move back upstream to overwinter. By October, adult coho salmon would likely have migrated from critical habitat in the estuary to upstream spawning habitats but the timing and progress of upstream migration could be influenced by drought and autumn precipitation. For example in fall 2011, significant rainfall did not occur until late December and adult coho held in mainstem pools for an extended period, waiting for rainfall, followed by increased discharge (ODFW 2012a). Adult coho could be present in designated critical habitat within the estuary, coincidental with in-water construction for the Project. Principal direct impact during in-water construction would most likely be related to acoustic effects and turbidity generated by dredging and construction of the slip and access channel and the marine waterway modifications. In the unlikely event of an inadvertent release of drilling mud into the estuary during HDD construction, this may also cause a direct effect.

Turbidity Effects from Construction and Maintenance Dredging in Coos Bay

Construction of the LNG Terminal slip would require the excavation and dredging of the shoreline of Coos Bay near Jordan Cove, including removal of about 5.7 mcy of sediment as part of the development of a slip and access channel. The 5.7 mcy of materials would be used to raise the elevation of the LNG Terminal and the South Dunes site to elevations above the tsunami inundation zone.

At least 3.6 mcy would be removed behind a berm in upland habitat away from the bay, with little potential for sediments to affect the marine environment. The remaining 1.9 mcy would be removed by saltwater dredging of the berm (0.5 mcy) and the new access channel (1.4 mcy) in the bay (see discussion in section 3.5.1.3).

The ambient suspended sediment levels in the water (generated by flows, waves and ship traffic) create a background level of suspended sediment. Within Coos Bay, suspended sediment values are moderately high an average summer turbidity level of 10 mg/l and an average winter level of 27.3 mg/l[42] with higher storm level values between 100 and 500 mg/l. See section 3.5.1 for more information on background turbidity levels. Aquatic organisms in Coos Bay are adapted to and exposed to periods of high to moderate turbidity during the winter months. Dredge operations are expected to result in similar effects, with higher concentrations of suspended sediments in the immediate area of dredging.

Resuspension of sediments and temporary increases in turbidity (suspended sediment) above Coos Bay background levels would occur while installing and removing the temporary earthen berm at the LNG Terminal slip and while dredging the access channel, developing marine waterway modification sites, and developing eelgrass mitigation site. Turbidity was modeled for new construction and maintenance dredging operations and was based on the anticipated geotechnical and environmental conditions for this project using the COE's DREDGE model and two dimensional numerical model Mike21 (see discussion in section 3.5.1.3, green sturgeon). Increases in suspended sediment and turbidity levels in the bay due to construction-related dredging would persist for a short period of time (4-6 months) affecting a relatively limited area. Modelling at the access channel has demonstrated the maximum turbidity plume extent, defined by the simulated 20 mg/l (about 10 NTU) above background levels.

The maximum TSS at a specific dredge site using a clamshell dredge was estimated to be about 6,000 mg/l decreasing substantially away from the dredge location. Moffatt & Nichol (2006) also estimated that average turbidity levels during dredging operations (covering changing tidal directions) would not exceed background levels (about 10 to 30 mg/l) for the mechanical dredge at the slip. These levels would be even less for the hydraulic dredge beyond the actual dredge location, while elevated levels would occur outside of the actual dredge area for periods not exceeding 2 hours in duration depending on tidal direction. At lower tidal velocities, values would not exceed 30 mg/l outside of 200 meters, and at high tidal velocity less than 50 mg/l in 200 meters. The concentrations and distribution are partly dependent on the type of dredging method that would be used. Proposed methods for dredging include use of mechanical or hydraulic (suction) dredging equipment. While the hydraulic cutter suction dredge is preferred due to its lower turbidity generation, a type of mechanical dredge may be used, especially in portions of the nearshore area due to buried wood. Model results for the access channel and slip construction indicate that elevated TSS above background would extend about 0.2 to 0.3 mile beyond the dredge sites during a full tidal cycle with any method considered and would exceed about 500 mg/l for about 0.1 mile. Maximum concentrations outside of the specific dredge location would only occur

[42] Jordan Cove included in its application to the FERC a study by Moffatt & Nichol entitled "Report on Turbidity Due to Dredging," attached as appendix F.2 of Environmental Resource Report 2 submitted May 2013.

for about 2 hours or less over the tidal cycle with the plume moving upstream or downstream of the dredge site on flood or ebb tide, respectively. Turbidity is expected to dissipate to background levels within a few hours after dredge operations cease (Moffatt & Nichol 2017a).

Therefore, short-term increases in turbidity above background levels would occur primarily in the vicinity of dredging activity. Due to the limited extent of increased suspended sediment during periods when rearing coho salmon are not abundant and the likely ability of juvenile and adult fish to avoid active construction areas, substantial adverse effects to coho salmon would not occur from slip and access channel construction.

During construction dredging for the Marine Waterway Modifications a total of approximately 590,000 cy of dredge material would be removed from four locations (referred to as Dredge Areas 1 through 4) adjacent to the existing Federal Navigation Channel between CM 2 and 7. These areas would be dredged to a controlled depth to match the adjacent Federal Navigation Channel, which is currently -37 feet MLLW. Construction at the four marine waterway modification areas would be done via hydraulic dredging (cutter suction or hopper) or clamshell dredging, or a combination of these. Hydraulic placement of materials at the upland sites (e.g., APCO Sites 1 and 2, and Kentuck project site) is the proposed method for dredging including material transport with temporary subtidal dredge material transport pipelines (see DMMP; Moffatt & Nichol 2017a). Dredging is expected to require about 5 months to complete, with an additional 45-day mobilization period, based on an assumed production rate of 7,700 cy per day and could be spread over four in-water work windows.

Suspended sediment concentrations at the four marine waterway modifications would reach background level (about 20 mg/l) over a distance of about 1.2 miles[43] with any of the dredging methods. However, hopper style suction dredging would have much higher concentrations during construction with TSS over 500 mg/l extending about 1.0 mile across the dredging site, while the hydraulic cutter suction dredge or mechanical clamshell dredge would produce TSS of 500 mg/l extending about 0.1 mile from the dredge site. The distribution of and concentrations of suspended sediment would be the same for construction or maintenance dredging. See the green sturgeon section for more information on dredging in the marine waterway modifications.

At the Eelgrass Mitigation site, a total of 40,000 cy of dredge material would be removed most likely with a small hydraulic dredge. Modeled turbidity values were determined to be about 1,700 mg/l (about 270 to 290 NTUs) in the active dredging area with plume over 20mg/l (10 NTU) above background levels, from the excavator dredge area would be generally limited to between 340 and 360 feet in all directions (Moffatt & Nichol 2017b). If a mechanical excavator would be used for the eelgrass site construction, a confined area of elevated TSS would extend less than 0.1 mile from point of dredging (Moffatt & Nichol 2017b). Because the site is a more confined and shallow area with somewhat limited circulation, the turbidity plume would be maintained within the local area of excavation. The duration of suspended sediment settling, therefore, is expected to be very short with turbidity dissipating to background levels within an hour after dredge operations cease, depending on the tidal cycle. Turbidity controls utilized during construction are anticipated to minimize risk of turbidity associated with the eelgrass mitigation area. See the green sturgeon

[43] Plume distance noted includes total spread both upstream and downstream of dredge site.

section for a discussion of these controls. See the green sturgeon section for more information on dredging in the Eelgrass Mitigation site.

Project maintenance dredging would remove about 115,000 cy every three years from the access channel area for the first 10 years, and occur in five-year intervals after 10 years (Moffatt & Nichol 2017a). During the project maintenance dredging period, the dredged material is expected to be primarily fines (mud, clay, silt). For the access channel, modeling results for maintenance dredging are the same as construction dredging for the access channel as noted above. However, the dredging of the slip would only be exposed to the larger bay during maintenance dredging.

After the first 10 years of operation, maintenance dredging is expected to occur every five years, with an estimated total volume per dredging event of 160,000 cy. Future maintenance dredging of the slip and access channel would likely be conducted using a mechanical clamshell dredge, which consists of a close-lipped bucket operated from a floating barge. The close-lipped bucket is specifically designed to reduce sediment resuspension into the overlying water column by forming a seal when the bucket surfaces. The material removed by clamshell dredging would be placed on either a flat-deck barge with watertight sideboards, or a bin-barge with one or multiple cells. The material would be transported to the APCO Sites. Saline decant water that does not evaporate or percolate into the sand below dredge disposal sites would be discharged back into the marine slip or bay at APCO via an outfall pipe. Return water from the decanted dredge material would be required to meet appropriate water quality standards (Moffatt & Nichol 2017a).

On average, the COE removes approximately 550,000 cy from the bar 200,000 cy from CM 2 to 12 and 150,000 cy from CM 12 to 15 each year. The COE claims that its maintenance dredging of the Federal Navigation Channel does not significantly increase turbidity below CM 12 (Roye 1979).

If coho salmon are exposed to moderate to high levels of suspended sediment for prolonged periods, a number of adverse effects could occur including behavioral changes, sub-lethal effects, and increased mortality from predators. The exposure of listed fish to increased suspended sediment may result in a behavioral response to move to locations with lower concentrations of sediment. If fish failed to avoid increased suspended sediment, such exposure could result in gill irritation or abrasion, which can reduce respiratory efficiency or lead to infection and a reduction in feeding efficiency due to reduced visibility. However, suspended sediment concentrations resulting from in-water construction are unlikely to reach levels that would cause these results except in the immediate vicinity of dredge operations. Dredging is expected to create localized, short-term spikes of high to moderate TSS and turbidity. Effects to salmonids are expected to be slight because of the limited area affected in the bay and limitations on construction periods. Rearing and migrating coho, which should be uncommon in Coos Bay during the in-water work window, would likely avoid active work areas.

Although localized, short-term, elevated levels of TSS concentrations and turbidity are anticipated from access channel and slip formation, the Marine Waterway Modifications, and maintenance dredging in Coos Bay such conditions may result in behavioral changes that could affect Oregon Coast coho salmon.

Contamination Effects from Dredging

Sediments within the proposed dredge prism for the access channel were sampled to determine whether they meet DMEF guidelines, as identified for the Lower Columbia River Management Area, for in-water disposal (SHN 2006). An analysis of grain size distribution and total volatile solids composition was initially performed to determine if the sediments require further testing for chemical analysis. All of the samples were primarily composed of medium to fine grained sand and had a very low percentage of total volatile solids. Since none of the samples exceeded 20 percent fines or 5 percent total volatile solids, no further chemical testing was required and the sediments were deemed suitable for in-water disposal, according to DMEF guidelines. These findings indicate that resuspension of sediments associated with the dredging for the access channel should not result in significant increases the bioavailability of contaminants to fish and fish food organisms within the Project analysis areas. Therefore, there is little to no risk of contamination as a result of dredging the access channel.

This conclusion is further supported by previous sediment evaluations conducted by the COE in 2004 for Coos Bay channel maintenance and improvement dredging at various stations along the Federal Navigation Channel (COE 2005). Throughout the entire sampling area, only low levels of sediment contaminants were identified, with all levels well below their respective DMEF screening levels. One of the sampling stations (0915CB-BC-10) was located approximately 0.4 mile downstream of the LNG Project. The 2004 sediment sampling effort found only low levels of chemical contaminants, with all levels below their respective DMEF screening levels. None of the samples contained DDT or its derivative by-products (DDE, DDD, see section 3.5.1.3, green sturgeon) at levels that could cause adverse effects to fish resources.

Turbidity Effects from Temporary In-water Construction

Additional in-water construction activities are likely to temporarily increase TSS concentrations and turbidity. Such increases would result from in-water construction related to the:

- TMBB,
- MOF,
- Pile Dike Rock Apron,
- Trans Pacific Parkway/US-101 Intersection Widening,
- APCO Site access bridge construction,
- replacement of anchoring systems for existing three meteorological ocean data collection buoys as well as addition of anchoring systems for two new buoys near the access channel, and
- establishment of hydraulic connections to the Kentuck project for estuarine habitat mitigation.

Turbidity increases would be localized and limited to the time required to complete each of the respective Jordan Cove Project components. Construction activities would occur within the ODFW in-water work window (October 1 to February 15) reducing potential period of juvenile coho exposure. Minor, localized increases in suspended sediments (resuspension lasting a few hours to a few days) may continue to occur until all disturbed materials in the construction area have been flushed out. Implementation of erosion and sediment control measures and in-water work conservation measures would greatly reduce the duration and intensity of sediment and turbidity in the waterways (see appendix N). The exposure of listed fish to increased suspended sediment may result in a behavioral response to move to locations with lower concentrations of sediment. If fish failed to avoid increased suspended sediment, such exposure could result in gill irritation or abrasion, which can reduce respiratory efficiency or lead to infection and a reduction in feeding efficiency due to reduced visibility. However, suspended sediment concentrations resulting from in-water construction are unlikely to reach the levels that would cause these results. Increased turbidity may affect Oregon Coast coho that occur in the immediate vicinity of construction.

Turbidity Effects – LNG Carriers in the Waterway

Propwash from LNG carriers and tug boat propellers associated with the Project, as well as ship wakes breaking on shore, could cause increased erosion along the shoreline and re-suspend the eroded material within the water column and displacing bottom organisms due to bottom scour. This may affect the diversity and health of the benthic community regarding food availability and feeding conditions for foraging and migrating fish species (see discussion in section 3.5.1.3, green sturgeon). Waves from vessels breaking on the shoreline can also cause fish stranding (see discussion below). The possible magnitude and effects of the proposed Project including approximately 120 LNG carrier round trips per year on shoreline erosion were approximated by Jordan Cove through model studies, the results of which are discussed below. The possible magnitude and effects of the proposed Project on shoreline erosion were approximated by Jordan Cove through model studies, the results of which are discussed in detail in green sturgeon section 3.5.1.3 and are summarized below. Overall effects on bank and bottom erosion and elevated suspended sediment effects are expected to be unsubstantial.

Models were developed to assess the likely size of waves hitting the shore relative to existing conditions. Additional models assessed likely magnitude of propwash effects on the channel and docking area (see section 3.5.1.3). The results of the wave model indicated that waves resulting from about 120 round trips per year were not greatly different in most areas than natural conditions. The Moffatt & Nichol (2008a) model found that the maximum wave height generated would be about 1.1 feet. Although waves of this size occur throughout much of the bay, they only occur about 2 percent or less of the time annually based on the locations modeled. Among the seven locations chosen by Moffatt & Nichol, the model predicted that the waves generated would equal from 0.0 to 3.1 percent of the annual wave energy at these locations above the current wave energy level. A separate wave model estimate estimated that additional waves generated by the new LNG traffic could increase shoreline sediment transport at the modeled point by 5 to 8 percent over existing conditions (wind-generated waves plus existing large vessel–generated waves). The effect on turbidity relative current conditions would likely be slight and not directly affect coho salmon.

The models addressing propwash effects had similar likely low effects on turbidity. The model by Moffatt & Nichol (2008a) generally found along most of the route no marked bottom disturbance or sediment suspension would occur, as the increased velocity would be similar to maximum tidal currents. Within about the last half- to quarter-mile before reaching the slip (based on the point selected for modeling) is where bottom velocity is increased. Some increased bottom scour and locally elevated turbidity may occur in this area but the effects would be limited in dimension. Disturbance would be limited, partly due to the coarse (mostly sand) bottom substrate that is relatively resistant to resuspension and rapidly settles. A separate model by CHE (2011) found bottom velocity greater than about 4 ft/sec would occur only in an approximate 80-foot-wide band. Therefore, velocity generated by the propeller in excess of tidal flow velocity would be limited to a narrow band in the mid-channel, limiting the area where sediment may be suspended from propeller actions of the LNG carrier. However, this region is generally of coarser sediment that is less prone to suspension. Turbidity would likely be slight due to the coarse characteristics of the navigation channel sediment that is resistant to current-induced suspension. Some increased velocity would occur in the docking area. Sediment analysis suggests that over 95 percent of the bottom material (mostly silt/clay size) in the access channel would be susceptible to suspension at this velocity. The report also estimated that bottom scour would be limited to about two inches over a limited bottom area (approximately 100 by 50 feet) in the access channel. Some bottom disturbance would likely occur during docking but over a very small area.

A more recent vessel wake analysis was recently completed (Moffatt & Nichol 2017c). This study compared two modeling scenarios – "without project" and "with project." The "with project" scenario included the latest anticipated dredged depths for the federal navigation channel, access channel, and marine slip. This study also incorporated the latest anticipated vessel characteristics for the new facility, which included 240 vessel transits, bulk carriers and tugs. For the "with project" scenario, all LNG carriers were assumed to travel no faster than 5 knots, with tugs traveling up to 10 knots outbound. Results of the 2017 wake analysis are summarized below.

The results of the more recent vessel wake analysis indicates the drawdown generated by LNG carriers' departure and arrival under the proposed project would be lower than existing conditions (0.4 to 0.5 feet for bulk carriers compared to 0.1 to 0.2 feet for LNG carriers at the shoreline). The tug vessel trips leaving to meet LNG carriers would be at the higher speeds, as high as 10 knots, and occur about 120 channel trips per year, but tug trips may not all be made at these higher speeds. The predicted tug generated wave heights at the shoreline are higher (0.6 to 0.8 feet) than with the bulk carriers under the proposed Project. Each vessel passage would generate some form of wave for about 15 minutes (CHE 2011), with the peak wave period much less in duration. This compares to a natural wave frequency that would last much longer (e.g., hours or days). The induced waves from these additional vessels, with the possible exception of outgoing tugs, would have an unsubstantial effect on shoreline erosion as they are well within the naturally occurring, wind-generated wave heights ranging from about 0.5 to 3 feet (CHE 2011, Moffatt &Nichol 2017e). The wave effect on the shoreline from increased vessel transits with the Jordan Cove can be managed by reducing vessel speed (Moffatt & Nichol 2017d).

An updated propwash memo (Moffatt & Nichol 2017d) included modeling the use of ship engines and tug assist for berthing and unberthing in the marine slip area. The model assumed the LNG carrier engines and propeller would be used in addition to that of tugs for this action. While berthing had low potential for scour, unberthing with the use of LNG carrier propeller engagement, could cause high potential for scour in the access channel and slip area. Results indicated high propwash velocities along the east side of the slip during unberthing. The largest bottom velocities (13.6 ft/sec) were estimated to occur on the eastern side of the access channel and the slip near the MOF. During berthing, the largest bottom velocities (5.4 ft/sec) are expected to be near the western slope within the slip and the access channel.

Scour depths were estimated to be nearly 0.5 foot due to propwash in the access channel and the Slip near the eastern side of the access channel and the slip if there is no slope protection installed. Overall about 12 acres of bottom could be scoured to a depth over 0.2 foot. However, slope protection is planned for each side of the slip, and for the east and west sides of the access channel. Likely plumes of turbidity could occur briefly in the vicinity of the slip and access channel primarily near the bottom during the period of unberthing. The turbidity increase would be local and settle once the propellers stopped.

These results do not change the earlier conclusion that suspended sediment levels during carrier docking are expected to only have short-term localized effects to Oregon Coast coho that may occur in the docking area.

Overall, models indicated some additional shore sediment movement could occur from the waves generated by the passage of LNG carriers through Coos Bay, particularly the tug vessels, the effects would be small because increased waves would occur infrequently, contribute a very small portion of total annual wave energy and sediment transport, and be within the normal magnitude of waves that naturally occur within the bay. Additionally bottom disturbance would likely occur during LNG carrier transit in the main channel where sediment is coarse and also during docking. In most cases, this disturbance is likely to be much less than estimated because of the conservative assumptions used for this model. Therefore, the total effect of suspended sediment is likely to be within the range of natural annual variability of wave conditions. Elevated suspended sediment levels from transit and docking are consequently expected to be brief and localized, having only short-term local effects to any Oregon Coast coho salmon along the route or in the access channel and marine slip area.

Erosion and Runoff from Coos Bay Upland Facilities

Impacts on marine resources could occur from the clearing of vegetation at the terminal, erosion and sediment runoff, and potential hazardous substance spills during construction. While no streams are present in the upland portion of the terminal, the removal of current vegetation could modify the character and amount of water runoff into the bay.

Nearshore vegetation clearing could indirectly affect aquatic resources in the bay. However, the amount of nearshore vegetation that would be removed for this Project is small. Other than an existing disturbed shoreline near the South Dunes site that would be used as a temporary laydown area, no planned nearshore disturbance would occur outside of the upland and shoreline excavated and dredged to create the marine slip for the terminal.

During construction, uncontrolled increases in sediment runoff to Coos Bay could impact local aquatic resources. Jordan Cove would prevent uncontrolled releases of sediment runoff during construction by implementing erosion control and revegetation measures from its Plan and Procedures. Additionally, accidental spills of hazardous materials (e.g., equipment fuel, oils, and paints) during construction could have effects on aquatic resources in the bay. Jordan Cove prepared a draft site-specific SPCCP to minimize the potential for accidental releases of hazardous materials.

Stormwater Discharge

Stormwater discharge has the potential to contain chemicals toxic to coho salmon. However the NPDES permit that the applicant would be obtained requires discharges to not modify state water quality standards of the receiving water (see discussion in section 3.5.1.3, green sturgeon for more details on facilities on stormwater controls below.

LNG Terminal

The LNG facility and marine LNG loading area would include various drainage elements to manage segregated networks for contaminated and uncontaminated water from designated areas. The proposed oil and grease treatment system at the LNG terminal facilities is designed to limit discharges of oil and grease. This system design would ultimately need approval from the State to obtain the NPDES permit. See discussion in section 3.5.1.3, green sturgeon for more details on the LNG Terminal stormwater controls.

Trans Pacific Parkway/US-101 Intersection Widening

Stormwater generated as a result of new impervious area at the Trans Pacific Parkway/US-101 Intersection Widening would be collected and conveyed to treatment facilities to provide treatment for 100 percent of the 2-year storm event. Drainage curbs would be installed near the edge of pavement along the northwest side of the roadway. These drainage curbs would collect and convey flow from the road crown to water quality treatment facilities. The water quality facilities would provide treatment for the design flow volume and bypass higher flows before discharging the runoff into Coos Bay.

APCO Sites

APCO Site 1 (East) would be surfaced with dense-graded gravel and would have existing drainage patterns would be preserved to the maximum extent practical. Stormwater would be treated primarily by vegetated swales and filter strips. Fill placed on APCO Site 2 (West) would be surfaced with native vegetation. Additional storm water controls would be added if necessary. The bridge connecting APCO Site 1 and 2 is in preliminary design. The stormwater run-off from the bridge would be treated prior to discharge to Coos Bay.

Pacific Connector Contractor Yards

Pacific Connector has proposed contractor yards that border Coos Bay at the shore and another that borders Isthmus Slough at the shoreline, all designated critical habitat for coho. Several other proposed yards border or are close (<100 feet) to waterbodies inhabited by Oregon Coast coho. Although the yards are previously disturbed industrial sites, stored materials and surface runoff could enter Oregon Coast critical habitat. Any potential risks due to surface runoff would be mitigated through implementation of an approved stormwater management plan.

Kentuck Project Site

Roadway improvements associated with the Kentuck Project, which include elevating and re-paving of East Bay Drive and Golf Course Lane, would result in the addition of new impervious area. The stormwater facilities at the Kentuck Project site would be designed to provide treatment for 100 percent of the 2-year storm event wherever feasible.

East Bay Drive would sheet flow stormwater runoff to roadside drainage curbs. Once along the curb, water would flow toward cartridge filters, which would treat water before discharging the runoff onto rip-rap road base adjacent to the receiving waters in Kentuck Inlet.

Along most of Golf Course Lane, surface water ditches and flow-through bio-infiltration conveyance systems are proposed. In these areas, collected flow that does not fully infiltrate into the underlying well-draining soils would be conveyed to an outfall into the Kentuck Slough. At the north end of Golf Course Road, runoff would be collected in drainage curbs and conveyed to cartridge filters before discharging to Kentuck Slough.

Temporary Construction Facilities

Construction laydown areas would be surfaced to a large extent with larger, open-graded aggregate that would allow infiltration; therefore, stormwater from these areas would be self-contained and would infiltrate without the need for outfalls. Impervious surface would not be added at the Myrtlewood Off-site Park & Ride for the Jordan Cove Project area. Stormwater treatment for temporary facilities is described further in the ESCP (see appendix F) and Jordan Cove's *Storm Water Management Plan.*[44]

Stranding from Ship Wake

Fish stranding can occur when fish become caught in a vessel's wake and are deposited on shore by the wave generated by the vessel wake. Stranding typically results in mortality unless another wave carries the fish back into the water. Pearson et al. (2006) in a study of fish stranding noted that a series of interlinked factors act together to produce stranding during vessel traffic and may include water surface elevations, with low tides more likely to result in strandings than high tide; beach slope, with strandings more likely on low gradients than high; wake characteristics influenced by vessel size, hull form, depth underwater (draught), and speed with faster speed producing larger wakes; and biological factors, such as numbers of small fish present near the shoreline and whether or not fish are strong swimmers (see discussion in section 3.5.1.3, green sturgeon). All of these factors can vary simultaneously, making it difficult to predict the location and to what degree strandings may occur. A few areas may have the potential to strand fish in Coos Bay. One is the mud flats on the west side of the navigation channel along the Coos Bay and Empire Range that have beach morphology that has been shown to have potential for stranding, especially at low tide. The sizes of juvenile coho in the estuary are expected to be comparable to sizes of juvenile Chinook salmon (less than 9 cm) that became stranded by ship wakes in the Columbia River (Pearson et al. 2006); juvenile coho may be susceptible to stranding by ship wake.

Ship wakes produced by deep-draft vessels traveling at speeds greater than the estimates for LNG carrier speeds along most of the route within the Coos Bay estuary have been observed to cause occasional stranding of juvenile salmon with no observed strandings as a result of vessels traveling at speeds under 9 knots (10.4 mph) (Pearson et al. 2006). The hull geometry of the LNG carriers is such that bow wakes are minimized, especially at the slower speeds of 4 to 6 knots (4.6 to 6.9 mph) that would occur during most of the transit route through Coos Bay. The exceptions are near the Coos Bay entrance (first mile), when LNG carriers may be traveling 8 to 10 knots (9.2 to 11.5 mph) and possibly LNG carrier tug along the whole navigation channel that could be traveling at 10 knots during outgoing trips. While waves generated near the entrance may be larger than farther in the bay, this is an area likely already receiving larger ocean-generated waves, so the vessel-generated waves would be little different than current conditions in this region. However tug vessel travel would increase risk of coho stranding along the shore of the navigation channel.

Therefore, the LNG carriers would be traveling along most of the route at speeds less than that observed (Pearson et al. 2006) to cause stranding. In models and research conducted by Jordan Cove, wave heights produced by LNG carrier traffic would not exceed that of normal conditions

[44] Included as Appendix N.7 of Resource Report 7 as part of Jordon Cove's September 2017 application to the FERC.

in Coos Bay and overall waves would contribute to a small portion of the total waves that occur in the bay. However the tug vessels would increase risk in these areas. In addition, the LNG carriers and likely tugs would be arriving and leaving at high tide, which is a period when gently sloping beaches are mostly covered and less likely dewatered from waves. Considering that LNG marine traffic (about 120 inbound and 120 outbound trips per year) would enter and leave at high slack tide, have mostly low vessel speeds, and wave height would be mostly in normal range, it appears unlikely that LNG carrier traffic in the waterway would strand Oregon Coast coho within Coos Bay.

Exotic, Invasive Species by LNG Carriers

Invasive species have the potential to modify the food base and induce other ecological modifications in the estuarine area of Coos Bay. NAS are aquatic species that degrade aquatic ecosystem function and benefits, in some cases completely altering aquatic systems by displacing native species, degrading water quality, altering trophic dynamics, and restricting beneficial uses (Hanson and Sytsma 2001). Within the Coos Bay estuary, over 67 NAS have been identified (ANSTF 2006).

There are no current studies that evaluate the impact of introduced fishes on coho salmon (ODFW 2005). The introduced species, striped bass and shad, presents the highest risk of impact to coho salmon in the Coos Bay estuary (ODFW 2005). However, navigational dredging within Coos Bay has altered salinity levels, which may have impacted striped bass egg and larval survival, reducing numbers and threat of striped bass predation on coho (Moore et al. 2000).

Loaded with water from the surrounding ports and coastal waters throughout the world, ships can carry a diverse assemblage of marine organisms in ballast water that may be foreign and exotic to the ship's port of destination. If water were to be directly transported from port to port, which is not proposed, this transfer could result in aquatic biological invasions. Invasive species threaten to outcompete and exclude native species and the overall health of an ecosystem, causing algal blooms and hypoxic conditions and affecting all trophic levels resulting in a decline in biodiversity.

Potential new invasions of zebra mussel (*Dreissena polymorpha*), Chinese mitten crab (*Eriocheir sinensis*), and hydrilla (*Hydrilla verticillata*) can potentially affect Oregon Coast coho salmon. Other invasive organisms including varied plants, invertebrates, and other fish are also known to be detrimental to native Oregon Coast coho salmon (Stout et al. 2012). For example, Oregon Coast coho smolts during out-migration consume a mudshrimp (*Upogebia pugettensis*), the major food sources in Yaquina Bay (Stout et al. 2012). These intertidal benthic invertebrates have been dramatically affected by the recently introduced isopod parasite (*Orthione griffenis*), likely introduced from Asia in the 1980s (Dumbauld et al. 2011).

EPA developed specific requirements for ballast water treatment under the Vessel General Permit requirement under the CWA NPDES program to reduce the chance of releasing invasive organisms in U.S. waters in 2013 (78 *Federal Register* 121938). This regulation requires that beginning December 19, 2013, all newly built large vessels would be required to treat ballast water to kill potential invasive organisms, with older vessels of the size that would be used for the Project having some delay in implementation of this requirement (first scheduled dry dock date after January 1, 2016). Most LNG carriers would have implement these new anti-nuisance species protective measures by this date; however, for the few outstanding vessels that have not yet implemented this standard, they would discharge ballast water within 200 miles of the U.S. coast and would be required to exchange ballast water outside of this 200-mile area.

This was originally established by Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 and further amended by National Invasive Species Act of 1996 and National Aquatic Invasive Species Act of 2003, amended in 2005 and again in 2007 (NEMW 2007).

The required treatment of water would ultimately be an improvement over the requirement to just exchange ballast water to "flush" potential invasive organisms outside of the 200-mile territorial waters of the U.S., which was reported to reduce organisms by 88 to 99 percent (NRC 2011). The new requirement for treatment level is to reduce most organism types to less than 10 living organisms per cubic meter of ballast water. While this requirement may not eliminate all risk of invasive species entering waters, it is a substantial measure that would reduce the risk of project actions introducing invasive organisms. Several other regulations apply to ballast water management and discharge that would be followed by all LNG carriers; these regulations would also aid in both ensuring reduction of discharge of potentially invasive species and, through vessel inspections, that procedures are followed, as noted in section 3.1.1.3.

All ships utilizing the Port of Coos Bay are subject to the 2012 USCG Final Rule on Ballast Water Discharges. Pursuant to this Final Rule, in order to discharge ballast water into the slip area while concurrently loading LNG cargo, all LNG carriers are required to carry out an exchange of ballast water in waters beyond the EEZ, from an area more than 200 nautical miles from any shore, and in waters more than 2,000 meters deep, or utilize one of several USCG-approved Ballast Water Management methods. It is expected that LNG carriers calling at the LNG Project would be required to exchange ballast water at sea, more than 200 miles offshore; therefore, the discharge of ballast water would comply with the 2012 Ballast Water Discharge Standards and the potential impact for ballast water to introduce invasive species of interest in Coos Bay would be negligible.

ODEQ recently revised the Oregon ballast water regulations to make the Oregon regulations more stringent for vessels arriving from "low salinity ports" by requiring ballast exchange in addition to the current Federal ballast water treatment requirements. This applies to vessels that represents a "high-risk" for the transport and release of aquatic invasive species arriving from "low salinity ports" (like those in Oregon). A "low salinity port" is defined as a port where ballast water salinity is less than or equal to 18 parts per thousand (or when the vessel operator is unable to verify ballast salinity). A "High Risk Voyage" is defined as voyages originating in the "low salinity ports" that represents a "high-risk" for the transport and release of aquatic invasive species arriving from such "low salinity ports."

The new rules retain ballast water exchange requirements, in addition to meeting federal ballast water treatment requirements, for what is termed as "high-risk voyages," , that is those that have taken ballast from low-salinity environments. This is a measure to protect Oregon's low-salinity ports during a period when the reliability of new "first generation" ballast water technologies are proven to be effective for low salinity ballast.

The ballast water discharged at the terminal would be that from 200 miles out in the open sea. Therefore, it is expected that current and future provisions apply both to the import and export of nuisance species, and by compliance with this Act and other regulations, the LNG carriers would not likely cause exotic nuisance species to be introduced into Coos Bay, U.S. waters, or the ports of destination of the LNG cargos. As a result, adverse effects on Oregon Coast coho salmon are expected to be unsubstantial (see section 3.5.1.3 for more details).

Another potential source of invasive species, other than LNG carrier ballast water, is transfer between waterbodies by construction equipment used in water, or other water transfer actions. USGS (2017) identified two NAS that may occur within the Coos Bay estuary: New Zealand mud snails (*Potamopyrgus antipodarum)* and brackish water snail *(Assiminea parasitologica)*. Pacific Connector would not obtain hydrostatic test water from either Coos Bay or the Coos River, to prevent the spread of NAS from the estuary to inland watersheds. Pacific Connector currently has procedures in the *Hydrostatic Test Plan* (see appendix U), which includes measures such as inspection and cleaning of all dredge and similar equipment prior to use intended to reduce or eliminate the chance of spreading invasive species.

<u>Entrainment of Coho Salmon from Dredging</u>

After a review of dredging studies done through 1998, Reine et al. (1998) concluded that "much of the available evidence suggests that entrainment is not a significant problem for many species of fish and shellfish in many bodies of water that require periodic dredging." Dredge entrainment studies over a four-year period in the Columbia River found no juvenile or adult salmonids entrained during dredging, although some other pelagic fish were entrained (Larson and Moehl 1990). Juvenile salmonids also generally remain in shallower depths likely away from the typically deeper bottom dredge areas (Carlson et al. 2001) and dredging would occur when few or no rearing or migrating juvenile coho salmon would be present. Based on these factors, it is not anticipated that construction or maintenance dredging would substantially entrain individual Oregon Coast coho salmon regardless of dredging method used.

<u>Entrainment and Impingement through Vessel Cooling Water Intake at the LNG Project</u>

During operation of the LNG Project, vessels at LNG slip may entrain marine organisms including juvenile coho salmon through cooling water intake needed for vessel power plant operations. The quantity of cooling water used depends primarily on size and type of vessel, time at the terminal, and power source used while at the terminal, and amount of recirculation. LNG carriers would re-circulate water while loading LNG at the berth and the amount of cooling water to be re-circulated is a function of the propulsion system for the vessels. The details of the cooling water intake and flow amount are discussed in section 3.5.1.3 but based on assumptions estimated cooling water used for each LNG carrier, depending on vessel type while at the LNG Project is between 20.3 and 69.7 million gallons of cooling water recirculated to the slip over a 24 hour loading cycle of LNG cargo.

LNG carrier sea chests are typically 3.5 to 4.2 square meters covered by a screen with 4.5 mm bars, spaced every 25 mm and approximately 15 to 20 feet above the channel bottom. Additional finer mesh screens are located internally on the vessels to prevent larger items from entering the system. These screens would not meet NMFS (1997c) screening criteria for juvenile salmonids. Smaller marine and estuarine fish, juvenile stages of crab and shrimp and other zooplankton, eggs, and larvae fish could also be entrained. Some estuarine organisms, potentially including juvenile salmonids, would be removed from Coos Bay with this process during every loading cycle. It is expected that a high portion of juvenile larval stages of fish and invertebrates entrained or impinged would suffer mortality. Nevertheless, natural mortality of these early life stages is extremely high. The result would be less than 1 percent of earliest life stages reaching adult size, with natural mortality more than 20 to 30 percent per day during the earliest growth periods (Comyns pers. comm. 2003). For example, data from an estuarine cooling water intake site determined that intake water larval stage entrainment had very low natural survival (Marine Research Inc. 2004). On a typical LNG carrier, the location of the water intake is near the inner portion of the slip at a depth of about 30 feet, and as a result, it is unlikely there would be an abundance of aquatic organisms in the intake area. Salmonids migrating in Coos Bay would more likely be swimming in the main channel, away from the shoreline and the inset slip, thus reducing their chance of encountering the LNG carrier intakes. Therefore, the off-channel, artificially-created marine slip would probably have a lower presence of fish than the rest of Coos Bay, and the risk of juvenile salmonids becoming impinged or entrained in the LNG carriers' water intakes is expected to be low.

The estimated velocity at the opening of the cooling water intake for a steam propulsion system ranges from 3.4 to 4.3 ft/sec (1.04 to 1.32 meters/second), depending on the intake dimensions of cooling water intake. The estimated velocity at the opening of the cooling water intake for a dual propulsion system is approximately 1.0 to 1.3 ft/sec (0.30 to 0.38 meter/second), depending on the intake dimensions of the cooling water intake. NMFS recommends an approach velocity for screening systems for salmonids of less than 60 mm is 0.33 ft/sec, and 0.8 ft/sec for larger juvenile salmonids (NMFS 1997c). These guidelines also include other requirements such as sweeping velocity and type and size of openings that are not present on these screens. The result is likely to be that fish at fry and larger juvenile size salmonids including coho salmon near the intakes may be entrained or impinged during cooling water intake.

Loss of juvenile coho salmon could reduce adult coho salmon returns. NMFS (2008d) in their assessment of effects of loss of juvenile coastal coho salmon from local airport expansion assumed a 4 percent Coos Bay coho salmon smolts survived to return as adults. Even so, due to the extremely small portion of total water intake relative to the volume of Coos Bay, the relative portion of juvenile salmonids that would suffer direct mortality would be small. In the case of coho salmon, few would be as small as 60 mm, as most would be outmigrating as age 1+ likely greater than 120mm. So, many of the juvenile coho salmon would actively be able to avoid being entrained or impinged at the unscreened intake. Also, the slip would be excavated from the current upland, located away from the main channel of Coos Bay, which may, depending on coho salmon distribution, reduce overall chance of coho salmon being in the vicinity of the LNG carrier intakes while at the terminal. This would reduce the chance of juvenile migrating coho salmon in the Coos Bay being in the vicinity of the intake. Actual distribution of juvenile coho salmon within the project area is unknown. However, juvenile salmonid studies in the lower Columbia River observed that juvenile coho salmon were in greater abundance away from shoreline areas often in deep water during their outmigration (Johnson and Sims 1973; Dawley et al. 1986; Ledgerwood et al. 1991). Carlson et al. (2001) found that in the lower Columbia River that less than 20 percent of all fish were found along the shore, with about evenly split between the channel and channel margins.

Based on the Columbia River studies coho salmon migrating to the ocean would likely be more closely associated with the main channels than the nearshore area and the inset slip, reducing their chance of encountering the intakes. While actual Coos Bay distribution is unknown available literature suggest relative abundance near the LNG carrier intake would be relatively low. Considering likely distribution of coho salmon relative to the vessel intake, size of juvenile coho salmon that would allow avoidance, and limited frequency and magnitude of cooling water intake, loss of coho salmon from entrainment would be slight.

Entrainment of Food Organisms

As noted above, entrainment of organisms, including plankton that are a source of food for juvenile coho salmon, would occur from water intake for LNG carriers. Food organisms used by juvenile estuarine coho salmon and other salmonids include a variety of taxa. Many forms of invertebrates including epibenthic and pelagic zooplankton (e.g., harpacticoid copepods, calanoid copepods, amphipods, and mysids), larval stages of other groups, and larval fish are known sources of food used by estuarine rearing stages of coho salmon.

Shanks et al. (2010, 2011) sampled zooplankton and ichthyoplankton in Coos Bay near the LNG Terminal. The primary intent of these studies was to help characterize what food sources are present in the region of the water intake and the relative effect entrainment may have on these food sources. The sampling was intended to determine seasonal, tidal, and daily changes in abundance of zooplankton including larval fish, shellfish, potential salmonid prey organisms, and other miscellaneous zooplankton that may occur in the Project area. A variety of zooplankton were found to be present within the bay (see table 3.5.4-13). Among the potential salmonid forage items, copepod adults, larvaceans, harpacticoid copepods, and Daphnia had the highest peak abundance. Overall, larval fish abundance was generally low, with those that spawn primarily in or near estuaries common (surf smelt, sand lance, and staghorn sculpins). At times, other larval or juvenile fish were relatively abundant including English sole, buffalo sculpin, anchovy, and pipefish. A total of nine fish species were captured (Shanks et al. 2011). Over 12 taxa of crab and shrimp larvae were also collected, including some recreational and commercially important crab and shrimp species, such as Dungeness crab and ghost shrimp larvae (Shanks et al. 2011).

TABLE 3.5.4-13

Taxa Groups Collected in Coos Bay Near the LNG Terminal during 2009–2011

Categories	Specific Taxa
Fish larvae/juvenile	Surf smelt, sand lance, staghorn sculpin, buffalo sculpin, anchovy, pipefish, English sole, gunnel, pricklefish
Crab/Shrimp larvae	Porcelain crabs, pea crabs, green crab (invasive), xanthid crabs, majid crabs, cancer crabs (e.g., Dungeness, rock crab), Lithodidae, Hippidae, Pagurid (hermit crabs), Callinassa (ghost shrimp), Sergestid shrimp, Pachygrapus crassipes (striped shore crab)
Gastropod and Bivalves larvae	Mytilus (mussels), Clinocardium (cockles), Bivalve juveniles, Gastropod juveniles
Larval Invertebrates	Barnacle nauplii and cyprids, Mytilus larvae, bivalve larvae
Cnidaria/ctenophore	Sea anemone, Hydroids, sea goose berry
Polychaete Worm Larvae	Marine worms
Salmonid Food Prey	Mysids, Amphipods, Isopods, Cumaceans, Copepod adults, Harpacticoid copepods, Calanoid copepods, Daphnia, Larvaceans, larval fish

Source: Shanks et al. 2010, 2011

To make a reasonable estimate of potential loss from cooling water intake, we compared the relative amount of water used while at terminal to the amount of water in the Coos Bay project area. There are several assumptions with this method; the three major ones are: 1) organism distribution would be similar in water used to that in the bay as a whole, 2) all organisms entrained would be lost to the system, and 3) no avoidance to entrainment would occur. In addition, the estimate of entrainment loss was compared to what typical natural mortality loss would be for invertebrate and vertebrate life stages that are common in zooplankton as potential salmonid food sources. This information provides a perspective of how entrainment loss may influence food supply relative to natural conditions. This approach was developed in the Shanks et al. (2010, 2011) documents.

The amount of water that would be used during one LNG carrier loading event, assuming no recirculation, is estimated to range from 76.8 to 263.8 thousand m^3 (20.3 to 69.7 million gallons) over the course of about 24 hours while the LNG carrier would be at the terminal. The period at the terminal would span approximately two tidal cycles (each tidal cycle takes approximately 12 hours). An approximation of average tide water exchange in the Project vicinity over a tidal cycle one complete high, low, and back to high tide is 106.0 million m^3 based on data from the SHN Consulting Engineers and Geologist, Inc., technical memo (see Shanks et al. 2010, 2011). Using the figure of 106.0 million m^3 for water in Coos Bay, it was estimated that from 0.07 to 0.25 percent of the water passing near the marine slip would be taken in for engine cooling while an LNG carrier is at the terminal based on average tidal cycle exchange. This means that conservatively[45] from 0.07 to 0.25 percent of the water passing the marine slip would be taken in for engine cooling while an LNG carrier is at dock at the terminal, based on average tidal exchanges. Theoretically, organisms in this entrained water would be lost to the Coos Bay system and therefore not available as a food source.

The loss of these organisms from entrainment can also be compared to loss from natural mortality in the bay environment. Instantaneous natural mortality rate (per day) can be defined by the function: $M = \ln (N_0/N_t)/\text{-}t$, where M is instantaneous mortality rate, and N_0 and N_t are the initial and final abundance of larval after time t (Rumrill 1990). The comparison between entrainment and natural mortality loss of potential larval food organisms was made assuming 100 percent mortality of all organisms entrained during water intake and all mortality occurred during a single day. Additionally, it was assumed that all pelagic zooplankton in the project area during water exchange on an average day (i.e., 106.0 million m^3) suffered one day's natural mortality at the rate determined in the literature.

Rumrill (1990) provides estimates of mortality rates for a variety of marine invertebrate larval and in some cases through juvenile stages. McGurk (1986) supplies similar information for a variety of larval stages of marine fish. These values provide the bases for comparison of potential Project entrainment loss to that from natural mortality. Rumrill (1990) supplied estimates of morality rate using two methods with different data sets. One set is based on the contrast between larval production and subsequent recruitment, and the other is based on the monitoring of larval cohort in the plankton. The lowest and average mortality rates from Rumrill (1990) and McGurk (1986) are shown in table 3.5.4-14 for invertebrates and fish larvae. Invertebrate 1 and 2 in this table refer to the two respective rate groups from Rumrill (1990). Average and lowest mortality rates data for larval invertebrates and larval fish from these two sources were similar. Average loss of organisms from entrainment during one LNG carrier loading cycle would range from 0.3 to 1.7 percent of what would occur from natural morality in one day. For the lowest literature mortality rate of larval taxa among those reported, daily entrainment loss would be much higher ranging from 2.4 to 15.5 percent depending on what water volume was used during one vessel loading cycle and which taxa group data are used. These values are conservative estimates when compared

[45] Values is conservative (likely high) because total cooling water intake/discharge period is about 24 hours while we used the one tidal exchange period, about 12 hours for the estimate. Actual volume of water passing area would be about double, but some portion would be the "same" water.

to natural mortality that would occur in the Coos Bay system overall because entrainment would not occur daily whereas natural mortality would.

Because about 120 round LNG carrier trips a year would occur, LNG loading and water intake use would occur on average every three days. Therefore, relative fish food organism loss from entrainment annually would be considerably less than that estimated. Overall reduction in food sources for marine predators from entrainment of planktonic organisms appears to be slight, considering various factors. On average, water intake would be less than 0.25 percent of the water passing the project on a daily tidal cycle, so relatively few organisms would be subject to entrainment assuming similar planktonic organism distribution at the intake. Typical "loss" on average would be about 1.7 percent or less of loss from natural mortality of invertebrate and fish larvae during the day of LNG cargo loading (table 3.5.4-14). These values are conservative estimates when compared to natural mortality that would occur in the Coos Bay system overall because entrainment would not occur daily whereas natural mortality would, not all entrained organisms would suffer mortality, and, as noted, we assumed half the daily water volume passing the loading area. Overall, the loss of marine fish and their prey resources that may be utilized by coho salmon from entrainment, relative to numbers in Coos Bay, would be small and have unsubstantial effects on supply of coho salmon food resources.

TABLE 3.5.4-14

Comparison of Relative Loss of Larval Invertebrates and Larval Fish from Entrainment to Natural Mortality during Water Intake (Cooling) during One LNG Vessel Loading Event in Coos Bay, Oregon

Mortality Category in Literature Source	Taxa Group b/	Natural Mortality Rate M (daily)(M=ln(S)/-t) c/	Estimated Percent Loss from Entrainment Relative to Daily Loss from Natural Mortality a/	
			Low Intake	High Intake
Lowest	Larval Invertebrate 1	0.0305	2.4%	8.2%
Lowest	Larval Invertebrate 2	0.0161	4.5%	15.5%
Lowest	Larval Fish	0.0200	3.6%	12.5%
Average	Larval Invertebrate 1	0.1450	0.5%	1.7%
Average	Larval Invertebrate 2	0.2470	0.3%	1.0%
Average	Larval Fish	0.1969	0.4%	1.3%

a/ Values based on average daily Coos Bay tidal water exchange rate of 114,250,000 m^3, and one LNG carrier water intake of 82,500 m^3 (low) and 263,800 m^3 (high). Assumes 100% mortality of entrained organisms.
b/ Sources: Invertebrates from Rumrill (1990), and fish from McGurk (1986).
c/ S= Survival, t=days, ln=natural log base e

Temperature Effects in the Marine Slip from LNG Carriers at the LNG Terminal

As previously discussed above for green sturgeon (section 3.5.1.3), the release of engine cooling water from LNG carriers at the terminal would result in warming the nearby water in the slip. Results of the earlier modeling by (CHE 2011) modeling showed that for typical ambient flow conditions at a distance of 50 feet from the discharge point (LNG carrier sea chest), temperatures from DFDE LNG carriers would not exceed 0.3°C (0.54°F) above the ambient temperature. This difference would decrease with further distance. Based on estimated slip volume this total heat could result in an average water increase for the total slip volume during one day when the vessel is loading would range from 0.03 to 0.06°F. Additionally, no temperature effects would extend beyond the slip due to the much larger water volume of Coos Bay.

However, the slight increase in water temperature in the slip due to the release of engine cooling water while the vessel is at terminal would be ameliorated by cooling of the slip water during cargo load, due to the fact that LNG is at a temperature of -260°F. There would be a heat exchange between the cold hull of the vessel and the surrounding slip water, as discussed for green sturgeon above.

The results of the 2011 modeling described above were supplemented in 2017 with additional thermal plume modeling to investigate the extent of the RMZ where cooling water discharge would be greater than 0.3°C above ambient (Moffatt & Nichol 2017e). The RMZ used in the temperature plume modeling is defined as the three-dimensional extent where water quality standards may be exceeded as long as acutely toxic conditions are prevented and fish habitat and other uses are protected. This modeling analyzed both steam turbine and DFDE LNG carriers with capacity of 148,000 m^3 and 170,000 m^3 , respectively. It also modeled cooling water discharges of 10 degrees to nearly 21 degrees Celsius into various ambient temperatures ranging from 8 degrees to 18 degrees Celsius and under constant and stratified salinity conditions. Results of the modeling showed that for typical ambient flow conditions the estimated water temperature of the discharged water would be up to about 2 to 3°C (3.6 to 5.4°F) warmer at the discharge port than ambient water temperature. The results indicated the maximum distance of the RMZ zone [(0.3ºC (0.54ºF) above the ambient temperature] from the port discharge point where the plume would reach this temperature was 80 and 37 feet for the steam turbine vessel and DFDE vessel, respectively (Moffatt & Nichol 2017f). Distance to achieve this temperature would be less under many environmental conditions. We expect the actual average increase in water temperature in the slip would be less than the higher value estimated due to tidal exchange and the vessel uptake of heat from its surroundings due to the transfer of liquid gas into the vessel at -260°F (-162°C).

It is unlikely that the water temperature of the slip would be greatly increased from the release of engine cooling water; therefore, effects on aquatic species in the bay are expected to be insignificant.

Fish and invertebrates are adapted to function over the normal range of conditions encountered in their environment. Moderate to large temperature increases have the potential to reduce fish and invertebrate growth, reproductive success, and if high enough cause direct mortality. Fish of the north Pacific, including those found in Coos Bay, are adapted to cool water conditions and could be adversely affected by sharp large increases in water temperature. Temperatures over about 24 to 26°C (75.2 to 78.8°F) would be considered lethal in the short-term (a few days) for salmonids (WDOE 2002). Mortality of juvenile salmonids starts to occur at constant exposure to temperatures above 71.6°F (Hicks 2000), with an acute lethal temperature of 78.4°F (Beschta et al. 1987), while optimum temperatures are much lower for salmonids, with preferred ranges generally between 50ºF and 59ºF for rearing juvenile coho salmon (Brett 1952; Reiser and Bjornn 1979; Jobling 1981; Konecki et al. 1995; McCullough 1999; Sullivan et al. 2000; Carter 2008). Juvenile coho salmon are taxed in the temperature range of 60.1ºF to 68.5ºF but are still capable of growing at a reduced rate (Stenhouse et al. 2012). Short-term local temperature increases would remain well below short-term adverse levels for salmonids, and any small changes in temperature including to the area within 80 feet of the discharge port would be easily avoided by fish. Therefore, the cooling water discharge should result in no adverse effect on coho from temperature changes. The temperature of the water in Coos Bay undergoes both seasonal and diurnal fluctuations. In December and March, the ocean and fresh water entering the estuary had similar temperatures, around 50°F (10°C). In summer, low stream flows results in a rise of temperatures in the bay, to above 60°F (15.6°C) in September at CM 8 (Roye 1979).

Therefore it is expected that water temperature in the terminal slip influenced by engine water releases from an LNG carrier at the terminal is not likely to cause adverse impacts to coho salmon. First, engine cooling water released into the slip would only slightly increase water temperature for a limited distance away from the vessel. Second, the slight increase in water temperatures from engine cooling water releases would be offset by cooling from contact with the hull of a vessel loading LNG. Third, the volume of water in the slip and exchanges during tidal cycles would further minimize temperature variations.

Effects of Lighting

Localized changes in light regime have been shown to affect fish species behavior in a variety of ways (Simenstad et al. 1999; Valdimarsson et al. 1997; Tabor et al. 2004; Nightingale and Simenstad 2001). Disorientation may cause delays in migration, while avoidance responses may cause diversion of migratory routes into deeper, less protected waters. In some cases, increased light may attract both predators and potential prey species (Simenstad et al. 1999; Valdimarsson et al. 1997; Tabor et al. 2004). Juvenile coho salmon show no response to moderately high light intensity, but become inactive in very low light (Hoar et al. 1957). Depending on their reaction, fish may have migration delayed, be moved into less protected deepwater habitat, or they may become more susceptible to predation, as light increases predators' ability to see fish and also may be attracted to the area.

Nighttime construction is likely to occur in the estuarine analysis area for in-water work activities such as dredging or placing revetment, as well as on-water activities such as receiving deliveries at the TMBB or MOF. Construction lighting would be designed, installed, and operated at a level that allows construction work to be completed safely and effectively while minimizing glare to surrounding areas. Construction lighting would be directed only to the surface waters of Coos Bay when necessary, in order to minimize impacts to aquatic organisms. Lighting for in-water work would be limited to the area around each vessel and the area of the in-water work. For example, during dredging, the area under the crane boom for clamshell dredging or derrick arm for cutter suction dredging would be lit. Lighting is anticipated to be a mix of fluorescent and sodium fixtures around the vessels (dredge, barges, tugs, and support vessels) with larger sodium or halogen lights shining on the work area (i.e., the water) under the crane boom or derrick of the suction dredge. Lighting for on-water work, such as barge or ship unloading, would be limited to the vessels and adjacent landing areas. Final marine construction lighting requirements would be subject to review and approval by the Coast Guard as part of the Construction Security Plan.

Lighting at the LNG Terminal would likely include a mixture of low-power fluorescent lighting and higher intensity security lighting that would primarily be located on shore, in and adjacent to the slip. When an LNG carrier is not in the berth, the lighting would be reduced to that required for security. It would be focused upon the structures and not be in proximity to the water so as to serve as an attractant or deterrent to fish species. No high intensity lighting would be present near the water except possibly during vessel docking. When an LNG carrier is at the berth, it would physically block the lighting on the berth from the slip waters and, due to its proximity to the slip wall, would block the fish from getting too close to the lighting on the berth.

Lighting on the tug dock would be low intensity lighting for safety, providing sufficient light for personnel movements on the trestle out to the tug berth and for movement on the berth itself. There is no intention to provide lighting near the water line or high intensity lighting that would be associated with activities other than the simple berthing of the tugs at this location. The reduced lighting levels near the water would reduce or eliminate any behavioral effects to fish in the Project vicinity. The final details of the lighting arrangement would be determined through consultation with resource agencies including FWS, NMFS, and ODFW to reduce potential adverse effects. Considering the limited distribution of the affected area, mitigation measures in place to reduce the light intensity, ample deep water adjacent to the affected area where fish could avoid lights at the LNG slip, and that final managing agencies approved plans would be in place to further minimize light on water areas, adverse effects to Oregon Coast ESU coho salmon are not anticipated.

Acoustic Effects from Construction and Operation

Underwater noise may affect coho salmon. Noise from construction of the LNG Terminal and related effects on aquatic species in Coos Bay were previously discussed for green sturgeon (section 3.5.1.3). During construction and operation, noise would be generated by:

- excavation and dredging of the slip and access channel;
- installation of the open cell sheet pile bulkhead at the LNG berth;
- installation of the piles to support the LNG berth and tugboat dock;
- installation of land-based mooring bollard piles at the MOF face;
- installation of temporary mooring piles at the TMBB;
- installation of temporary dredge transport pipelines to the APCO site, Kentuck project, and Eelgrass Mitigation site;
- Trans-Pacific Parkway/US-101 intersection temporary work bridges and permanent road widening;
- installation of temporary mooring piles for booster pump and off loader barges used for marine waterway modification dredging, APCO temporary work bridge piles, MOF fender piles;
- LNG carrier transit in Coos Bay; and
- general operations at the terminal.

These activities would generate underwater sounds pressure levels that could elicit some behavioral responses in aquatic organisms including fish. The number and locations of piling that would potential generate in-water noise is shown in tables 3.5.1-1a and 3.5.1-1b.

The Fisheries Hydroacoustic Working Group (2008), a group including the FWS, NMFS, and the states of Washington, Oregon and California, has established recommended interim criteria for protecting fish from noise generated by pile driving of a peak level of 206 dB and cumulative level of 187 dB (fish greater than two grams) and 183 dB (fish less than two grams).

Construction air noise levels for the LNG Terminal are expected to be similar to typical commercial structure construction programs, which average from 47 to 57 dBA at 2,000 feet in the air (H&K 1994). Noise levels 50 feet air distance from typical construction equipment (not including pile driving, or sheet wall installation) to be used at the site would typically range from about 70 to 90 dB (see table 3.3.2-1 in section 3.3.2, Western Snowy Plover). Typical noise generated from operation would be less. Considering that noise levels would be attenuated from this equipment into water, based on the interim NMFS criteria, levels of noise that could cause direct adverse effects to fish would be unlikely from typical equipment and future operations.

Land-based Pile

Underwater noise may also be generated by driving sheet piles on land (dry piles) since some noise propagates through ground and sediments (especially through harder substrates such as rock and clay), and may transfer to the water column somewhere else (known as sound flanking). Sound in the water column would be at a lower level than at the source (WSDOT 2019) because most sound energy does not travel through water but rather through the sediment. The potential effects of pile driving on land and in the water are discussed in detail in the green sturgeon section.

To summarize, injury to fish from peak sound pressure levels (206 dB in current guidelines) would occur up to 37 meters from the face of the MOF. Also, this study predicted that injury to both small (less than 2 grams) and large (greater than or equal to 2 grams) fish from cumulative sound exposure levels (183 and 187 dB respectively under current guidelines) would occur up to 1,723 meters from the shoreline. This distance was the same for both 10,000 and 20,000 total impact strikes because, in both cases, this was the distance when the noise attenuated to the sound level considered effectively quiet (150 dB). Under proposed guidelines (Popper et al. 2014), modeled distances to injury were considerably less, although the distance to TTS was the same – 1,723 meters. Based on the results of Wladichuk et al. (2018), installation of land-based piles at the MOF face would increase potential exposure of individual coho to underwater noise in an area encompassing the navigation channel from the MOF across the bay to the airport and southwest to the vicinity of Southport Lumber yard (figure 3.5.1-2). These noise thresholds could be reached during pile driving of the 8 mooring bollards at the MOF that would take approximately 14 days to install and the 28 east mooring piles at the LNG berth that would be installed after the berm is breached. These 28 piles would take approximately 8 days to install. Individual fish occurring in this area during pile driving could experience physiological effects sufficient to cause injury. Sheetpile installation away from the water edge using vibratory hammer would not reach noise levels in the range of those noted above to cause harm to fish other than possibly at worst a few feet (<10 ft) from shore (data from Deveau and MacGillvray 2017 using NMFS [2009f] model).

Land-based pile driving at the MOF shown to generate injury-level in-water noise would be limited to the approved in-water work window, which is October 1 through February 15. This window would minimize risk of physical injury or disturbance to individual Oregon Coast coho that may occur in the Project vicinity during construction.

In-water Pile

In addition to the large number of piles that would be driven on land, a smaller number of piles would be driven in the water column using primarily a vibratory hammer at various locations (table 3.5.1-1) (e.g., TMMB, APCO site, etc.) that could create temporary noise levels sufficient to cause physical injury within approximately 300 feet of pile driving activities (table 3.5.1-2). For impact pile driving, fish would experience physical injury within 40 feet (12 meters) from peak sound pressures. Physical injury from cumulative sound exposure levels would occur within 1,712 feet (522 meters) for larger fish (greater than or equal to two grams) and within 2,415 feet (736 meters) for smaller fish (less than two grams) (table 3.5.1-3). Figures 3.5.1-2 and 3.5.1-3 show the physical extent of underwater noise disturbance and injury thresholds measured above. These distances assume no sound attenuation (e.g., bubble curtain, cushion blocks, etc.). In-water pile driving would be limited to the approved in-water work window for the Project, which is October 1 through February 15. This window would minimize potential interaction with Oregon Coast coho juvenile rearing and outmigration through the estuary.

Also, there would be 1,150 wood piles and sheetpiles constructed at the Trans Pacific Parkway/US-101 intersection widening. These may be installed above or below water level depending on tide level. The methods for wood pile installation are unknown, but sheetpile would be installed by vibratory hammer with an impact hammer being used if necessary. One report measured peak values of 180 dB 10 meters from wood piling when using an impact hammer (Illinworth and Rodking 2007). Data are not available on noise level from a vibratory hammer on wood; but vibratory hammer noise levels are generally much lower at peak noise production compared to an impact hammer. With the number of pilings to be installed, the frequency of piling contacts would be high. There is some risk of cumulative noise levels associated with wood piling being an issue if peak noise values were near 180 dB. Jordan Cove has indicated that an impact hammer would not be used on sheet piles if they were inundated by high tides; implementation of this commitment would reduce the effects of cumulative and peak noise levels on fish.

Conservation measures that would be considered include sound attenuation and timing of impact hammer use (seasonal and/or daily timing restrictions) to minimize risk of physical injury or disturbance to individual Oregon Coast coho that may occur in the Project vicinity during construction.

Operation

For vessel traffic and dredging activities, the intensity of the sound pressure levels can vary considerably. However, sound pressure levels are generally in the range of 112 to 160 dB, intensities that may influence organism behaviors or perceptions but are not great enough to cause physiological damage (Richardson 1995; Hastings and Popper 2005; Fisheries Hydroacoustic Working Group 2008).

It is expected that LNG carrier noise in Coos Bay would be less than in the marine analysis area as vessel speed would be greatly reduced, which affects the magnitude of sound levels. In the Hatch et al. (2008) study, an LNG carrier during travel produced sound levels (with one standard error) of 182 ± 2 dB re: 1 µPa at 1 meter that attenuated to 160 dB at 35 ± 11 meters and to 120 dB at 16,185 ± 5,359. Other than possibly values within one meter (3.3 feet) of the vessel hull, these are all values less than the current interim noise levels for fish noted above. Some dredging activities may generate noise levels that may be harmful to very small fish close to the activity. Fischer (2004) noted dredging source dB levels of 172 and 185 at one meter (3.3 feet) from the dredge. The upper range of these values exceeds the interim noise criteria for small fish (those less than two grams). Small fish very near the dredging (within about a meter) may be harmed if they remained in the area for a period of time. Initial slip dredging would involve some sediment removal from shallow water but maintenance dredging would occur in the deepest channel areas where very few, if any, juvenile coho salmon would be present. Since dredging would occur during a period of low fish abundance, with few rearing juvenile coho present, it is expected coho salmon would rarely if ever be in a zone considered directly hazardous from noise levels.

Generally, response to noise impacts would be behavioral and perceptual, and not physiological in nature, as fish would tend to avoid the area during periods of high noise output. Underwater noise generated during on land construction and operation, ship noises from LNG carriers within the estuarine analysis area, and construction and maintenance dredging in Coos Bay are all not expected to adversely affect coho salmon. It is expected that construction and operations noise would have slight short term adverse effects on aquatic resources including Oregon Coast coho salmon.

Habitat and Food Source Effects – Slip and Access Channel, Pile Dike Rock Apron, and Marine Waterway Modification Sites, and Propwash

The construction of the LNG Terminal marine slip and access channel would impact local aquatic resources by removal or conversion of some habitats (table 3.5.1-4). About 36.7 acres of current upland habitat would be converted to open water, primarily deep subtidal habitat, during construction of the marine slip. Development of the LNG Terminal access channel, TMBB, and MOF would affect about 34.0 acres of estuarine habitat. About 14.5 acres of intertidal to shallow subtidal habitat, plus 1.9 acres of eelgrass habitat and 0. 1 acre of salt marsh, would be permanently modified to primarily deep subtidal habitat during the dredging process of the deepened channel.

The construction of the proposed marine slip, pile dike rock apron, and access channel would impact local aquatic resources by removal or conversion of some habitats. The pile dike rock apron would permanently convert approximately 2.3 acres of former estuarine soft bottom habitat (eelgrass, intertidal, subtidal, etc.) into angular rock. This change in habitat would create a variety of effects to listed fish species, including providing new substrate for seaweeds that can provide cover, providing potential habitat for predators (particularly in subtidal areas), and interrupt normal shoreline drift processes by acting like a groin. Use of riprap in the proposed marine slip would have no significant impacts to listed fish. There would also be short-term turbidity from dredging in the bay, and additional erosion of the shoreline during construction activities could result in sedimentation. To control soil erosion and potential sedimentation, Jordan Cove would follow the measures outlined in its ESCP.

Eelgrass habitat supplies a diverse habitat for fish (Murphy et al. 2000) and is thought to supply salmon fry with food and cover from predators (Simenstad 1987 and 1994). Generally, increases in eelgrass are considered to result in increases in juvenile salmon, including coho salmon (Plummer et al. 2012). Eelgrass is an important ecological component in Coos Bay affecting many species. For example, submerged aquatic grasses are important habitat for small prey species of adult lingcod (in Appendix B-2 of PFMC 2008). Submerged grass meadows provide cover and food for a large number of organisms including burrowing, bottom-dwelling invertebrates; diatoms and algae; herring that deposit eggs clusters on leaves; tiny crustaceans and fish that hide and feed among the blades; and, larger fish, crabs and wading birds that forage in the meadows at various tides. Eelgrass provides shelter for a variety of fish and may lower predation, allowing more opportunity for foraging. The protective structure attribute of eelgrass is primarily for smaller organisms and juvenile life history stages of fishes. Previous studies (Akins and Jefferson 1973) have reported that Coos Bay has 1,400 acres of lower intertidal and shallow subtidal flats covered by eelgrass meadows. Permanent eelgrass impacts at the access channel and other facilities would affect less than 1% of the estimated total area where eelgrass was detected in lower Coos Bay. This impact would result in an unnoticeable and extremely localized, short-term loss in forage food available for coho salmon. Located south of the impact site, the mitigation site would be created within an existing eelgrass bed to replace the narrow band of eelgrass habitat lost at the impact site. The mitigation site would take several years to develop, but it would result in a long-term benefit to eelgrass, listed fish, critical habitat, and EFH.

Dredging at the four marine waterway modifications sites would take place in deep subtidal habitat used by benthic organisms, macroinvertebrates, and demersal fishes (e.g., worms, clams, crustaceans, mollusks, flatfish, and Pacific sand lance) some of which serve as prey to green sturgeon. Entrainment from dredging could injure or kill these and other bottom-dwelling species that have limited mobility and move, rest, find shelter, and feed within the dredge prisms for these areas.

The marine waterway modifications sites are located entirely within deep subtidal habitats along the Federal Navigation Channel. Such habitat is less productive than shallow subtidal and intertidal habitats. Furthermore, the Federal Navigation Channel is subject to periodic dredging and propeller scour which can disturb the associated benthic community. Impacts to bottom-dwelling marine life where dredging is planned at the marine waterway modifications sites, LNG terminal slip, and access channel, therefore, are expected to occur over a short-term duration. When benthic communities on mud substrates have been disturbed by dredging in Coos Bay, they typically recovered to pre-dredging conditions within 4 weeks (McCauley et al. 1977, as cited in Wilber and Clarke 2007). However, recovery in estuarine channel muds has been reported in a review paper of dredging to be typically six to eight months (Newell et al. 1998). In the lower Columbia River, McCabe et al. (1997, 1998) noted benthic organism recovery in three months. Studies of a dredged sandy substrate area in Yaquina Bay Oregon found recovery of benthos took one year (Swartz et al. 1980, as cited in Wilber and Clarke 2007). Because of the large quantity being dredged and type of substrate, it may take longer than a four-week period relative to typical dredging and thus the benthic communities in the areas to be dredged may take a more varied time period to recover. The similarity of sandy substrate, like that of Yaquina Bay, suggest it is likely that recovery would be closer to a year for benthic resources particularly in the navigation channel modifications. While it is anticipated that affected areas would partly recolonize by similar species within a month or two following dredging, complete recovery could be closer to a year and with the relative composition among species likely altered over the near term.

Direct mortality or injury from dredging is not expected for most pelagic fishes due to their swimming ability and behavioral tendency to avoid disturbance. Dredging could affect other bottom-dwelling fishes, however, such as Pacific sand lance (*Ammodytes personatus*) which frequently inhabit sands and fine-grain sediments for rest and predator avoidance. Sand lance are an important prey species for many marine mammals, birds (including MAMU), and fishes (including Pacific salmon and green sturgeon). While sand lance could be subject to mortality or injury from proposed dredging, the timing and extent of their presence in the lower bay at the NRI sites has not been confirmed.

The dredging operation would change physical conditions of the bottom, locally altering the bathymetry and potentially altering the morphology and water currents. Benthic and epibenthic invertebrates that presently inhabit shallow intertidal and subtidal regions within the boundaries of the access channel would be removed with the dredged material. Ghost shrimp and sand shrimp (adults, juveniles and larvae), amphipods, clams, Dungeness crab, and various fish species are important prey for Oregon Coast coho. Therefore, the loss of invertebrates and vertebrates at the access channel would result in a reduction in fish food available to coho salmon in those areas affected by the Project in the short-term. However, the resulting deeper, less diverse habitat would likely be less productive for benthic food sources, and juvenile coho salmon are less likely to forage on benthic resources at these deeper depths. As noted above the CHE (2011) modeling indicated during LNG transit, bottom disturbance from high bottom velocities would occur. This could result in some benthic organisms (potential coho salmon prey) being disrupted and some sediment would be moved during arrival and departure. Mobile organisms (e.g. crabs, shrimp) would be able to return to the region, while some benthic organisms may be permanently displaced.

Turbidity would likely be slight due to the coarse characteristics of the navigation channel sediment that is resistant to current induced suspension. Overall, some loss of benthic organisms may occur from LNG carrier propwash during each transport trip near the slip approach, but the magnitude would be small and likely less than currently occurs under each existing large vessel trip. The CHE (2011) report also modeled velocities and likely effects on sediment scour at the docking facility from the tugboat pushing of vessels to the terminal. Assuming very high power use by the tug to dock the LNG carrier, the model estimated maximum velocity on the far bank (about 275 feet from the propeller) would be mostly less than 2.0 ft/sec, which would be unlikely to erode the bank. Furthermore, this area would be armored so no erosion would occur. Near the bottom, maximum velocity in the docking channel would be about 2.16 ft/sec. Sediment analysis suggests that over 95 percent of the bottom material (mostly silt/clay size) in the docking channel would be susceptible to suspension at this velocity. The report also estimated that bottom scour would be limited to about two inches over a limited bottom area (approximately 100 by 50 feet) in the docking channel. Some bottom disturbance would likely occur during docking. In most cases, this disturbance is likely to be much less than estimated because of the conservative assumptions used for this model. An updated propwash memo (Moffatt & Nichol 2017d) included modeling the use of ship engines and tug assist for berthing and unberthing in the marine slip area. The effects of propwash from LNG carriers and related tugboat vessels on bottom erosion and turbidity likewise would not reach levels to cause substantial disruption to benthic or pelagic resources other than in the immediate access channel and slip area. Scour depths were estimated to be nearly 0.5 foot due to propwash near the eastern side of the Access Channel and the Slip if there is no slope protection installed. Overall, about 12 acres of bottom could be scoured to a depth over 0.2 foot.

Overall, while some sessile benthic and fewer mobile organisms may be displaced during boat transit in the main channel and landing within the docking channel, the limited occurrence and magnitude of bottom disturbance and sediment suspension would result in unsubstantial area organism effects and therefore no marked reduction in potential food sources for Oregon Coast coho.

Because most juvenile coho are not present in Coos Bay until the spring outmigration period, and dredging would occur in fall to winter, many benthic food organism would be recovered in the dredged area prior to their arrival, limiting effects of organism loss to coho salmon. However, because of the large quantity being dredged and increased depth, it may take a longer period relative to typical dredging.

Although the substrate proposed for maintenance dredging in the access channel and berth would largely be sand and silt, it is anticipated that recovery would occur within a similar although possibly longer time frame than for Coos Bay mud substrate recovery. This likely would result in short-term adverse effects to the benthic community and potential food resources for Oregon Coast coho salmon. Potential long-term effects of habitat modification would be offset by replacement of shallow water habitat, including eelgrass beds, in other portions of the Coos Bay (see section 3.5.4.4, Conservation Measures).

Shading Effects

Shading from over-water structures reduces the amount of light available to phytoplankton and aquatic macrophytes. However, the area where shading LNG Terminal facilities would occur is intended for industrial uses and not the creation of new habitat. The general habitat in the slip's region would not be conducive for many marine resources because of depth and steep rip/rapped armored banks, so relatively few resources would likely utilize this newly created area. The water areas within the slip are being created from upland areas and therefore shading of currently un-shaded habitat would occur, and no net loss in productivity due to shading would occur. Project components that potentially could shade the new open water created by the construction of the slip include:

- The tug dock would be built over an open water portion of the newly developed slip and it would generally be about 470 feet long by 18 feet wide, connected from shore by a pile-founded trestle.
- Floats for mooring and accessing the security vessels, which would be 360 feet long by 8 feet wide.

Most fish, including coho salmon, have developed countershading as an adaptation to avoid predation (Moyle and Cech 2000) from above (dark dorsal surface blends with bottom substrate) and from below (light ventral surface blends with light from the surface). Fish within a shaded area would be more easily detected by a predator, especially from below because light colored ventral surfaces would stand out against a shaded water surface. Predation potential by fish is a concern, based on some observed fish behavior (Nightingale and Simenstad 2001). However actual increased occurrence in predator numbers from even substantial overwater structures has rarely been documented. Additionally review of many marina and pier studies have not documented actual increased predation at these facilities (Nightingale and Simenstad 2001). For example, marine marina studies have found no documentation of increased concentrations of juvenile salmonid predators and some predators such as birds may be of lower abundance than under natural shoreline conditions (Cardwell et al. 1980, and Heiser and Finn 1970, as cited in NMFS 2005c). The extent to which any of these predators affect juvenile or adult coho salmon in shaded areas created by the proposed action is unknown, however, the probability of this occurring is low since facilities would shade less than one percent of the slip surface area and the dock is located at the north side of the slip.

<u>Kentuck and Eelgrass Mitigation Sites</u>

There would be short-term localized impacts to aquatic resources to construct the Kentuck project and Eelgrass Mitigation site. Kentuck project construction activities would include transporting dredge material into the site and earthwork and civil infrastructure improvements to re-establish a connection with Kentuck Inlet and Coos Bay. Dredge material is currently proposed to be unloaded and hydraulically transported into the site through a Temporary Dredge Transfer Line from a Temporary Dredge Off-Loading Area located as close as possible to the site in a minimum 20 feet of water depth. The Off-Loading Area could include a hydraulic unloader on a deck barge, mooring/fleeting barges, and booster pump(s). The number of temporary piles and/or spuds required to moor barges would vary depending on actual equipment and configuration. Intake water for offloading operations may be drawn through self-cleaning fish screens sized to minimize fish entrapment. Infrastructure improvements would include: constructing a new bridge in East Bay Drive to allow tidal exchange between Kentuck Inlet and the Kentuck project; improving the existing dike separating the site from Kentuck Slough; constructing a new muted tidal regulator (i.e., a “fish-friendly” tide gate) in the upper portion of the Kentuck project to redirect a portion of Kentuck Slough flows into the Kentuck project; and raising the profile of East Bay Drive and approximately 1,900 lineal feet of Golf Course Lane to be above the zone of tidal influence. A fish-friendly culvert or other structure would be constructed within Golf Course Lane to allow passage into the drainage above the former golf course irrigation sump pond. The earthwork and the majority of the infrastructure construction activities would be isolated from Kentuck Slough, Kentuck Inlet, and Coos Bay. Construction of the East Bay Drive bridge and muted tidal regulator would require in-water work and isolation measures. The new bridge and tide gate would be designed to meet ODFW and NMFS fish passage requirements. Jordan Cove would continue to work with both agencies, as the designs progress, to address fish passage without impacting the current influx of salt water on adjacent properties. There would be a short-term increase in turbidity into Kentuck Inlet and Coos Bay when the connection is reestablished to the bay and while the site equilibrates.

As part of the Eelgrass Mitigation site, a shallow-water hydraulic dredge is proposed to be used to lower areas that are currently too shallow to support eelgrass. A temporary dredge line would connect the dredge and temporary loading area, which would be located as close to the site as possible in a minimum 20-foot water depth. The loading area is proposed to include deck barge, transport barges/scows and tug boats. As noted above, the number of temporary mooring pile and/or spuds would depend on equipment and configuration. Construction would occur during the ODFW in-water work window. Construction of the mitigation site would likely result in direct mortality of marine organisms and would temporarily elevate turbidity levels from dredging. The resulting habitat increase from the Eelgrass Mitigation site would provide benefits to the fish and marine organisms that utilize this habitat overall by increasing the natural cover and forage production in Coos Bay. It is likely that the increased habitat would offset the losses from the LNG Terminal site.

Suspended Sediment – HDD across Coos Bay Estuary and Coos River

Coos Bay would be crossed by two HDDs, one from MP 0.28 to MP 1.00 (West HDD), the other from MP 1.46 to MP 3.02 (East HDD). The Coos River (a tributary to the estuary) would also be crossed using HDD at MP 11.13. At that location, the Coos River is under tidal influence and is addressed here in the estuarine analysis area rather than in the riverine analysis area. The details of methods of construction, likely release of drilling fluid, potential effects on turbidity and sediment and procedures in place to prevent and mitigate potential spills are presented in section 3.5.1.3 (North American Green Sturgeon).

Inadvertent Release of Drilling Muds (Inadvertent Return)

The HDD installation method, general mitigative actions, and effects to coho salmon are discussed above under SONCC coho salmon in section 3.5.4.3 and would be the same for Oregon Coast coho salmon ESU where HDD are used. HDD crossing would occur in the Coos Bay estuary, and discussed under green sturgeon and the Coos River where this ESU may be present.

Overall, at the site of any inadvertent return, the amount of drilling mud released into a waterbody would be low. The HDD locations on the Coos Estuary and on the Coos River have a large volumes of water and swift flows, where the drilling mud would be diluted. If an inadvertent release of drilling mud from an HDD occurred on the Coos River, it would be expected to have minor short-term adverse effects to aquatic resources including coho salmon.

Direct and Indirect Effects – Riverine Analysis Area

The Pipeline would cross 43 waterbodies that are known or presumed to be inhabited by the Oregon Coast coho salmon ESU (see table 3.5.4-2, above). Outside of Coos Bay, the Pipeline would cross 116 of the waterbodies in table 3.5.4-4 (summarized below in table 3.5.4-15). Effects by the Project could occur to freshwater, in-water construction activities, terrestrial/riparian habitat modification, accidental spills or leaks of hazardous materials, and periodic maintenance of the Pipeline. Construction of the Project could directly and/or indirectly affect Oregon Coast coho salmon and critical habitat through one or more of the following pathways:

1. interference with key life history functions;
2. acoustic shock from blasting pipe trench through bedrock streambeds;
3. underwater noise produced during use of a track hoe or impact hammer if fish are proximate to the construction site;
4. suspended sediment (turbidity) generated during pipeline construction across waterbodies can adversely affect coho;
5. inadvertent release of drilling mud during HDD construction;
6. movement blockage during in-stream construction;
7. salvage of fish that are entrained and/or entrapped;
8. removal of riparian vegetation ;
9. streambank erosion, bed stability and crossing unstable slopes;
10. effects to aquatic habitats including freshwater stream invertebrates;
11. hydrostatic testing and risk of test water entering streams;
12. introduction and/or redistribution of aquatic nuisance species;
13. mobilization of contaminated substances;
14. accidental release of fuels and entry of other petroleum products into surface waters;
15. risk of channel migration, avulsion, widening, and/or streambed scour;
16. effects to hyporheic exchange and hyporheic zones;
17. run-off from new permanent access roads, new temporary access roads, existing access roads and temporary extra work areas;
18. application of herbicides to control noxious weeds near waterbodies.

TABLE 3.5.4-15

Proposed Pipeline Construction Methods for Crossing Waterbodies within Subbasins and Fifth-Field Watersheds Coinciding with the Proposed Pipeline Route and Coho in the Oregon Coast ESU

Subbasins and Fifth-Field Watersheds	Number of Waterbodies with Construction Method							
	HDD or Direct Pipe	Bore	Wet Open-Cut	Diverted Open-Cut	Dry Open-Cut: Fluming	Dry Open-Cut: Bedrock a/	Total Crossed	Adjacent Not Crossed b/
Coos Subbasin								
Coos Bay-Frontal Pacific Ocean	3				10	0	**13**	6
Coquille Subbasin								
North Fork Coquille River					7	0	**7**	1
East Fork Coquille River					9	4	**13**	1
Middle Fork Coquille River					15	1	**16**	3
South Umpqua Subbasin								
Olalla Creek-Lookingglass Creek					12	5	**17**	1
Clark Branch-South Umpqua River	1				9	3	**13**	9
Myrtle Creek					11	3	**14**	0
Days Creek-South Umpqua River				1	9	5	**15**	4
Upper Cow Creek					7	1	**8**	3
TOTAL	**4**	**0**	**0**	**1**	**89**	**22**	**116**	**28**

a/ Bedrock streambeds would be crossed by dry open-cuts but may require special construction techniques to ensure pipeline design depth including rock hammering, drilling and hammering, or blasting. The need for blasting would be determined by the contractor and would only be initiated after ODFW blasting permits are obtained.
b/ Waterbodies within the construction right-of-way that would not be crossed.

All affected waterbodies within the three subbasins and nine fifth-field watersheds that are within the range of Oregon Coast coho salmon ESU proximate to the Pipeline are included in table 3.5.4-15. There are 144 waterbodies included in the table, of which 55 are perennial, 83 are intermittent, three are estuarine (Coos Bay crossed twice and the Coos River), and three others are ponds, not crossed (see table 3.5.4-4, above).

Dry open cuts using a flume would be utilized at 89 crossings if water is present at the time of construction, while the South Umpqua River would be crossed twice, once by a Direct Pipe (DP) technology at MP 71.3 and again by a diverted open cut at MP 94.7. Twenty-eight of the waterbodies summarized in table 3.5.4-13 would not be crossed by the Pipeline but are adjacent to the centerline and within the construction right-of-way. Blasting may be necessary to construct across 22 streams that would be crossed by dry open-cut because the streambed of each is bedrock (see tables 3.5.4-4 and 3.5.4-15). The details of each of the crossing methods indicated as used in table 3.5.4-15 are summarized in the EIS section 2.4.2.

Timing to Life History Functions

Within the range of Oregon Coast coho ESU, Pacific Connector would avoid constructing across fish-bearing streams during periods of sensitive fish use. This construction window would typically occur in periods of lower flow rates in streams. The ODFW (2008) in-stream construction window for coastal tributaries, the Coquille River and tributaries, and tributaries to the South Umpqua River is July 1 to September 15. In-stream work within the South Umpqua River mainstem is permitted from July 1 to August 31.

In general, construction of the Pipeline would be timed to miss periods of major juvenile or adult migrations in freshwater based on allowed fishery construction windows, typically July 1 to mid-September for most streams, and some other dates for specific waterbodies. Timing of in-water work in aquatic habitats within the Coquille and South Umpqua subbasins would generally coincide with low flows and high water temperatures during summer and early autumn, discussed above in section 3.5.4.2 (see figure 3.5.4-4, Coos subbasin; figure 3.5.4-5, Coquille subbasin; and figure 3.5.4-6, South Umpqua subbasin). The in-stream construction windows could coincide with upstream adult migration by coho. Construction across waterbodies within the Coquille and South Umpqua subbasins would be completed before spawning (see figure 3.5.4-1). However, juvenile coho would be present and migrating adults might be present within waterbodies flowing at the time of construction. Juveniles rear for about 15 months in freshwater before migrating as smolts in spring to the ocean. Consequently, juveniles present would likely be limited to juvenile pre-smolts that are several months old from the current year's emergence.

Acoustic Shock

There are 22 waterbodies within the Oregon Coast coho ESU where shallow bedrock may occur where potentially necessitating blasting and/or mounted impact hammers be used to construct a trench through bedrock substrates (see table 3.5.4-4, summarized above in table 3.5.4-15). Of these streams only 15 are known or assumed to support Oregon Coast coho: three in the East Fork Coquille watershed (tributary to East Fork Coquille River at MP 28.9, tributary to Elk Creek at MP 32.4, South Fork Elk Creek at MP 34.5); five in the Olalla Creek-Lookingglass Creek watershed (tributary to Shields Creek at MP 56.3, tributary to Olalla Creek at MP 57.1, tributary to Olalla Creek at MP 58.6, tributary to McNabb Creek at MP 60.1, McNabb Creek at MP 60.5); two in the Clark Branch-South Umpqua River watershed (Rice Creek at MP 65.8, Willis Creek at MP 66.9); three in the Myrtle Creek watershed (North Myrtle Creek at MP 79.1, tributary to North Myrtle Creek at MP 79.2, South Myrtle Creek at MP 81.2); and two in the Days Creek-South Umpqua River watershed (Fate Creek at MP 88.5, Days Creek at MP 89.6).

Explosives detonated near water produce acoustic shock waves that can be lethal to fish, eggs, and larvae by rupturing swim bladders and addling egg sacs (British Columbia Ministry of Transportation 2000). Explosives detonated underground produce two modes of seismic wave:, 1) body waves that are propagated as compressional primary (P) waves and shear secondary (S) waves; and 2) surface waves produced when a body wave travels to the earth surface and is reflected back (ADFG 1991). Acoustic shock waves propagated from ground to water are less lethal to fish than those from in-water explosions because some energy is reflected or lost at ground-water interface (ADFG 1991). Peak overpressures as low as 7.2 psi produced by blasting on a gravel/boulder beach caused 40 percent mortality in coho salmon smolts. Other studies revealed 50 percent mortality in smolts with peak overpressures ranging from 19.3 to 21.0 psi (ADFG 1991).

In 1991, the ADFG established a standard for blasting effects to anadromous fish that limited blast-induced overpressures in the water column. ADFG (1991) reported that a pressure change of 2.7 psi is the level for which no fish mortality occurs. ADFG (1991) calculated the straight line distances for a single shot explosive charge of given weight through rock and other materials to dissipate to an overpressure standard of 2.7 psi (non-lethal pressure for anadromous fish). Typical trench blasting scenarios use multiple 1- to 2-pound charges separated by an 8-millisecond delay to excavate the trench. With use of 1- to 2-pound charges in rock, the setback distance (at which

2.7 psi would occur) from the blast trench to the fish habitat is between 34 and 49 feet (see Table 3 in ADFG 1991).

New research (Dunlap 2009) and an in-depth review (Kolden and Aimone-Martin 2013) of empirical studies of the physiological effects of blasting on adult salmonids and embryos prompted ADFG to revise the blasting standard (Timothy 2013):

> *The instantaneous pressure rise in the water column in rearing habitat and migration corridors is limited to no more the 7.3 psi where fish are present. Peak particle velocities in spawning gravels are limited to no more the 2.0 in/s during the early stages of embryo incubation before epiboly is complete.*

Application of the new standard for 7.3 psi in equations in ADFG (1991) was used to derive setback distances from water for 2-pound charges in rock. Based on these calculations, a distance of about 26 feet would result in the avoidance of adverse effects to salmonids in water. The setback distance used in Pacific Connector's *Fish Salvage Plan* (appendix T) added 25 feet to each side of the construction right-of-way, totaling at least 50 feet from the blasting location at the trench. Application of the new ADFG blasting standard for a 2-pound charge in bedrock would indicate that the current setback distance is more than adequate to ensure that any blasting that does occur would not adversely affect ESA-listed coho salmon and other salmonid species.

Several approaches have been suggested to reduce risk of injury or mortality to fish in closest proximity to blasting locations (Wright and Hopky 1998):

- deployment of bubble curtains/air curtains to disrupt the shock wave;
- deployment of noise generating devices, such as an air compressor discharge line, to scare fish away from the site; or
- removal or exclusion of fish from the work area before the blast occurs.

To reduce impacts on resources, Pacific Connector developed a *Blasting Plan* (see Appendix C to the POD [appendix B to this BA]) with measures that incorporate many of these recommendations. Pacific Connector would attempt to minimize acoustic shock waves from blasting that may affect aquatic resources by the types of explosives selected, the size of charges, and the sequences of firing. The details of specific site blasting actions would be determined in coordination with managing resource agencies.

Prior to any blasting, proper permits would be obtained and agencies notified as required by permits.

Estimates of juvenile coho present in at crossing sites in streams were based on the following assumptions: 1) all rights-of-way are 95 feet wide at each stream crossing within which coho would be salvaged, and 2) coho would be excluded from an additional 50 feet (a total of 145 feet of stream length) from the right-of way edges (25 feet from each edge) so total stream length where fish would be salvaged at potential bedrock crossings is 145 feet. Numbers of juvenile coho fry potentially present or assumed to be present in the streams with bedrock substrates are provided in table 3.5.4-16. Construction of the Pipeline through bedrock at those streams is likely to require blasting and the estimates in table 3.5.4-16 represent numbers of juvenile coho fry (287 juveniles expected) that could be displaced and or salvaged prior to blasting. The estimates in table 3.5.4-16 are based on no fish being herded out of the work area prior to dewatering (see *Fish Salvage*

Plan). The actual number that would be salvaged is expected to be much less. Fish salvaged at other non-bedrock stream crossings is discussed below under *Entrapment and Fish Salvage*.

TABLE 3.5.4-16

Worst Case Estimates of Juvenile Coho Fry Present or Assumed as Present at Streams with Bedrock Substrates and Juveniles Salvaged Prior to Blasting During Construction of the Pipeline Project within the Oregon Coast ESU

Subbasin and Fifth-Field Watersheds	Dry Open-Cut w/ Juvenile Coho Fry Present	Juvenile Fry Present at Each Crossing a/	Total Juvenile Fry Present b/	Juvenile Fry Salvaged at Each Crossing c/	Total Juvenile Fry Salvaged d/
Coos					
Coos Bay-Frontal Pacific Ocean	0	N/A	0	N/A	0
Coquille					
North Fork Coquille River	0	N/A	0	N/A	0
East Fork Coquille River	3	61	184	40	184
Middle Fork Coquille River	0	N/A	0	N/A	0
South Umpqua					
Olalla Creek-Lookingglass Creek	5	9	45	6	45
Clark Branch-South Umpqua River	2	11	22	7	22
Myrtle Creek	3	11	32	7	32
Days Creek-South Umpqua River	2	8	16	5	16
Upper Cow Creek	0	N/A	0	N/A	0
TOTAL	**15**		**287**		**287**

a/ Juvenile Fry Present at Each Crossing based on Juveniles per Mile (see table 3.5.3-6) within a stream crossing length of 145 feet (95 feet construction right-of-way plus an additional 25 feet on each side, a worst case, see text).

b/ Total Juvenile Fry Present (worst case) = number of Juvenile Fry Present at Each Crossing multiplied by number of Dry Open-Cut crossings with potential for blasting and with Juveniles Coho Present.

c/ Juvenile Fry Salvaged at Each Crossing based on Juveniles per Mile (table 3.5.4-7) within a stream crossing length of 145 feet (worst case, see text).

d/ Total Juveniles Salvaged (worst case) = number of Juvenile Fry Salvaged at Each Crossing multiplied by number of Dry Open-Cut crossings with blasting and Juvenile Coho Fry Present. The estimate is based on no fish being herded out of the work area prior to dewatering (see *Fish Salvage Plan* in appendix T). The actual number that would be salvaged is expected to be much less.

Underwater Noise

Dry open-cut construction, more than likely dam-and-pump methodology, would be used at sites where blasting and/or mounted impact hammers would be required to construct a trench through bedrock substrates. Impulsive type sounds, sound generated by pile driving for example, create stress waves in the piling material that radiate sound through the surrounding media of substrate, air, and water and may propagate outward from the source through bottom sediment (Popper and Hastings 2009). Various studies have reported fish mortality, physical injury, auditory tissue damage, decreased viability of eggs, and decreased larval growth due to noise, mostly explosive blasts, seismic survey blasts, and air gun blasts (Hastings and Popper 2005). State agencies in Washington, Oregon, and California along with federal agencies have developed interim noise exposure threshold criteria for pile driving effects on fish (WSDOT 2019; Fisheries Hydroacoustic Working Group 2008; Popper et al. 2006; and see discussion above in section 3.5.3.3 for coho salmon SONCC ESU). The threshold noise levels are assumed to be applicable to noise from a mounted impact hammer operating on bedrock substrates for 15 waterbodies potentially affected by the Pipeline Project in the Coos, Coquille, and South Umpqua subbasins (see table 3.5.4-14, above).

Average maximum noise produced by mounted impact hammers due to impact on substrates (e.g., rock) has been reported at 90 dBA from 50 feet away in the air (see Table 7-4 in WSDOT 2019). Using a simplified conversion of dB between air and water (see footnotes and discussion above in section 3.5.3.3 for coho salmon SONCC ESU) the noise produced by the impact hammer in air would be equivalent to about 182 dB re: 1 µPa @ 1 meter in water (see section 3.5.3.3 above for source impact hammer dB value). However, there is no information available to determine whether that noise level would be equivalent to peak sound levels or RMS levels, which are the basis for evaluating potential harm to fish, particularly related to cumulative sound exposure levels caused by multiple impact hammer strikes. However using the most conservative criteria (cumulative levels which assume multiple impacts over a short period), impact hammer values of 182 dB are at the limit of the current criteria considered to cause harm (183 dB; see section 3.5.3.3 above).

Further, the estimate of noise produced by in-water use of an impact hammer in any waterbody would be influenced by water currents, water depth, and bottom material and topography, as well as configuration and materials of the river banks. The effects of these factors are unknown (WSDOT 2019). However, noise propagation in any waterbody, upstream and downstream from the construction site would be limited by the stream channels' sinuosity since the propagation is limited to straight-line distance from the source (WSDOT 2019). Noise produced by impact hammers would be much reduced if construction does not occur within the water column, similar to reduction set back distances from the blast trench to the fish habitat to reduce blast overpressures to below 2.7 psi, discussed above.

Sounds produced by a mounted impact hammer operating in dry conditions might be conducted through bedrock substrate to approach the hearing threshold of fish, as for example the Atlantic salmon, which is around 90 dB re: 1 µPa (see Figure 3 in Hastings and Popper 2005). It is assumed that salmonids in the Pipeline Project area at the time of construction would have hearing thresholds similar to Atlantic salmon. With that assumption, listed and non-listed salmonids present at the time of construction might detect the noise produced by an impact-hammer striking bedrock, but the noise is not expected to be of sufficient intensity to cause them injury as would SELs produced by pile driving.

When using the dam-and-pump stream crossing methodology, the typical right-of-way distribution of an isolated streambed (dry open-cut) would be no less than 25 feet on one side of the pipe trench and 50+ feet on the opposite side of the pipe trench depending on whether it is a 75- or 95-foot-wide crossing. Therefore, an area within the waterbody crossing equivalent to length of the blasting trench and approximately 25 feet wide (in the worst-case scenario) would be exposed to instantaneous hydrostatic pressure changes above 2.7 psi. In reality the distance in water affected outside of the 25 feet on land would be less than an additional 25 feet because water does not transmit energy pressure waves as well as rock (only about 70 percent of the distance away from the charge relative to rock, the most conductive substrate of pressure waves; see calculations in ADFG 1991), which the maximum distance is based upon. As noted above (see *Acoustic Shock* subsection) a fish salvage plan (see section 3.5.4.4, Conservation Measures, below) is in place that would result in any fish present being removed from the area within this 25-foot potential effect area, eliminating potential noise effects from stream crossings.

There would be no in-water blasting; therefore, no in-water noise monitoring has been proposed. Procedures for conducting blasting in-the-dry have been provided in in appendix T, *Fish Salvage Plan*. Monitoring for efficacy of each stream crossing and fish salvage would be conducted throughout the entire process including function of upstream block nets to exclude fish from areas where they might be affected by blasting in the dry thus eliminating potential noise effects to fish during stream crossings. In situations where blasting would occur in uplands adjacent to streams or within dry streambeds, Pacific Connector would attempt to minimize acoustic shock waves from blasting that may affect aquatic resources by the types of explosives selected, the size of charges, and the sequences of firing. In-air noise due to blasting would be mitigated in all noise-sensitive areas as described in Pacific Connector's *Blasting Plan* (see Appendix C to the POD [appendix B to this BA]).

Suspended Sediment by Pipeline Crossing Methods

Pipeline crossings of surface waterbodies would cause some downstream turbidity and sedimentation. The type of crossing and stream sediment characteristics can affect turbidity and suspended sediment in streams. All streams in the range of Oregon Coast coho salmon ESU would be crossed using the dry open-cut method (flume and dam-and-pump) (table 3.5.4-15), except those streams crossed by HDD, DP, or diverted open cut. Dry crossing methods including diverted open cut would result in minimal impacts, including temporary increases in suspended sediments in restricted areas. DP and HDDs would be installed without in-water work and would not directly affect the aquatic environment and associated species, except in the case of an inadvertent return during an HDD crossing, which could affect stream suspended sediment levels as discussed below.

Suspended Sediment – Dry Open Cut

Pipeline crossings of surface waterbodies would cause some downstream turbidity and sedimentation. The type of crossing and stream sediment characteristics can affect turbidity and suspended sediment in streams. All streams in the range of Oregon Coast coho salmon ESU, other than those crossed by HDD, DP, or diverted open-cut, would be crossed using the dry open-cut method (flume and dam-and-pump) (see table 3.5.4-15). Turbidity and sedimentation impacts from the dry open-cut methods are associated with: 1) installation and removal of the upstream and downstream dams used to isolate the construction area; 2) water leaking through the upstream dam and collecting sediments as it flows across the work area and continues through the downstream dam; 3) movement of in-stream rocks and boulders to allow proper alignment and installation of the flume and dams; and 4) when streamflow is returned to the construction work area after the crossing is complete and the dams and flume are removed. Dry techniques produce much less sediment in the water than alternative "wet" open cut methods (Reid and Anderson 1999; Reid et al. 2002; Reid et al. 2004; Reid et al. 2008; Harper 2012). Therefore, if properly installed and maintained during construction and restoration, dry open-cut construction across waterbodies would produce minor levels of sediment and turbidity.

Pacific Connector would minimize impacts on surface waters and aquatic resources by implementing the waterbody crossing and erosion and sediment control measures as described in its Pipeline Project-specific ECRP. Actions described in GeoEngineers (2017d) would also be used to determine level of stream crossing risk. The details of the crossing risk assessment and actions that would be taken to reduce risk to stream channels and banks are discussed below under the *Streambank Erosion and Streambed Stability* section.

GeoEngineers (2017f) evaluated the potential risk of turbidity increasing during construction across waterbodies. The qualitative evaluation was based on each affected waterbody's hydroperiod, presence of erodible clay and loam soils in streambanks, presence of clay in streambed (suspended clay contributes to turbidity disproportionally to its erodibility), long-term stability of stream channels, and level/duration of construction effort and stabilization measures likely added at the time of construction. The turbidity risk was scored from 1 (low) to 5 (high). Of 133 waterbodies evaluated within range of Oregon Coast coho, 23 were scored with a low risk (score of 1 or 2) of turbidity increase over a 24-hour period, and 110 were scored with a moderate risk (score of 3 or 4), generally due to soil erosion potential, presence of clay or mud, and/or the presence of steep slope or an incised channel that would require construction of a deep trench (GeoEngineers 2017f). The evaluation concluded that turbidity generated during construction may exceed Oregon water quality standards for short distances and short durations downstream from each stream crossing, either coinciding with construction across perennial waterbodies or in intermittent streams coincidental with autumn precipitation.

Construction across waterbodies would be completed as quickly as possible to shorten the duration of sedimentation and turbidity. If channels are dry during construction, small streams (less than 10 feet) are projected to be crossed in less than 24 hours, and intermediate streams (10 to 100 feet) usually in less than 48 hours. Times may be longer when flow diversion is required. Reid et al. (2004) examined stream crossing data from 46 crossings (23 dam and pump, 12 flumed, and 11 open cut) over a range of stream types across Canada and the U.S. from streams that were mostly less than 10 meters wide. Reid et al. (2004) noted that in flowing streams they monitored, in-stream work averaged 38 and 64 hours for dam-and-pump and flumed crossings, respectively. However, the times noted for crossings include all activities that occur, which influence when active suspended sediment may occur, but do not indicate the actual periods when increased suspended sediment development would occur, which is mostly influenced by periods of active in-stream installation or removal of flow diversions for dry open-cut methods. If circumstances required a construction delay, adequate site stabilization measures would be employed in accordance with the ECRP and permit conditions. However, failure of flow sealing and other in-stream structures at upstream diversions structures could occur from a variety of malfunctions such as pump failure, dam and flume failure, poor dam seal and others. Reid et al. (2004) noted seal failures of monitored diverted open cut crossing in one of 23 dam-and-pump projects and five of 12 for flumed projects. Should these occur, suspended sediment would be relatively elevated over those without failure, but immediate repair work could reduce the magnitude and duration of elevated suspended sediment. The effect on suspended sediment from planned dry crossings and unintended wet cuts crossings with repairs are discuss below in this subsection.

Alternatively, Harper (2012) modeled sediment following dry open-cut crossing of intermediate and minor waterbodies but was restricted to a one hour period of duration associated with a "quick-flush" that occurs after a pipe is installed, the trench is backfilled, and water barriers, upstream and downstream from the workspace, are removed and turbulent, high energy flow across the backfilled trench suspends sediments which are expected to last for one hour (Harper 2012). The effect on suspended sediment from planned dry crossings and unintended wet cuts crossings with repairs are discussed below in this subsection.

Severity of Effects from Suspended Sediment

Salmonids may avoid areas of increased turbidity levels at 20 mg/l suspended sediment, and possibly lower concentrations depending on length of exposure (Newcombe and Jensen 1996). Elevated suspended sediment conditions would be short-term during pipeline installation and would not be continuous at any one location. This would reduce the chances of continuous elevated exposure for fish that may move little. Some other studies have found varied effects including lesser effects at these concentrations, with overall effects related to both duration as well as concentration (Newcombe and Jensen 1996).

Sediment resuspended into the water column can be redeposited on downstream substrates, which could bury aquatic macroinvertebrates (an important food source for salmonids, and other fish in estuarine areas). Additionally, downstream fine particle sedimentation could affect spawning substrate habitat, spawning activities, eggs, larvae, and juvenile fish survival, as well as benthic community diversity and health (reviewed and compiled by Bash et al. 2001). Because the effects of increased sedimentation and turbidity are often limited to the period of in-stream work, the duration of these effects are usually relatively short. One long-term study (during construction through three years after construction) of multiple pipeline crossings of coldwater streams found no measurable effect to fish or benthic resources or their habitat within 2 months to 3 years of construction (Blais and Simpson 1997) and Gartman (1984) reported rapid recolonization of benthic organisms on 30 pipeline projects post-construction.

Newcombe and Jensen (1996) compiled research from many sources that demonstrate effects to anadromous and resident salmonids by various levels of suspended sediment and exposure over time. This modelling process is used to assess the possible effects to salmonid resources in the project area from in-stream pipeline construction based on estimates of sediment concentration exposure duration. The developed models that approximate the level of effect is based on known levels of suspended sediment concentration and duration of exposure to that concentration in a stream. In order to use these models to estimate effects to salmonids, an estimate of these two parameters is needed.

Output from each model provides SEV scores that are summarized below. Values range from 0 to 14, where an SEV of 0 indicates no effects, an SEV between 1 and 3 indicates behavioral effects, an SEV from 4 to 8 indicates sublethal effects, and an SEV from 9 through 14 indicates lethal and paralethal effects (see Table 1 in Newcombe and Jensen 1996).

<u>Behavioral Effects SEV scores</u>

1 = Alarm reaction
2 = Abandonment of cover
3 = Avoidance response

<u>Sublethal Effects SEV scores</u>

4 = Short-term reduction in feeding rates and/or feeding success
5 = Minor physiological stress (increase coughing rate and/or increased respiration rate)
6 = Moderate physiological stress
7 = Moderate habitat degradation; impact on homing
8 = Major physiological stress; long-term reduction in feeding rate- feeding success; poor condition

Lethal and Paralethal Effects SEV scores

9 = Reduced growth rate and/or delayed hatching and/or reduced fish density
10 = 0 to 20 percent mortality and/or increased predation and/or moderate to severe habitat degradation
11= >20 to 40 percent mortality
12= >40 to 60 percent mortality
13= >60 to 80 percent mortality
14= >80 to 100 percent mortality

SEV scores are complex interactions of TSS concentrations and time of exposure to those concentrations where higher concentrations and longer exposures result in higher SEV scores and greater impact to fish. Effects of high concentrations may be ameliorated by brief exposures and conversely effects of low concentrations may be exasperated by prolonged exposures. In the analyses, downstream effects of TSS are primarily caused by very fine sand, silt and clay particles; coarser sediments settle out of suspension over relatively short distances downstream, closer to the crossing site.

Because of the lack of both available site-specific information and the unknown accuracy of models when applied to varied locations of the specific route, two approaches were taken to estimate the concentration of suspended sediment and its effect on SONCC coho salmon based on SEV levels discussed above. One method used literature values from other stream pipeline studies concerning concentrations and durations of the activity to estimate reasonable approximations of likely sediment concentrations and effects to fish. The other was a detailed approach using models to predict sediment concentrations at Project stream pipeline-crossing sites based on known and assumed values.

Literature-Based Assessment of Sediment Effects

The literature-based assessment of sediment effects for SONCC coho salmon ESU is the same as discussed in section 3.5.3.3 for the Oregon Coast coho salmon ESU.

Modeled Estimates of Likely Effects from Suspended Sediment

Specific information about each waterbody crossing is required to estimate amounts of suspended sediment that would be generated, transported, and deposited downstream. That information includes: 1) stream width and depth, 2) water velocity, 3) streambed roughness, 4) grain size of excavated materials, and 5) background (ambient) levels of suspended sediment (Reid et al. 2008). The methods used to determine or approximate the values of each of these parameters are presented below. Once TSS concentrations generated by in-stream activities have been determined, they are applied in the dose-response assessments of sediment exposure, the SEV models by Newcombe and Jensen (1996).

Pacific Connector incorporated site data, regional data, and available literature based models to provide an estimate of both suspended sediment levels and extent of effects to Oregon Coast coho salmon ESU from construction across streams.

Average Channel Characteristics. Specific channel characteristics for streams crossed by the Pipeline are not available. However, data provided in the ODFW (2014c) stream surveys included bankfull channel widths, bankfull depths, and stream gradients, in addition to substrates (Sand-

Silt-Organics) noted in table 3.5.4-10a and table 3.5.4-10b above, for multiple streams within fifth-field watersheds crossed by the Pipeline (table 3.5.4-17). Those data were used to develop stream channel characteristics in each fifth-field watershed crossed that are assumed to apply to the actual streams that would be crossed in each of the watersheds.

TABLE 3.5.4-17

Channel Conditions for Streams Sampled during the Aquatic Habitat Inventory (ODFW 2014c) in Nine Watersheds within the Oregon Coast ESU that would be Crossed by Pipeline Project

Subbasin and Fifth-Field Watersheds	Number of Stream Reaches Surveyed a/	Average Values for Stream Reaches Sampled in Watershed a/			
		W = Bankfull Width (meters)	D = Bankfull Channel Depth (meters)	S = Channel Gradient (percent slope)	Percent Sand, Silt, Organics in Substrate
Coos					
Coos Bay-Frontal Pacific Ocean	30	5.8	0.5	2.2	59.2
Coquille					
North Fork Coquille River	73	5.8	0.5	3.6	33.4
East Fork Coquille River	74	6.9	0.5	5.3	24.9
Middle Fork Coquille River	99	7.2	0.6	4.6	22.4
South Umpqua					
Olalla Creek-Lookingglass Creek	54	5.6	0.5	3.4	24.4
Clark Branch-South Umpqua River	33	4.9	0.5	5.0	15.7
Myrtle Creek	60	5.3	0.4	4.6	42.8
Days Creek-South Umpqua River	98	4.6	0.5	4.6	22.3
Upper Cow Creek	28	4.3	0.7	6.2	30.4

a/ Stream reach-specific values are provided in appendix Y.

Estimates of Bankfull Flows. Sediment transport in streams depends, in part, on stream channel characteristics. Stream-specific values that were averaged in table 3.5.4-17 were used to determine stream discharged rate (Q) and water velocity (V_A). Manning's Formula (Limerinos 1970; Arcement and Schneider 1989) was used to estimate Q, the stream discharge rate (cubic meters per second, meter^3/sec):

$$Q = A\,(k/n)\,(R^{2/3})\,(S^{1/2})$$

with estimates of A, the cross-sectional area of a stream (square meters); R, the hydraulic radius (meters, where R = A/P, and P is the wetted perimeter in meters); S, the slope of channel (channel gradient); the constant *k* equals 1.486 if English units are used or 1 with metric units; and n, Manning's roughness coefficient. Stream-specific Aquatic Habitat Inventory data (see appendix Y) were used to estimate the stream channel cross-section shape and cross-section area. If the predominant depth was greater than half the bankfull width, the cross-section channel shape was assumed to be a V. If the bankfull depth was less than half the bankfull width, the cross-section channel shape was assumed to be a trapezoid with each bank as a 1:1 slope, dependent on predominant depth (bottom = W – (2 D)). If the bankfull depth was equal or greater than half the bankfull width, the cross-section channel shape was assumed to be a V. Manning's n was estimated from various sources (Chow 1959; Limerinos 1970; Arcement and Schneider 1989) and ranged from n = 0.060 for floodplain channels with light brush and trees in summer, to n = 0.050

for channels with pools, shoals and stones to n = 0.045 for mountain streams with bottom gravels, cobbles, and boulders and no vegetation in the channel (Chow 1959).

Estimates of Q derived with Manning's Formula are assumed to be measures of the carrying capacity (bankfull flow) of a particular channel section (Arcement and Schneider 1989). Carrying capacities of a channel section are assumed to occur during periods of high flow, generally during winter months in the Pipeline Project area. Stream flow rate or discharge rate, Q, is related to cross-sectional area (A) and average streamflow velocity (V_A):

$$Q = A \cdot V_A, \text{ alternatively } V_A = Q / A$$

Estimates of Q derived with Manning's Formula are assumed to be measures of the carrying capacity (bankfull flow) of a particular channel section (Arcement and Schneider 1989). Carrying capacities of a channel section are assumed to occur during periods of high flow, generally during winter months in the Pipeline Project area. Estimates of variables used to derive Q and V_A are provided in table 3.5.4-18, averaged by watershed.

TABLE 3.5.4-18

Estimates Used to Derive Bankfull Flow and Bankfull Velocity in Nine Watersheds within the Oregon Coast ESU that would be Crossed by Pipeline Project

Subbasin and Fifth-Field Watersheds	Average Estimates for Streams Sampled in Watershed a/				
	A = Channel Cross Sectional Area (meter²)	P = Wetted Perimeter (meters)	R = Hydraulic Radius (meters)	Q = Bankfull Flow (meter³/sec)	V_A = Bankfull Velocity (meter/sec)
Coos					
Coos Bay-Frontal Pacific Ocean	2.6	6.2	0.4	2.5	1.0
Coquille					
North Fork Coquille River	3.3	6.2	0.4	6.4	1.9
East Fork Coquille River	3.4	7.3	0.4	7.9	2.3
Middle Fork Coquille River	4.8	7.7	0.5	11.7	2.2
South Umpqua					
Olalla Creek-Lookingglass Creek	2.5	6.0	0.4	4.8	1.8
Clark Branch-South Umpqua River	2.6	5.3	0.4	5.1	2.1
Myrtle Creek	2.5	5.7	0.4	4.2	1.7
Days Creek-South Umpqua River	2.2	4.9	0.4	4.7	1.9
Upper Cow Creek	2.8	4.9	0.4	9.1	2.6

a/ Stream-specific estimates are provided in appendix Y.

Seasonal Discharge. Pipeline construction across waterbodies would occur during ODFW (2008) in-stream construction windows (section *Timing to Life History Functions*, above). Hydrographs of monthly discharges of waterbodies within the Coos (figure 3.5.4-4), Coquille (figure 3.5.4-5), and South Umpqua (figure 3.5.4-6) subbasins to be crossed by the Pipeline show peak seasonal flows during winter months, December through February. Lowest flows occur during summer months, coinciding with the ODFW construction windows. Assuming that high winter stream flows correspond to the bankfull carrying capacities of channel sections (Arcement and Schneider 1989), in-stream flows during the ODFW construction window would be some fraction of the winter flows. Those fractions are included in table 3.5.4-19 with the mid-point that is used to adjust low flows and velocities for each sampled reach of Aquatic Habitat Inventory data (see appendix Y).

TABLE 3.5.4-19

Recorded High Flows During Winter and Average Low Flows during the ODFW In-stream Construction Window in Hydrographic Data within the Coos, Coquille, and South Umpqua Subbasins Crossed by the Pipeline Project

Subbasin and Hydrograph	High Flow (cfs) (Month)	In-stream Construction Window	Average Flows (cfs) During Window	Percent of High Flow During Window	Percent Mid-Point
Coos					
Pony Creek a/	17 (Feb)	Jul 1-Sep15	0.01	0.03	1.4
W. Fk. Millacoma River	489 (Jan)	Jul 1-Sep15	13.7	2.8	
Coquille					
Mid. Fk. Coquille River	2,220 (Feb)	Jul 1-Sep15	40.5	1.8	2.0
N. Fk. Coquille River	630 (Dec)	Jul 1-Sep15	14.4	2.3	
South Umpqua					
N. Myrtle Creek	182 (Dec)	Jul 1-Sep15	4.8	2.6	2.8
S. Umpqua River	6,862 (Dec)	Jul 1-Aug 31	196	2.9	

a/ Ten-year flows in Pony Creek were evaluated from 1992 to 2001 rather than from the most recent 10 years, 1999 to 2008, because of releases from Upper Pony Creek Reservoir since completion of the new dam in 2001.

The 10-year average of low water stream flows in the Coos River subbasin during the ODFW in-stream construction window are assumed to be 1.4 percent of high winter flows (see table 3.5.4-19) based on discharge data for Pony Creek and West Fork Millacoma River during December (see figure 3.5.4-4). Average low water flows in the Coquille Subbasin during the construction window are 2.0 percent of high winter flows (see figure 3.5.4-5) and average low flows in the South Umpqua Subbasin are 2.8 percent of high winter flows (see figure 3.5.4-6). Stream depths for all waterbodies within the each subbasin were reduced by the same proportion through iterations that reduced bankfull flows in the Coos, Coquille, and South Umpqua subbasins to 1.4 percent, 2.0 percent, or 2.8 percent, respectively, in all streams in the Aquatic Habitat Inventory samples. Reduced stream depths generate reduced values of A, P, and R in Manning's Formula. Stream-specific estimates of Q and V_A during low water flow conditions were likewise derived and are provided in table 3.5.4-20, averaged by watershed. Reduced stream depths generated reduced values of A, P, and R in Manning's Formula.

Background Turbidity and Suspended Sediment. Turbidity, generally reported in NTUs, is a measure of the lack of transparency (cloudiness) of water caused by suspended or dissolved substances that cause light to be scattered and adsorbed. Turbidity is often measured on-site using a turbidity meter that measures the scattering of light in a water sample relative to a known range turbidity standards. Turbidity is directly related to the concentration of sediments suspended in water but the relationship between turbidity and suspended sediment is complicated by sediment particle size, particle composition, and water color (ODEQ 2010).

TABLE 3.5.4-20

Estimates Used to Derive Low Water Flows and Velocities during In-stream Construction in Nine Watersheds within the Oregon Coast ESU that would be Crossed by Pipeline Project

Subbasin and Fifth-Field Watersheds	Average Estimates for Streams Sampled in Watershed a/				
	A = Channel Cross Sectional Area (meter^2)	P = Wetted Perimeter (meters)	R = Hydraulic Radius (meters)	Q = Low Water Flow (meter^3/sec)	V_A = Low Water Velocity (meter/sec)
Coos					
Coos Bay-Frontal Pacific Ocean	0.18	4.89	0.04	0.04	0.22
Coquille					
North Fork Coquille River	0.29	4.86	0.05	0.13	0.45
East Fork Coquille River	0.30	6.03	0.05	0.16	0.52
Middle Fork Coquille River	0.42	6.21	0.05	0.23	0.51
South Umpqua					
Olalla Creek-Lookingglass Creek	0.27	4.80	0.05	0.13	0.47
Clark Branch-South Umpqua River	0.47	4.13	0.10	0.14	0.81
Myrtle Creek	0.27	4.61	0.05	0.12	0.46
Days Creek-South Umpqua River	0.23	3.79	0.05	0.13	0.52
Upper Cow Creek	0.27	3.23	0.08	0.26	0.81

a/ Stream-specific values are provided in appendix Y.

Ambient turbidity was not addressed by GeoEngineers (2017f). Turbidity (NTU) has been evaluated by ODEQ (2013) and retrieved from LASAR Web Application in 2013 before ODEQ discontinued support of the site (ODEQ 2017), making the data unavailable. Turbidity within individual streams may be highly variable, but during the period coinciding with ODFW (2008) in-stream construction windows, reported turbidity was minimal and of low variability in streams for which data exists (see table 3.5.4-21).

The majority of ODEQ LASAR data were turbidity (NTU) measurements taken in the field. TSS were occasionally been reported but mostly without measuring corresponding turbidity. Relationships between turbidity and suspended solid concentrations are best if determined on a stream-by-stream basis (Downing 2008). However, since stream-specific data for turbidity and TSS were not available, four available literature generated models were used to supply a reasonable range of the possible relationships. Relationships are reported for streams in Alaska (Lloyd 1987; Lloyd et al. 1987) and streams in the Puget Lowlands (Packman et al. 1999); the models are non-linear. At low turbidity levels (see table 3.5.4-21), conversions of NTUs to TSS are relatively consistent among the models. Based on these conversions, an overall background level of 2 mg/l is assumed for TSS concentrations for all streams crossed by the Pipeline during the ODFW in-stream construction window. Available turbidity data (NTU) from stations included in the table averaged for July, August, and September yielded an average of 0.8 NTU. When converted to TSS using the models in the table, the conversion yields an average of 1.0 mg/l as a background level within range of the Oregon Coast coho. In support of that assumption, ODEQ (2010) reported that during dry seasons, background turbidity levels are relatively low and consistent in small streams throughout Oregon, generally from 1 to 2 NTUs. A background TSS concentration of 2 mg/l during summer is also consistent with measurements reported by USGS in Myrtle Creek, Big Butte Creek, and the Rogue River mainstem during summers 1977, 1978, and 1979 (historical data provided by the Forest Service). Results from the ODEQ data analysis and other sources reported above support using 2 mg/l as ambient TSS levels during the in-stream crossing period including all or portions of July, August, and September.

TABLE 3.5.4-21

Turbidity (NTU) Records Measured by ODEQ during all Seasons in Waterbodies Proximate to the Pipeline Project in the Coos, Coquille, and South Umpqua Subbasins and Conversion to TSS by Available Models

Subbasin and Waterbody	Number of Records	Period of Record	Mean Turbidity (NTU) (Maximum) (Minimum)	Model Conversion to TSS (mg/l) a/ Model 1 Mean TSS (Maximum) (Minimum)	Model 2 Mean TSS (Maximum) (Minimum)	Model 3 Mean TSS (Maximum) (Minimum)	Model 4 Mean TSS (Maximum) (Minimum)
Coos							
Kentuck Slough	10	2005-2007	27.6 (89) (4)	136.5 (487.1) (13.1)	34.9 (115.0) (4.7)	49.2 (189.6) (3.2)	112.9 (434.8) (7.2)
Willanch Creek	1	1982	29	131.8	36.1	43.2	99.0
Catching Slough	13	2005-2007	11.1 (39) (1)	47.2 (186.2) (2.6)	13.6 (49.0) (1.1)	14.8 (63.8) (0.5)	34.0 (146.3) (1.2)
Coquille							
Cunningham Creek	11	2001-2010	26.2 (82.8) (9.3)	127.5 (447.8) (3.5)	33.0 (106.7) (1.5)	45.0 (172.4) (0.7)	103.2 (395.3) (1.6)
N. Fk. Coquille River	12	2004-2010	6.9 (26.8) (2)	26.5 (120.3) (5.8)	8.2 (33.3) (2.3)	7.6 (38.9) (1.3)	17.4 (89.2) (2.9)
Mid. Fk Coquille River	13	2001-2010	12.5 (48.1) (1.2)	53.8 (237.8) (3.3)	15.4 (60.9) (1.4)	17.0 (84.2) (0.7)	38.9 (193.0) (1.5)
South Umpqua							
Bilger Creek	26	2004-2006	7.6 (81) (0.2)	37.7 (436.5) (0.4)	9.6 (104.3) (0.2)	13.7 (167.4) (0.1)	31.5 19384) (0.2)
Clark Creek	2	1994	1.5 (2) (1)	4.2 (5.8) (2.6)	1.7 (2.3) (1.1)	0.9 (1.3) (0.5)	2.0 (2.9) (1.2)
S. Fk. Myrtle Creek	26	2004-2006	4.5 (33) (0.7)	17.3 (153.3) (1.6)	5.4 (41.2) (0.7)	5.0 (51.2) (0.3)	11.4 (117.4) (0.7)
Days Creek	4	2006	4.3 (15) (0.5)	16.6 (61.1) (1.2)	5.1 (18.3 (0.5)	4.8 (18.1) (0.2)	10.9 (41.5) (0.5)
S. Fk. Cow Creek	1	1990	1	2.60	1.11	0.51	1.16

a/ Models used to convert Turbidity (NTU) to Suspended Solids Concentration (SSC) or Total Suspended Solids (TSS) in waterbodies crossed or proximate to the Pipeline Project. Turbidity information source: ODEQ (2013) included data collected prior to 2013.
Model 1 (Lloyd 1987; Lloyd et al. 1987) applicable to waters throughout Alaska: $T = 0.44 (SSC)^{0.858}$
Model 2 (Lloyd 1987; Lloyd et al. 1987) applicable to interior Alaskan streams: $T = 1.103 (SSC)^{0.968}$
Model 3 (Packman et al. 1999) Rutherford Creek, King County, Washington: ln(TSS) = 1.32 ln(NTU) – 0.68
Model 4 (Packman et al. 1999) nine streams sampled in the Puget Lowlands, Washington: ln(TSS) = 1.32 ln(NTU) + 0.15

NTU – nephelometric turbidity unit

Particle Transport. Sediment particles would be transported distances downstream (L, in meters) based on 1) the particle size and settling velocity (V_S, - centimeters per second – in water at 20°C, see for example the Wentworth Grain Size Chart, USGS 2003), 2) the average streamflow velocity (meters per second), and 3) the average depth of flow (D, meters) downstream, using the following "velocity-distance-time" equation;

$$L = V_A (D / V_S)$$

Estimates of transport distances (L in meters) for various sediment particles ranging in sizes from clay to coarse gravel are provided, as examples, in table 3.5.4-22 for three waterbodies in the Pipeline Project vicinity for which data are available. Particle sizes deleterious to salmonids (250 µm or less in the models of Newcombe and Jensen (1996), above) could settle out of suspension less than 1 meter (0.2 feet) downstream (e.g., medium sand in low flows for Tributary to Catching Creek). Alternatively, particles could remain suspended for 4.7 km (2.9 miles) or more (very fine silt in Willis Creek).

TABLE 3.5.4-22

Estimated Downstream Transport Distances for Particles (ranging from Very Fine Silt to Coarse Gravel) in Three Streams (as examples)

Particle Description	Particle Diameter a/	Settling Velocity (V_S)	Estimated Particle Transport Distance (L) Downstream b/		
			Tributary to Catching Creek	Steele Creek	Willis Creek
Coarse Gravel	1.60 cm	90 cm/s	0 m	0 m	0 m
Very Coarse Sand	0.1 cm	15 cm/s	0 m	0 m	0 m
Coarse Sand	0.05 cm	8 cm/s	0 m	0 m	1 m
Medium Sand	0.025 cm	3 cm/s	0 m	0 m	2 m
Fine Sand	0.0125 cm	1.25 cm/s	0 m	1 m	5 m
Very Fine Sand	0.0062 cm	0.329 cm/s	1 m	4 m	20 m
Coarse Silt	0.0031 cm	0.085 cm/s	3 m	16 m	78 m
Medium Silt	0.0016 cm	0.023 cm/s	9 m	59 m	289 m
Very Fine Silt-Clay	0.0004 cm	0.0014 cm/s	153 m	977 m	4,742 m

a/ note that 0.025 cm = 250 µm
b/ Parameter values used to estimate L:
Trib. Catching Creek: V_A =0.27 m/s; D = 0.01 m.
Steele Creek: V_A = 0.53 m/s; D = 0.03 m.
Willis Creek: V_A = 0.66 m/s; D = 0.1 m.

Sediment Generated During Pipeline Construction. Modeled concentrations of TSS produced in waterbodies during wet open-cut pipeline construction were developed from empirical data collected during construction across 15 to 19 streams in North America (Reid et al. 2004). Models were developed to predict mean TSS concentrations immediately downstream (approximately 50 meters) of pipeline construction sites. Models included TSS generated by all construction activities and by trenching, pipe lowering, and backfilling. The models predicting mean TSS generated by all activities (including trenching, pipe lowering, and backfilling) had the highest correlation coefficients (Reid et al. 2004). The model predicting mean TSS (C_{av}) at about 50 meters downstream by all activities associated with wet open-cut pipeline construction is:

$$C_{av} = 1.5 \times 10^6 \; U^{1.09} \; d_{50}^{0.95} \; P_f^{0.35} \; q^{-1}$$

where U = mean flow velocity (m per second) at the crossing location during the construction period, equivalent to V_A derived using Manning's Formula (table 3.5.4-17 and appendix Y); d_{50} = the median sediment size (m) of the excavated material by weight, P_f = percentage of fines (silt and clay) in the excavated material (%) and is assumed to equal the percent of silt and organics in surface substrates for all streams within a given fifth-field watershed (estimated as 2/3 of the

Percent Sand, Silt, Organics in Substrate tabulated in table 3.5.3-12); q = the width adjusted stream flow rate where $q = Q/B$, (m^2 per second) with B = the watercourse width (m) adjusted for a particular flow rate and Q = stream flow rate (m^3 per second) derived using Manning's Formula (values for Q are in table 3.5.4-18 and appendix Y). Values for d_{50} in these analyses were derived by regressing values of d_{50} and P_f provided in Table 2 of Reid et al. (2004); the relationship of d_{50} to P_f from that study is $d_{50} = 38.12\ e^{-0.0963\ Pf}$ (r^2 = 0.636, P<0.001).

In these simulations, Q is related to B through Manning's Formula and as B increases numerically, Q also increases but at a faster numerical rate (as a power function). If all other model parameters are held constant in the Reid et al. (2004) model, increased width adjusted stream flow rate, q (due high flow, Q, and proportionally smaller watercourse widths, B) will decrease the TSS concentration (C_{av}) because q is factored as q^{-1} in the equation. Conversely, lower q values will generate higher C_{av} with all other parameters in the equation held constant. Stream reach -specific estimates of U, $d50$, P_f, q^{-1}, and C_{av} during low water flow conditions are provided in appendix Y and averaged by watershed in table 3.5.4-23.

TABLE 3.5.4-23

Estimates Used to Predict TSS Concentrations at 50 meters Downstream from Wet Open-Cut Pipeline Construction in Nine Watersheds within the Oregon Coast ESU that would be Crossed by Pipeline Project

	Average Estimates for Stream Reaches Sampled in Watershed a/					
Subbasin and Fifth-Field Watersheds	**U Low Water Velocity (m/sec)**	**D_{50} Median Sediment Size (m)**	**P_f Percent Fines (Silt, Clay)**	**q Width Adjusted Stream Flow (m^2/sec)**	**B Watercourse Width (m)**	**C_{av} Predicted TSS Concentration at 50 meters (mg/L)**
Coos						
Coos Bay-Frontal Pacific Ocean	0.22	0.117	39.5	0.01	4.86	4,101
Coquille						
North Fork Coquille River	0.46	0.219	22.24	0.03	4.82	2,922
East Fork Coquille River	0.52	0.297	16.59	0.03	5.99	2,783
Middle Fork Coquille River	0.51	0.978	14.96	0.03	6.16	2,576
South Umpqua						
Olalla Creek-Lookingglass Creek	0.47	0.234	16.27	0.03	4.76	2,424
Clark Branch-South Umpqua River	0.81	0.629	10.48	0.08	4.04	1,195
Myrtle Creek	0.46	0.027	28.52	0.03	4.57	3,435
Days Creek-South Umpqua River	0.13	1.306	14.84	0.02	3.74	726
Upper Cow Creek	0.84	0.038	20.24	0.09	3.15	1,996

a/ Stream Reach-specific values are provided in appendix Y.

In addition to developing predictive models of TSS concentrations generated by wet-open cut pipeline construction, Reid et al. (2004) measured TSS downstream from 12 flumed pipeline crossings and 23 dam-and-pump crossings (dry-open cut or isolated pipeline construction crossings) with comparisons to 11 wet open-cut construction crossings. By accounting for flow, background TSS concentrations, sampling distance downstream, and duration of construction, Reid et al. (2004) determined that mean TSS concentrations generated during dry open-cut construction by fluming were 3.7 percent of the wet open-cut concentrations and were 0.85 percent of the wet open-cut concentrations for dam-and-pump construction. These relationships were used in table 3.5.4-24 to adjust average TSS concentrations estimated at 50 meters downstream from wet open-cut pipeline crossings to average TSS concentrations at flumed pipeline crossings and dam-and-pump pipeline crossings.

TABLE 3.5.4-24

Estimates of Average TSS Concentrations Generated During In-stream Construction and Estimated Downstream Distance from Wet Open-Cut Construction to Attenuate to Ambient TSS in Nine Watersheds within the Oregon Coast ESU that would be Crossed by Pipeline Project

	Average Estimates for Stream Reaches Sampled in Watershed a/			
Subbasin and Fifth-Field Watersheds	**Wet Open-Cut TSS (mg/l) at 50 m**	**Fluming TSS (mg/l) at 50 m**	**Dam & Pump TSS (mg/l) at 50 m**	**Distance (m) for TSS (Clay Fraction) to Equal Ambient (= 2 mg/l)**
Coos				
Coos Bay-Frontal Pacific Ocean	4,102	153	35	595
Coquille				
North Fork Coquille River	2,923	109	25	1,840
East Fork Coquille River	2,783	104	24	1,744
Middle Fork Coquille River	2,576	96	22	2,072
South Umpqua				
Olalla Creek-Lookingglass Creek	2,425	90	21	1,780
Clark Branch-South Umpqua River	1,195	73	17	2,402
Myrtle Creek	3,436	128	29	1,713
Days Creek-South Umpqua River	727	27	6	638
Upper Cow Creek	1,996	74	17	7,319

a/ Stream-specific values are provided in appendix Y.

Estimated Downstream Distance of Suspended Sediment. Ritter (1984) provided a variant of the "velocity-distance-time" equation, above to estimate concentrations of suspended sediments (C_X, as mg/L) some distance (x) downstream from a pipeline trench being constructed across a waterbody. Ritter's model for downstream sediment transport distance during construction across minor streams, with complete mixing of sediment particles, estimates the concentration downstream C_X by:

$$C_X = C_O \, e^{-(vs / d)(x / u)}$$

where C_O (mg/L) is the initial concentration of suspended solids in the water column at the trenching site, vs = the settling velocity (m/second) of sediment particles, d = stream depth (m), and u = stream current velocity (m/second).

The formula for estimating the concentration downstream (Ritter 1984) is used to estimate the distance downstream for TSS concentrations at 50 m (C_O) to equal assumed ambient concentrations (C_X = 2 mg/l). The estimate is calculated by solving for x (distance) in the equation with appropriate transformations and inclusion of only the estimated clay fraction as TSS concentration since the silt fraction would settled out of suspension upstream:

$$x = (\ln(C_X) - \ln(C_O)) + (d / vs)\, u$$

where x = distance (m) downstream, C_O = the initial concentration (mg/l) of suspended solids in the water column at the trenching site, vs = the settling velocity (m/second) of the clay fraction, d = stream depth (m), u = stream current velocity (m/second), and x = distance (m) downstream.

The distances x for TSS generated by wet open-cut construction techniques to attenuate to ambient TSS (C_X) are provided in table 3.5.4-24.

Inverse relationships between TSS concentrations produced at 50 meters from in-stream construction and TSS concentrations at variable distances downstream were evaluated for each of the three pipeline crossing techniques by nonlinear regressions of distance downstream (from 1 to 1000 m) and total TSS concentrations at distance x, solving for x in the above equation [$x = (\ln(C_X) - \ln(C_O)) + (d / vs) u$]. Best fit regression models were selected (exponential vs. logarithmic) to model the inverse relationships between distance and TSS concentration for data averaged in each watershed. Those regression equations are provided in table 3.5.4-25 and define the nonlinear relationships between y = concentration (mg/l) and x = downstream distance (m).

TABLE 3.5.4-25

Nonlinear Regression Equations (with Coefficients of Determination, r^2) for Estimating TSS Concentrations (y, mg/l) at Distances Downstream (x, m) during In-stream Construction in Nine Watersheds within the Oregon Coast ESU to be Crossed by Pipeline Project

Subbasin and Fifth-Field Watersheds	Wet Open–Cut Regression TSS = y Distance (m) = x	Fluming Regression TSS = y Distance (m) = x	Dam & Pump Regression TSS = y Distance (m) = x
Coos			
Coos Bay-Frontal Pacific Ocean	y= -397.1 ln(x) + 2,860.9 r^2 = 0.986	y= -14.78 ln(x) + 106.46 r^2 = 0.986	y= -3.38 ln(x) + 24.39 r^2 = 0.986
Coquille			
North Fork Coquille River	y= -262.0 ln(x) + 2,215.8 r^2 = 0.954	y= -9.75 ln(x) + 82.46 r^2 = 0.954	y= -2.23 ln(x) + 18.89 r^2 = 0.954
East Fork Coquille River	y= -238.3 ln(x) + 2,172.7 r^2 = 0.925	y= -8.87 ln(x) + 80.85 r^2 = 0.925	y= -2.03 ln(x) + 18.52 r^2 = 0.925
Middle Fork Coquille River	y= -223.0 ln(x) + 2,000.7 r^2 = 0.933	y= -8.30 ln(x) + 74.45 r^2 = 0.933	y= -1.90 ln(x) + 17.05 r^2 = 0.933
South Umpqua			
Olalla Creek-Lookingglass Creek	y= -207.5 ln(x) + 1,882.9 r^2 = 0.930	y= -7.72 ln(x) + 70.07 r^2 = 0.930	y= -1.77 ln(x) + 16.05 r^2 = 0.930
Clark Branch-South Umpqua River	$y = 1{,}098.9\ e^{-0.0013x}$ r^2 = 0.903	$y = 40.89\ e^{-0.0013x}$ r^2 = 0.903	$y = 9.37\ e^{-0.0013x}$ r^2 = 0.903
Myrtle Creek	y= -310.1 ln(x) + 2,637.8 r^2 = 0.948	y= -11.54 ln(x) + 98.16 r^2 = 0.948	y= -2.64 ln(x) + 22.48 r^2 = 0.948
Days Creek-South Umpqua River	y= -59.76 ln(x) + 526.87 r^2 = 0.963	y= -2.22 ln(x) + 19.61 r^2 = 0.963	y= -0.51 ln(x) + 4.49 r^2 = 0.963
Upper Cow Creek	$y = 1{,}193.8\ e^{-0.0011x}$ r^2 = 0.918	$y = 44.43\ e^{-0.0011x}$ r^2 = 0.918	$y = 19.18\ e^{-0.0011x}$ r^2 = 0.918

Suspended Sediment Downstream Effects. Newcombe and Jensen (1996) developed six different models assessing effects of TSS on various fish and habitat groupings. As noted above the model addressing effects on both adult and juvenile stages of salmonids (Model 1) provides the best overall assessment of general level of severity of effects for juvenile and adult coho salmon in project area streams at the time of in-stream construction. Input for the model includes TSS concentration (mg/l) and duration (hours) of exposure to the suspended sediments and has the form:

$$z = a + b\ (\log_e x) + c\ (\log_e y)$$

where z = SEV score, x = duration of exposure in hours, and y = concentration of suspended sediment in mg/l. Constants a, b, and c were empirically derived for Model 1, used here, and other models (see Table 3, in Newcombe and Jensen 1996). If duration of exposure is known, and z

(SEV) is set as a defined value, TSS concentration for that defined SEV score can be computed as:

$$y = e^{((z - a) - b (\log e\ x)) / c} \text{ or } y = \exp (((z - a) - (b (\log_e x))) / c$$

In any of the Newcombe and Jensen models, there is a nearly consistent range for the whole number z, varying from z – 0.5 to z + 0.49. For example, if SEV = 3, the range for that score in the exponential equation, above would be between 2.50 and 3.49; for SEV = 5, the range is 4.50 to 5.49, and so on. For any given duration of exposure (x), the TSS concentration (y) is minimized using (z – 0.5) in the solution. Using the minimum TSS concentration for any given SEV score maximizes the predicted downstream distances for that concentration when solving the regression equations in table 3.5.4-25 for each of the three waterbody crossing methods in each of the nine watersheds.

Duration of Exposure. Following recommendations by NMFS (2017j), personnel with pipeline contractor EnSite USA were asked to provide typical durations, based on their experience, for in-stream time requirements for placing and removing isolation structures for streams in different width categories. High pulses of sediment suspended during dry open-cut procedures are generated during installation and removal of isolation structures prior to and after fluming or dam-and-pump installation, trenching, pipe installation, and trench backfilling. EnSite provided the following durations of typical sediment pulses for four stream width classes during installation of stream-crossing structures: for widths ≤10 feet - 2 hours; widths >10 feet to ≤25 feet - 4 hours; >25 feet to ≤50 feet - 5 hours; and > 50 feet to ≤100 feet, 6 hours. EnSite also provided the following durations of sediment pulses for the same four width classes during removal of dry open-cut crossing structures: for widths ≤10 feet - 2 hours; widths >10 feet to ≤25 feet - 3 hours; >25 feet to ≤50 feet - 4 hours; and > 50 feet to ≤100 feet, 5 hours. Numbers of streams in range of Oregon Coast coho and streams with coho and streams with assumed coho presence and corresponding critical habitat within those four width categories that would be crossed by the Pipeline in each watershed are provided in table 3.5.4-26 using the duration of structure installation. In general, there are very few streams with widths >25 feet.

TABLE 3.5.4-26

Numbers of Streams in Range of Oregon Coast Coho within Four Width Classes that Would Be Crossed by Dry Open-Cuts and Estimated Durations of sediment pulses for In-stream Sediment Generating Actions

Subbasin and Fifth-Field Watersheds	Total Number of Streams Crossed	Total Streams Crossed with Coho and Critical Habitat a/	Number by Width Class and Duration b/			
			≤10 ft 2 hours	>10 to ≤25ft 4 hours	>25 to ≤50 ft 5 hours	>50 ft 6 hours
Coos						
Coos Bay-Frontal Pacific Ocean	10	7	7	3	0	0
Coquille						
North Fork Coquille River	7	3	3	2	2	0
East Fork Coquille River	14	8	8	5	0	1
Middle Fork Coquille River	22	0	13	1	2	0
South Umpqua						
Olalla Creek-Lookingglass Creek	17	5	13	2	1	1
Clark Branch-South Umpqua River	13	4	6	4	1	1
Myrtle Creek	14	5	9	3	2	0
Days Creek-South Umpqua River	15	4	5	8	1	1
Upper Cow Creek	8	0	4	2	2	0

a/ Includes assumed presence from table 3.5.4-4 but not coho in the Coos Bay Estuary.
b/ Durations for structure installation by width class provided by personnel with pipeline contractor EnSite USA.

SEV Scores Downstream. Durations for in-stream sediment generating actions (i.e., in-stream sediment plume duration) provided by EnSite USA from table 3.5.4-26 are used in table 3.5.4-27 with minimum TSS concentrations for specific SEV scores ranging from minor behavioral effects (SEV = 1, alarm reaction) to extreme sublethal effects (SEV = 8, major physiological stress) to estimate the maximum downstream distances at which those SEVs would occur to Oregon Coast coho by in-stream construction across streams in the four watersheds.

Failures of isolation structures to exclude streamflow during fluming or dam-and-pump would result in suspended sediment entrained downstream, assumed to be equal to TSS levels generated during wet open-cut in table 3.5.4-27. Scenarios of exposures as long as six hours could occur while work crews repair the failed isolation structures. Six-hour exposure would cause SEV = 7 (moderate habitat degradation, impaired homing) for all stream widths and could cause major physiological stress (SEV = 8) to Oregon Coast coho for relatively short distances downstream (<55 meters) in six of the nine watersheds in table 3.5.4-27. Longer exposures could be required if dry open-cut construction (flume or dam-and-pump) is abandoned and the waterbody crossing is completed using wet open-cut construction.

Values of 0, in columns associated with specific SEV scores and TSS concentrations in table 3.5.4-27, indicate that there are no distances downstream from construction by wet open-cut or dry open-cut (flume or damp-and-pump) that the specified TSS concentration and exposure duration during a particular crossing method would generate the SEV score for that column in that watershed. For example, there is no distance downstream for construction during fluming in the Days Creek-South Umpqua River watershed at which a SEV score = 5 if the TSS value of 59.4 mg/l and the exposure duration is 2 hours.

The modeling results provided in table 3.5.4-27 provide the maximum downstream distances that TSS generated by each of the crossing methods would attenuate to the concentrations shown (rows labeled TSS (mg/L) with specific durations based on stream width (groupings labeled with width category followed by hours) that would yield a specific SEV score (columns SEV=1 to SEV=8) for fluming or dam-and-pump crossing methods. Using estimates for fluming in streams ≤10 feet wide within Coos Bay Frontal-Pacific Ocean watershed as an example, for the range of distance = 0 (actually 50 meters downstream from the pipe trench as applied in the Reid et al. 2004 model for average TSS generated by all activities) to distance = 24 m, SEV =5 with TSS concentration = 59.4 mg/l and duration = 2 hours. Other estimates include:

- From downstream distance = 24 meters to distance = 478 meters, SEV = 4 with TSS concentration = 15.3 mg/l and duration = 2 hours.
- From downstream distance = 478 meters to distance = 1,031 meters, SEV = 3 with TSS concentration = 3.95 mg/l and duration = 2 hours
- From downstream distance = 1,031 meters to distance = 1,257 meters, SEV = 2 with TSS concentration = 1.02 mg/l and duration = 2 hours.
- From downstream distance = 1,257 meters to distance = 1,323 meters, SEV = 1 with TSS concentration = 0.26 mg/l and duration = 2 hours.
- Past distance = 1,323 m downstream, SEV = 0.

TABLE 3.5.4-27

Maximum Distances Downstream to Attain SEV Scores 1 to 8 with TSS Concentrations and Durations due to Wet Open-Cut, Flume, and Dam-and-Pump Crossing Procedures in Each Watershed within the Oregon Coast Coho ESU to be Crossed by the Pipeline Project

Construction Method Stream Widths	Duration a/	Concentration	SEV=1	SEV=2	SEV=3	SEV=4	SEV=5	SEV=6	SEV=7	SEV=8
Wet Open Cut										
All Stream Widths	**6 hours**	**TSS (mg/L) =**	**0.11**	**0.41**	**1.60**	**6.21**	**24.1**	**93.2**	**361**	**1,399**
Watersheds:			**Maximum Distance (m) to Equal SEV Level with Duration and Concentration b/**							
Coos Bay-Frontal Pacific Ocean			1,346	1,345	1,341	1,326	1,268	1,065	542	40
North Fork Coquille River			4,701	4,695	4,674	4,593	4,290	3,295	1,185	23
East Fork Coquille River			9,092	9,081	9,035	8,862	8,223	6,152	1,999	26
Middle Fork Coquille River			7,867	7,856	7,814	7,655	7,066	5,182	1,559	15
Olalla Creek-Lookingglass Creek			8,743	8,731	8,681	8,490	7,790	5,582	1,534	10
Clark Branch-South Umpqua River			7,107	6,065	5,023	3,981	2,940	1,898	856	0
Myrtle Creek			4,946	4,941	4,923	4,850	4,579	3,663	1,544	54
Days Creek-South Umpqua River			6,731	6,697	6,565	6,078	4,508	1,417	16	0
Upper Cow Creek			8,474	7,243	6,012	4,781	3,549	2,318	1,087	0
Fluming										
Widths ≤10 ft =	**2 hours**	**TSS (mg/L) =**	**0.26**	**1.02**	**3.95**	**15.3**	**59.4**	**230**	**9,520**	**12,906**
Watersheds:			**Maximum Distance (m) to Equal SEV Level with Duration and Concentration b/**							
Coos Bay-Frontal Pacific Ocean			1,323	1,257	1,031	478	24	0	0	0
North Fork Coquille River			4,578	4,236	3,135	977	11	0	0	0
East Fork Coquille River			8,830	8,107	5,824	1,617	11	0	0	0
Middle Fork Coquille River			7,625	6,960	4,887	1,243	6	0	0	0
Olalla Creek-Lookingglass Creek			8,454	7,664	5,241	1,202	4	0	0	0
Clark Branch-South Umpqua River			3,881	2,839	1,787	755	0	0	0	0
Myrtle Creek			4,836	4,529	3,512	1,312	29	0	0	0
Days Creek-South Umpqua River			5,991	4,262	1,139	7	0	0	0	0
Upper Cow Creek			4,661	3,430	2,199	968	0	0	0	0
Widths >10 ft to ≤25 ft =	**4 hours**	**TSS (mg/L) =**	**0.15**	**0.58**	**2.24**	**8.67**	**33.6**	**130**	**504**	**1,952**
Watersheds:			**Maximum Distance (m) to Equal SEV Level with Duration and Concentration b/**							
Coos Bay-Frontal Pacific Ocean			1,333	1,295	1,158	749	139	0	0	0
North Fork Coquille River			4,632	4,433	3,739	1,934	150	0	0	0
East Fork Coquille River			8,945	8,523	7,068	3,424	206	0	0	0
Middle Fork Coquille River			7,731	7,342	6,011	2,770	138	0	0	0
Olalla Creek-Lookingglass Creek			8,581	8,117	6,547	2,847	113	0	0	0
Clark Branch-South Umpqua River			4,319	3,277	2,235	1,193	152	0	0	0
Myrtle Creek			4,885	4,707	4,076	2,335	270	0	0	0
Days Creek-South Umpqua River			6,307	5,202	2,466	137	0	0	0	0
Upper Cow Creek			5,179	3,948	2,717	1,486	255	0	0	0
Widths >25 ft to ≤50 ft =	**5 hours**	**TSS (mg/L) =**	**0.12**	**0.48**	**1.86**	**7.21**	**28**	**108**	**419**	**1,625**
Watersheds:			**Maximum Distance (m) to Equal SEV Level with Duration and Concentration b/**							
Coos Bay-Frontal Pacific Ocean			1,335	1,304	1,187	826	203	1	0	0
North Fork Coquille River			4,644	4,477	3,885	2,244	268	0	0	0
East Fork Coquille River			8,970	8,616	7,374	4,033	389	0	0	0
Middle Fork Coquille River			7,754	7,428	6,289	3,299	271	0	0	0
Olalla Creek-Lookingglass Creek			8,608	8,220	6,873	3,436	234	0	0	0
Clark Branch-South Umpqua River			4,460	3,418	2,376	1,334	293	0	0	0
Myrtle Creek			4,895	4,746	4,211	2,648	439	0	0	0
Days Creek-South Umpqua River			6,378	5,433	2,919	263	0	0	0	0
Upper Cow Creek			5,346	4,115	2,884	1,652	421	0	0	0
Widths >50 ft =	**6 hours**	**TSS (mg/L) =**	**0.11**	**0.41**	**1.60**	**6.21**	**24.1**	**93.2**	**361**	**1,399**

TABLE 3.5.4-27 (continued)

Maximum Distances Downstream to Attain SEV Scores 1 to 8 with TSS Concentrations and Durations due to Wet Open-Cut, Flume, and Dam-and-Pump Crossing Procedures in Each Watershed within the Oregon Coast Coho ESU to be Crossed by the Pipeline Project

Construction Method Stream Widths	Duration a/	Concentration	SEV=1	SEV=2	SEV=3	SEV=4	SEV=5	SEV=6	SEV=7	SEV=8
Watersheds:			**Maximum Distance (m) to Equal SEV Level with Duration and Concentration b/**							
Coos Bay-Frontal Pacific Ocean			1,337	1,310	1,208	885	264	2	0	0
North Fork Coquille River			4,652	4,508	3,990	2,487	399	0	0	0
East Fork Coquille River			8,987	8,682	7,592	4,516	604	0	0	0
Middle Fork Coquille River			7,770	7,488	6,488	3,724	433	0	0	0
Olalla Creek-Lookingglass Creek			8,628	8,291	7,107	3,913	387	0	0	0
Clark Branch-South Umpqua River			4,574	3,533	2,491	1,450	408	0	0	0
Myrtle Creek			4,903	4,774	4,306	2,889	615	2	0	0
Days Creek-South Umpqua River			6,428	5,599	3,280	413	0	0	0	0
Upper Cow Creek			5,482	4,251	3,020	1,789	557	0	0	0
Dam-and-Pump										
Widths ≤10 ft =	**2 hours**	**TSS (mg/L) =**	**0.26**	**1.02**	**3.95**	**15.3**	**59.4**	**230**	**9520**	**12,906**
Watersheds:			**Maximum Distance (m) to Equal SEV Level with Duration and Concentration b/**							
Coos Bay-Frontal Pacific Ocean			1,246	996	419	15	0	0	0	0
North Fork Coquille River			4,180	2,978	801	5	0	0	0	0
East Fork Coquille River			7,989	5,503	1,299	5	0	0	0	0
Middle Fork Coquille River			6,851	4,600	983	2	0	0	0	0
Olalla Creek-Lookingglass Creek			7,536	4,911	935	2	0	0	0	0
Clark Branch-South Umpqua River			2,747	1,705	663	0	0	0	0	0
Myrtle Creek			4,478	3,363	1,108	15	0	0	0	0
Days Creek-South Umpqua River			4,020	909	3	0	0	0	0	0
Upper Cow Creek			3,322	2,090	859	0	0	0	0	0
Widths >10 ft to ≤25 ft =	**4 hours**	**TSS (mg/L) =**	**0.15**	**0.58**	**2.24**	**8.67**	**33.6**	**130**	**504**	**1,952**
Watersheds:			**Maximum Distance (m) to Equal SEV Level with Duration and Concentration b/**							
Coos Bay-Frontal Pacific Ocean			1,289	1,136	695	104	0	0	0	0
North Fork Coquille River			4,400	3,632	1,727	97	0	0	0	0
East Fork Coquille River			8,451	6,845	3,024	128	0	0	0	0
Middle Fork Coquille River			7,276	5,808	2,426	82	0	0	0	0
Olalla Creek-Lookingglass Creek			8,040	6,310	2,468	65	0	0	0	0
Clark Branch-South Umpqua River			3,185	2,143	1,101	60	0	0	0	0
Myrtle Creek			4,676	3,977	2,122	186	0	0	0	0
Days Creek-South Umpqua River			5,032	2,170	83	0	0	0	0	0
Upper Cow Creek			3,839	2,608	1,377	146	0	0	0	0
Widths >25 ft to ≤50 ft =	**5 hours**	**TSS (mg/L) =**	**0.12**	**0.48**	**1.86**	**7.21**	**28**	**108**	**419**	**1,625**
Watersheds:			**Maximum Distance (m) to Equal SEV Level with Duration and Concentration b/**							
Coos Bay-Frontal Pacific Ocean			1,298	1,168	777	160	0	0	0	0
North Fork Coquille River			4,449	3,793	2,043	186	0	0	0	0
East Fork Coquille River			8,556	7,178	3,637	261	0	0	0	0
Middle Fork Coquille River			7,373	6,111	2,955	177	0	0	0	0
Olalla Creek-Lookingglass Creek			8,155	6,665	3,051	148	0	0	0	0
Clark Branch-South Umpqua River			3,326	2,284	1,243	201	0	0	0	0
Myrtle Creek			4,721	4,125	2,446	323	0	0	0	0
Days Creek-South Umpqua River			5,285	2,624	174	0	0	0	0	0
Upper Cow Creek			4,006	2,775	1,544	313	0	0	0	0
Widths >50 ft =	**6 hours**	**TSS (mg/L) =**	**0.11**	**0.41**	**1.60**	**6.21**	**24.1**	**93.2**	**361**	**1,399**

TABLE 3.5.4-27 (continued)

Maximum Distances Downstream to Attain SEV Scores 1 to 8 with TSS Concentrations and Durations due to Wet Open-Cut, Flume, and Dam-and-Pump Crossing Procedures in Each Watershed within the Oregon Coast Coho ESU to be Crossed by the Pipeline Project

Construction Method Stream Widths	Duration a/	Concentration	SEV=1	SEV=2	SEV=3	SEV=4	SEV=5	SEV=6	SEV=7	SEV=8
Watersheds:			**Maximum Distance (m) to Equal SEV Level with Duration and Concentration b/**							
Coos Bay-Frontal Pacific Ocean			1,305	1,192	839	215	1	0	0	0
North Fork Coquille River			4,484	3,908	2,294	292	0	0	0	0
East Fork Coquille River			8,629	7,419	4,131	428	0	0	0	0
Middle Fork Coquille River			7,440	6,330	3,386	300	0	0	0	0
Olalla Creek-Lookingglass Creek			8,235	6,922	3,533	261	0	0	0	0
Clark Branch-South Umpqua River			3,441	2,400	1,358	316	0	0	0	0
Myrtle Creek			4,752	4,231	2,698	472	1	0	0	0
Days Creek-South Umpqua River			5,467	2,992	290	0	0	0	0	0
Upper Cow Creek			4,142	2,911	1,680	449	0	0	0	0

a/ Durations for wet open-cut indicate time to repair isolation structures after failure. Durations for dry open-cut from table 3.5.4-26.
b/ Maximum downstream distances derived by solving SEV equation ($Y = e^{((z - a) - b(\log_e x)) / c}$) for concentration (Y) by minimizing SEV scores (Z - 0.5) and using durations (hours) from table 3.5.4-26. Concentrations derived from appropriate equations, table 3.5.4-25.

Evident from examining table 3.5.4-27, no flumed crossings in any of the four watersheds would cause SEV scores greater than 5 (sublethal effects including minor physiological; increase in rate of coughing; increased respiration rate) except for distances 2 meters or less downstream when fluming waterbodies >25 feet wide in the Coos Bay Frontal-Pacific Ocean and Myrtle Creek watersheds. Likewise, no crossings with dam-and-pump procedures applied would cause SEV scores greater than 4 (sublethal effects, including short-term reduction in feeding rates; short-term reduction in feeding success) except for distances of 1 meter downstream when fluming waterbodies >50 feet wide in the Coos Bay Frontal-Pacific Ocean and Myrtle Creek watersheds. Except for possible failures of isolation structures that would cause TSS concentrations similar to wet open-cut procedures with exposures as long as 6 hours (discussed above), no in-stream construction would cause moderate or major physiological stress (SEV scores 6 to 8, respectively; see Newcombe and Jensen 1996) or cause lethal conditions for salmon (SEV > 8).

A failure of crossing isolation structures lasting up to 6 hours could cause a SEV score of 8 (major physiological stress; long-term reduction in feeding rate/feeding success; poor condition) up to 40 meters downstream and a SEV score of 7 (moderate habitat degradation, impact on homing) for at least 542 meters downstream from dry open cut crossings within five streams with critical habitat in the Coos Bay Frontal-Pacific Ocean watershed; SEV score of 8 up to 23 meters and SEV score of 7 up to 1,185 meters of three streams crossed by dry open-cut with critical habitat within the North Fork Coquille River watershed; SEV score of 8 up to 26 meters and SEV score of 7 up to 1,999 meters of two streams crossed by dry open-cut with critical habitat within the East Fork Coquille River watershed; SEV score of 8 up to 10 meters and SEV score of 7 up to 1,534 meters of two streams crossed by dry open-cut with critical habitat within the Olalla Creek-Lookingglass Creek watershed; SEV score of 7 up to 856 meters of four streams crossed by dry open-cut with critical habitat within the Clark Branch-South Umpqua River watershed; SEV score of 8 up to 54 meters and SEV score of 7 up to 1,544 meters of three streams crossed by dry open-cut with critical habitat within the Myrtle Creek watershed; and SEV score of 7 up to 16 meters of four streams crossed by dry open-cut with critical habitat within the Days Creek-South Umpqua River watershed. To ensure an SEV score less than 7 (moderate habitat degradation, impact on homing), in-stream work to repair a failed containment structure would likely have to be restricted to less than 4 hours. However all of these estimates of sediment and distances of effects are based on average of many parameters within a watershed. So individual stream crossing are likely to have some lower or higher values. For example, a range of sediment concentrations at a hypothetical crossings at a specific stream reach is noted in appendix Y for each of the individual reaches as modeled. So while the maximum potential severity of effects noted was SEV of 8, which is based on averages of all of the database reaches in that watershed, the estimates at some of the reaches would be higher (e.g., SEV of 9; categorized as potentially reduced growth/fish density) if actual stream crossing had similar characteristics to some of the worst case reach conditions reported in appendix Y. While it is unlikely in most potential crossing, considering the ranges presented in appendix Y, the severity of effects may be in the paralethal levels if sealing failure were to occur under some stream conditions.

Similar analyses were conducted for individual streams to be crossed in each watershed that provide critical habitat and fresh water EFH for Oregon Coast coho salmon. The specific stream value was determined by using the average values for the streams having the same width category and crossing method in the respective watershed. Based on the width-specific durations of exposure (table 3.5.4-26) and the minimum TSS concentrations and concomitant maximum distances downstream produced by fluming or dam-and-pump construction methods to equate to specific SEV scores (table 3.5.4-27), the greatest risk to Oregon Coast coho would be 1 to 2 meters downstream during fluming in streams greater than 25 feet wide within the Coos Bay Frontal and Myrtle Creek watersheds (table 3.5.4-27). At those distances, SEV = 6 would cause moderate physiological stress for juvenile or adult coho.

The possibility for known or assumed salmon-bearing streams to be affected by TSS generated during dry open-cutting neighboring streams was explored at the request of NMFS (NMFS 2017j). Distances of nearest neighboring streams from each salmon-bearing stream are included in table 3.5.4-28. Nearest-neighbor streams are only considered for effects if they are within the same fifth field watershed as the targeted stream. Distance for the confluence of a nearest neighbor stream with a coho-bearing stream is assumed to be the same as the distance between the two stream crossing sites, forming an equilateral triangle. For each neighboring stream, maximum downstream distances for minimum TSS concentrations that produced the highest SEV score were computed with the same procedure described and available in table 3.5.4-27. If a stream had bedrock substrate, dam-and-pump crossing was assumed; otherwise, a flumed crossing was assumed.

TABLE 3.5.4-28

Waterbodies with Critical Habitat and Known or Assumed to Support Oregon Coast Coho with Risks of TSS Effects Downstream Generated during Crossing and Risks of TSS Effects Generated by Crossing Nearest Neighbor Waterbodies

Waterbodies Supporting Oregon Coast Coho, Critical Habitat, and EFH								Nearest Neighbor with Risk of Downstream Effects to Coho				
Waterbodies Crossed and Waterbody ID	Pipeline Milepost (MP)	Critical Habitat	EFH	Proposed Crossing Method	OHM Width (feet)	Risk of TSS Downstream During Crossing (rationale) a/	Maximum Distance (m) Downstream from Crossing with Highest SEV Score b/	Crossing Distance (m) from Coho Stream c/	Proposed Crossing Method	OHM Width (feet)	Risk of TSS at Confluence by Crossing Nearest Neighbor (rationale) a/	Maximum Distance (m) Downstream from Nearest Neighbor with Highest SEV Score b/
Coos Subbasin (HUC 17100304), Coos Bay-Frontal Pacific Ocean (HUC 1710030403) Fifth-Field Watershed, Coos County												
Coos Bay (NE-26)	0.28 to 1.00	Yes	Migration, Rearing	HDD	N/A	None (HDD)	N/A	N/A	N/A	N/A	None (distance)	N/A
Coos Bay (NE-26)	1.46 to 3.02	Yes	Migration, Rearing	HDD	N/A	None (HDD)	N/A	N/A	N/A	N/A	None (distance)	N/A
Trib to Coos Bay (NW-117/EE-6)	6.39R	No	Unknown	Fluming	11	Moderate-High (perennial)	139 SEV=5	3,026	Fluming	24	None-Low (distance)	>1,333 SEV=0
Willanch Slough (EE-7)	8.27R	Yes	Migration, Rearing	Fluming	24	Moderate-High (perennial)	139 SEV=5	338	Fluming	13	None-Low (intermittent)	749 SEV=4
Trib. to Cooston Channel (Echo Creek) (SS-100-002)	10.21R	No	Spawning, Rearing	Fluming	9	None-Low (intermittent)	24 SEV=5	1,481	HDD	650	None (HDD)	N/A
Coos River (BSP-119)	11.13R	Yes	Migration, Rearing	HDD	650	None (HDD)	N/A	676	Fluming	6	Moderate-High (perennial)	1,031 SEV=3
Vogel Creek (SS-100-005)	11.55BR	Yes	Spawning, Rearing	Fluming	6	Moderate-High (perennial)	24 SEV=5	531	Fluming	10	None-Low (intermittent)	1,031 SEV=3
Stock Slough (BR-S-36)	15.11BR	Yes	Spawning, Rearing	Fluming	8	None-Low (intermittent)	24 SEV=5	338	Fluming	9	None-Low (intermittent	478 SEV=4
Stock Slough (EE-SS-9068)	15.32BR	Yes	Spawning, Rearing	Fluming	9	None-Low (intermittent)	24 SEV=5	338	Fluming	8	None-Low (intermittent)	478 SEV=4
Coquille Subbasin (HUC 17100305), North Fork Coquille River (HUC 1710030504) Fifth-Field Watershed, Coos County,												
Steinnon Creek (BR-S-63)	24.32BR	Yes	Migration, Rearing	Fluming	17	Moderate-High (perennial)	150 SEV=5	2,576	Fluming	3	None-Low (intermittent)	3,135 SEV=3
North Fork Coquille River (BSP-207)	23.06	Yes	Migration, Rearing	Fluming	47	Moderate-High (perennial)	268 SEV=5	547	Fluming	2	None-Low (intermittent)	977 SEV=4
Middle Creek (BSP-133)	27.04	Yes	Migration, Rearing	Fluming	48	Moderate-High (perennial)	268 SEV=5	48	Fluming	7	None-Low (intermittent)	977 SEV=4
Coquille Subbasin (HUC 17100305), East Fork Coquille River (HUC 1710030503) Fifth-Field Watershed, Coos County												
Trib. To E. Fork Coquille (BSP-77)	28.86	No	Assumed	Dam-and-Pump	8	None-Low (bedrock)	5 SEV=4	708	Fluming	6	None-Low (intermittent)	1,617 SEV=4
Trib. To E. Fork Coquille (BSP-74)	29.30	No	Assumed	Fluming	6	None-Low (intermittent)	11 SEV=5	274	Dam-and-Pump	4	None-Low (bedrock)	1,299 SEV=3
Trib. To E. Fork Coquille (BSI-76)	29.47	No	Assumed	Dam-and-Pump	4	None-Low (intermittent)	5 SEV=4	274	Fluming	6	None-Low (intermittent)	1,617 SEV=4

TABLE 3.5.4-28 (continued)

Waterbodies with Critical Habitat and Known or Assumed to Support Oregon Coast Coho with Risks of TSS Effects Downstream Generated during Crossing and Risks of TSS Effects Generated by Crossing Nearest Neighbor Waterbodies

Waterbodies Supporting Oregon Coast Coho, Critical Habitat, and EFH								Nearest Neighbor with Risk of Downstream Effects to Coho				
Waterbodies Crossed and Waterbody ID	**Pipeline Milepost (MP)**	**Critical Habitat**	**EFH**	**Proposed Crossing Method**	**OHM Width (feet)**	**Risk of TSS Downstream During Crossing (rationale) a/**	**Maximum Distance (m) Downstream from Crossing with Highest SEV Score b/**	**Crossing Distance (m) from Coho Stream c/**	**Proposed Crossing Method**	**OHM Width (feet)**	**Risk of TSS at Confluence by Crossing Nearest Neighbor (rationale) a/**	**Maximum Distance (m) Downstream from Nearest Neighbor with Highest SEV Score b/**
East Fork Coquille River (BSP-71)	29.85	Yes	Migration, Rearing	Fluming	75	Moderate-High (perennial)	604 SEV=5	596	Fluming	10	Moderate-High (perennial)	1,617 SEV=4
Trib. To E. Fork Coquille (AA-003-007B)	30.29	No	Assumed	Fluming	10	Moderate-High (perennial)	11 SEV=5	113	Fluming	10	Moderate-High (perennial)	1,617 SEV=4
Elk Creek (BSP-57)	32.40	No	Assumed	Fluming	10	Moderate-High (perennial)	11 SEV=5	64	Dam-and-Pump	5	None-Low (bedrock)	1,299 SEV=3
Trib. To Elk Creek (BSP-55)	32.44	No	Assumed	Dam-and-Pump	5	None-Low (bedrock)	5 SEV=4	64	Dam-and-Pump	10	None-Low (bedrock)	1,299 SEV=3
South Fork Elk Creek (CSP-5)	34.46	Yes	Migration, Rearing	Dam-and-Pump	15	None-Low (bedrock))	128 SEV=4	1,690	Fluming	4	None-Low (intermittent	1,617 SEV=4
Coquille Subbasin (HUC 17100305), Middle Fork Coquille River (HUC 1710030501) Fifth-Field Watershed, Coos County												
None												
South Umpqua (HUC 17100302) Subbasin, Olalla Creek-Lookingglass Creek (HUC 1710030212) Fifth-Field Watershed, Douglas County												
Trib. to Shields Creek (BSI-202)	55.90	No	Assumed	Fluming	20	None-Low (intermittent)	113 SEV=5	64	Fluming	8	None-Low (intermittent)	1,202 SEV=4
Trib. to Olalla Creek (BSI-138)	57.31	No	Assumed	Fluming	8	None-Low (intermittent)	4 SEV=5	274	Dam-and-Pump	5	None-Low (bedrock)	935 SEV=3
Olalla Creek (BSP-155)	58.78	Yes	Spawning, Rearing	Fluming	87	Moderate-High (perennial)	387 SEV=5	370	Dam-and-Pump	11	None-Low (bedrock)	2,468 SEV=3
Trib. to Olalla Creek (BSI-129)	59.65	No	Assumed	Fluming	16	None-Low (intermittent)	113 SEV=5	579	Fluming	8	None-Low (intermittent)	1,202 SEV=4
McNabb Creek (NSP-13)	60.48	Yes	Spawning, Rearing	Dam-and-Pump	12	None-Low (bedrock)	65 SEV=4	563	Dam-and-Pump	6	None-Low (bedrock)	935 SEV=3
South Umpqua (HUC 17100302) Subbasin, Clark Branch-South Umpqua River (HUC 1710030211) Fifth-Field Watershed, Douglas County												
Kent Creek (BSP-240)	63.97	Yes	Spawning, Rearing	Fluming	17	Moderate-High (perennial)	152 SEV=5	2,881	Dam-and-Pump	25	None-Low (bedrock)	2.143 SEV=2
Rice Creek (S2-04; BSP-227)	65.76	Yes	Spawning, Rearing	Dam-and-Pump	25	None-Low (bedrock)	60 SEV=4	1,916	Dam-and-Pump	30	None-Low (bedrock)	2,284 SEV=2
Willis Creek (BSP-168)	66.95	Yes	Spawning, Rearing	Dam-and-Pump	30	None-Low (bedrock)	201 SEV=4	80	Dam-and-Pump	3	None-Low (bedrock)	663 SEV=3
South Umpqua River (BSP-26)	71.27	Yes	Migration	Direct Pipe	35	None (Direct Pipe	N/A	129	Fluming	3	None-Low (intermittent)	663 SEV=3
South Umpqua (HUC 17100302) Subbasin, Myrtle Creek (HUC 1710030210) Fifth-Field Watershed, Douglas County												
Rock Creek (EE-SS-9032)	75.33	No	Assumed	Fluming	17	Moderate-High (perennial)	270 SEV=5	11	Fluming	16	Moderate-High (perennial)	270 SEV=5

TABLE 3.5.4-28 (continued)

Waterbodies with Critical Habitat and Known or Assumed to Support Oregon Coast Coho with Risks of TSS Effects Downstream Generated during Crossing and Risks of TSS Effects Generated by Crossing Nearest Neighbor Waterbodies

Waterbodies Supporting Oregon Coast Coho, Critical Habitat, and EFH								Nearest Neighbor with Risk of Downstream Effects to Coho				
Waterbodies Crossed and Waterbody ID	**Pipeline Milepost (MP)**	**Critical Habitat**	**EFH**	**Proposed Crossing Method**	**OHM Width (feet)**	**Risk of TSS Downstream During Crossing (rationale) a/**	**Maximum Distance (m) Downstream from Crossing with Highest SEV Score b/**	**Crossing Distance (m) from Coho Stream c/**	**Proposed Crossing Method**	**OHM Width (feet)**	**Risk of TSS at Confluence by Crossing Nearest Neighbor (rationale) a/**	**Maximum Distance (m) Downstream from Nearest Neighbor with Highest SEV Score b/**
Trib. to Rock Creek (EE-SS-9033)	75.34	No	Assumed	Fluming	16	Moderate-High (perennial)	270 SEV=5	11	Fluming	17	Moderate-High (perennial)	270 SEV=5
Bilger Creek (BSP-1)	76.38	Yes	Spawning, Rearing	Fluming	6	Moderate-High (perennial)	29 SEV=5	1,674	Fluming	21	Moderate-High (perennial)	2,335 SEV=4
North Myrtle Creek (NSP-37)	79.12	Yes	Spawning, Rearing	Dam-and-Pump	31	None-Low (bedrock)	323 SEV=4	48	Dam-and-Pump	8	None-Low (bedrock)	1,108 SEV=3
South Myrtle Creek (BSP-172)	81.19	Yes	Spawning, Rearing	Dam-and-Pump	41	None-Low (bedrock)	323 SEV=4	306	Fluming	2	None-Low (intermittent)	1,312 SEV=4
South Umpqua (HUC 17100302) Subbasin, Days Creek-South Umpqua River (HUC 1710030205) Fifth-Field Watershed, Douglas County												
Fate Creek (BSP-232)	88.48	Yes	Spawning, Rearing	Dam-and-Pump	20	None-Low (bedrock)	83 SEV=3	193	Dam-and-Pump	23	None-Low (bedrock)	2,170 SEV=2
Days Creek (BSP-233)	88.60	Yes	Spawning, Rearing	Dam-and-Pump	23	None-Low (bedrock)	83 SEV=3	193	Dam-and-Pump	20	None-Low (bedrock)	2,170 SEV=2
Saint John Creek (ASP-303)	92.62	Yes	Spawning, Rearing	Fluming	15	Moderate-High (perennial)	137 SEV=4	3,880	Diverted Open-Cut	160	Moderate-High (perennial)	N/A
South Umpqua River (ASP-196)	94.73	Yes	Rearing, Migration	Diverted Open-Cut	160	Moderate-High (perennial)	N/A	193	Fluming	10	None-Low (intermittent)	1,139 SEV=3
South Umpqua (HUC 17100302) Sub-basin, Upper Cow Creek (HUC 1710030206) Fifth field Watershed, Douglas County												
None												

a/ Risks from downstream TSS by crossing all streams with bedrock substrate are considered None to Low; risks of downstream TSS crossing intermittent streams are considered None to Low; risks from downstream TSS by crossing perennial streams are considered Moderate to High.

b/ Highest SEV scores for each given crossing method and stream width category in specific watershed provided in table 3.5.4-27.

c/ Distance for confluence of nearest neighbor with coho stream is assumed to be the same as the distance between the two stream crossing sites, forming an equilateral triangle.

Based on site conditions and crossing characteristics the likelihood, or risks, to coho salmon or their habitat really being affected by sediment severity modeled from the direct crossings or nearest neighbor construction was given a rating from "none" to "high." If the nearest neighbor distance to a salmon-bearing stream exceeded the maximum distance with highest SEV score downstream from the neighbor stream, then "None-Low" risk of TSS to the salmon-bearing stream produced during construction of the neighboring stream is assumed. Construction across nearest neighbors could generate some level of risk for elevated TSS concentrations in the known or assumed salmon-bearing streams crossed in the range of Oregon Coast coho. Risks from downstream TSS by crossing any stream with a bedrock substrate are considered "None-Low" because fine sediment (silt and clay) would not be mobilized in the water column; risks of downstream TSS crossing intermittent streams are considered "None-Low" because those streams would likely be dry during the in-stream construction period (ODFW 2008). Risks from downstream TSS by crossing perennial streams are considered "Moderate-High" because flowing water would be present at the time of construction. The highest risk for SEV = 5 (causing minor physiological stress) would occur at the confluence of the nearest neighbor to Rock Creek (Myrtle Creek watershed). But all other potential severity of effects would be low as SEV values at a nearest neighbor's confluence to coho-occupied and streams with critical habitat are SEV $\leq$ 4. Additionally, the dilution of sediment concentration from increased flow volume below confluences of the tributary and main stream would result in an even lower SEV level than estimated below the confluence in the main stream.

A similar analysis of sediment effects on EFH streams known to support Oregon Coast coho that are not directly crossed by the Pipeline but have a tributary that would be crossed and which could have an effect on the EFH fish-bearing stream is provided in section 4.2.3.2. However, conducting the analysis required a different methodology than used in the nearest neighbor analysis provided above for the Oregon Coast coho (see section 3.5.4).

Downstream effects and maximum SEV levels that could occur during diverted open-cut to cross the South Umpqua River at MP 94.73 are unknown. As discussed below, sediment generated by diverted open cut of the South Umpqua River would not severely impact juvenile or adult salmonids or salmon eggs or larvae downstream due, in part, to the short downstream transport distance of very coarse pebbles, but also because the grain size would not be within the range of particulates that cause adverse effects to fish under any duration of exposure. There would be short-term turbidity increases for short distances lasting for several hours during portions of the installation and removal of the diversion structures for the proposed diverted open-cut crossing of the South Umpqua River. However, suspended sediment generated during construction at this crossing would likely be less than levels that cause minor physiological stress for fish (SEV=5).

Summary of Effects of Dry Open-Cut Suspended Sediment

While the modeled results supply a reasonable estimate of likely level of effects to the Oregon Coast coho salmon ESU, the models rely on multiple input parameters (e.g., substrate composition and size distribution of fines, median substrate size (d_{50}), flow and water velocity at each stream) that are specific to fish streams in the watershed but not to specific crossing locations.

Therefore, overall summary assessment of effects considered both literature results from other pipeline crossings and the modeled results by fifth-field watershed in making overall assessments of level of effects to coho salmon. For both modeled and literature based assessment effects would be mostly short term (mostly less than 1 to 4 days) and remain near the crossing location (downstream distance a few hundred feet based on literature, and a few hundred to a few thousand feet based on models).

Modeled estimates of effects of suspended sediment to coho salmon resources from typical pipeline installation across streams would remain low to moderate (most SEV 5 or less) in the short term. These effects to coho salmon would include likely short-term avoidance, and short term reduction in feeding, minor physiological stress. Based on modeled results, effects would be similar among most of the nine fifth-field watersheds. Considering the literature based average conditions most effects (SEV mostly 4 to 7) are also expected be short-term behavioral and other sublethal (e.g., reduced feeding rate short and long term, minor to moderate physiological stress, rarely habitat degradation) for coho salmon. Based on literature values, if dry crossing methods have sealing failures in crossing, it is possible some local long-term effects (up to SEV 8) could occur to coho such as long-term reduction in feeding rate or success. Modeled result suggest similar effect (SEV 8) from failure which could result in effect on homing, and unlikely more severe effects (SEV 9) if certain basin stream conditions occurred. The occurrence of this type effect would be rare due to implementation of proper construction methods, but some system sealing failures are possible, resulting in increased suspended sediment levels and likely short term adverse effects to fish.

Overall model results, while approximating regional (watershed) conditions, are based on averages, and site-specific conditions, may vary from these averages, affecting site-specific model estimated values. The literature-based values of typical project-wide effects provides similar though slightly more severe effects, suggesting modeled watershed specific estimated effects are likely reasonable. The result for either estimating method suggest crossing would cause at least some short term adverse effects, primarily avoidance, short term feeding reduction and likely minor stress. No long-term adverse effect would likely occur to Oregon Coast coho salmon unless some major failure beyond those consider in the models occurred during construction.

Suspended Sediment – HDD

The Coos River at MP 11.13 is the only site within the riverine analysis area proposed to be crossed using HDD. At that location, Coos River is tidally influenced and the analysis of suspended sediment associated with HDD was discussed above with effects to HDD across the Coos Bay Estuary, estuarine analysis area.

Suspended Sediment – DP Crossing

DP technology would be used to cross the South Umpqua River at MP 71.3. Like HDD, DP crossings use a bentonite lubricant that theoretically could have an inadvertent return to the surface where it could enter the water contributing to suspended sediment levels. DPs are completed using an articulated, steerable MTBM mounted on the leading end of the product pipe or casing which is jacked into position using a pipe thrusting machine mounted at or near the ground surface. Soil and rock are excavated by the cutting head and removed through pressurized slurry pipes to the launching pit at a rate that is balanced with the advance rate of the machine, as the MTBM and pipe are jacked through the formation. A pipe-thrusting machine located in or near the launching pit provides the necessary force to advance the product pipe and provide the face pressure required for excavation. Small sections of pipe are welded to the back of subsequent sections after each section is advanced. Friction between the pipe and surrounding soil can create significant resistance during DP installation. To reduce the frictional resistance, over cutting is employed to create a small annular space between the pipe and external soil. The over cut is typically on the order of one to two inches.

The use of bentonite slurry helps reduce the frictional resistance between the pipe and soil as well as reducing the risk of collapse of the annulus around the pipe. Bentonite lubrication is typically added from the launch seal and from a specialized lubrication ring located behind the MTBM and in front of the jacking pipe. According to GeoEngineers' Technology Overview for Direct Pipe (see appendix E), the bentonite lubrication system used to lubricate the annulus between the product pipe and the excavation is introduced at a relatively low pressure reducing the potential for hydraulic fracture and inadvertent drilling fluid returns. Because the excavated hole is continuously supported and the risk of hydraulic fracture is low, the DP alignment can be designed much shallower than is typical for HDD. Because of the limited amount of lubricant used and relatively low pressure of this construction, the chance of any inadvertent return occurring is remote. Therefore, the chance of accidental contribution of increased suspended sediment to this crossing is unlikely and adverse effects to Oregon Coast coho salmon in this area would be unsubstantial.

Suspended Sediment – Diverted Open Cut

The diverted open-cut crossing method would require an in-stream tie-in, but it would be made in the dry behind the diversion structure. During the crossing, initial trenching would first occur on the dry side of the river; however, depending on the water levels during the season, it may be necessary to install a diversion to push or divert the flow to at least the middle of the river. Pacific Connector is proposing a diverted open-cut at the eastern crossing of the South Umpqua River at MP 94.7 because the river is too wide to utilize other dry crossing methods (flume or dam-and-pump).

The South Umpqua River channel is sufficiently flat, wide, and shallow to divert all of the river flow to one side or bank of the river while work is proceeding in the dry on the opposite bank. The eastern crossing of the South Umpqua River would require TEWAs to be located in the river and would require equipment to work in the river to place the diversion structures or dams to divert the river flow from one side of the river and then to the other. The diversion could be constructed using portadams, aqua dams, steel plates, plastic sheeting, and/or sand bags to divert the river's flow temporarily away from the work area in order to minimize contact between streamflow and the excavation and backfill activities. This would require Pacific Connector to place equipment within the stream to install, maintain, and ultimately remove the diversion structures. Pacific Connector estimates the crossing would take a minimum of 14 days to complete, including three to four days of in-stream work to install, rearrange, and remove the diversion structures.

Once the construction right-of-way has been isolated by the diversions and/or sediment control devices, trenching would proceed to approximately the middle of the river. Trench spoil would be stored within the stream channel below the diversion or sediment control structures to ensure that sedimentation from saturated materials does not flow back into the river. After the trench has been completed, a section of pipe would be placed in the trench. Trench boxes or another marker form would be placed at the end of the pipe section in the middle of the riverbed for the tie-in. The trench would be backfilled and the streambed restored to the original contour configuration, except for the immediate area around the tie-in.

The diversion structure would then be removed and rearranged to divert the flow temporarily to the other side or dry side of the river in order to minimize contact between streamflow and the excavation and backfill activities. This would again require Pacific Connector to place equipment within the stream to rearrange the diversion structures. Once the diversion structures have been properly reconfigured and extended beyond the tie-in location and the river flow diverted to the opposite side of the river, excavation for the other section of pipe would begin. Trenching would proceed across the river bed to the tie-in point in the middle of the river where it would be uncovered. Once the excavation is complete, the second pipe section would be carried in and tied into the first section. After the tie-in has been made, the streambed would be restored to its original contours and configuration and the diversions structures would be removed. Streambanks would be re-established and stabilized.

During the diverted open-cut at the eastern crossing of the South Umpqua River, multiple discharge pumps would be required to keep the tie-in area dry while the welds are being made and to control any flow seepage in the work areas. The discharge from this activity would occur to a straw bale discharge structure located in an upland area as far away from the river as possible to prevent any silt-laden water from flowing into the river.

GeoEngineers (see appendix W) provided results of sampled grain-size diameters of pebbles counted at the proposed diverted open-cut crossing site in the South Umpqua River (see table 1 in appendix W, under "Diverted Open Cut Crossing Design Support"). The smallest grain reported is 1.6 inches diameter which is classified as a "coarse" to "very coarse pebble" (see Wentworth Grain Size Chart, USGS 2003) with an approximate settling velocity (in water at 20^{o}C) of about 73 cm/sec or 0.24 feet/second. GeoEngineers also estimated discharge (cfs) in the South Umpqua River during the construction period (see table 2 in appendix W) and estimated maximum water depths and velocities under diverted flow conditions (see table 3 in appendix W). Those estimates ranged from a 4.9 feet depth with water velocity of 1.9 feet/second at discharge of 110 cfs to a 6.3 feet depth with velocity of 4.7 feet/second during discharge rate of 340 cfs. Based on the grain settling velocity (V_S), the stream flow velocity (V_A), and stream depth (D), the downstream distance (L) of grain transport is estimated by

$$L = (D \cdot V_A) / V_S$$

The composition of stream bed subsurface in the South Umpqua River channel was not sampled. However, GeoEngineers (2015) previously completed four geotechnical borings in the vicinity of the proposed crossing for the purpose of evaluating HDD feasibility. The boring logs are included in Appendix B within GeoEngineers' 2015 report. The borings were completed within the floodplain adjacent to the channel upstream of the proposed crossing location. Extrapolation of the information suggests bedrock is present at shallow depths throughout the streambed and adjacent floodplain. The depth to bedrock varied between approximately 3 feet at boring B-3 to 21.5 feet at boring B-2. Boring B-2 also included sandy gravel with cobbles between the surface and the bedrock. The pebble count conducted near the proposed crossing yielded a grain-size distribution of the existing alluvial material (GeoEngineers 2015), which is consistent with the reported grain-size distribution with the materials identified in boring B-2.

For the smallest grain sampled in the substrate (i.e., very coarse pebble), the transport distance downstream from the diverted open-cut would range from 39 feet with 110 cfs to 123 feet with 340 cfs. The sediment generated by diverted open cut of the South Umpqua River would not severely impact juvenile or adult salmonids or salmon eggs or larvae downstream due, in part, to the short downstream transport distance of very coarse pebbles, but also because the grain size would not be within the range of particulates that cause adverse effects to fish under any duration of exposure (see Newcombe and Jensen 1996). Suspended sediment generated during construction at this crossing would likely be less than levels that cause physiological stress for fish and may exceed the Oregon water quality standard for short distances and short durations downstream, either coinciding with construction across this perennial waterbody or coincidental with autumn precipitation. There would be short-term turbidity increases for short distances lasting for several hours during portions of the installation and removal of the diversion structures for the proposed diverted open-cut crossing of the South Umpqua River.

Movement Blockage

Of the 43 waterbodies with confirmed or assumed presence of Oregon Coast coho salmon, all but five would be crossed by dry open-cut. Dry open-cut construction is expected to temporarily preclude upstream and downstream movement by adult salmonids and juvenile coho. Restrictions on migration could occur from short-term elevation of sediment and method of water diversion around the stream crossing area. As discussed above, fish are expected to abandon cover and/or avoid turbidity plumes generated by in-stream construction. In-stream construction would be completed prior to most upstream migrations by Oregon Coast coho.

In addition, as described earlier block nets would be employed at all waterbody crossings in which water is present at the time of construction. Also, procedures to exclude fish from the construction right-of-way, maneuvering fish downstream of the crossing site, isolating and dewatering the construction site, removing fish from within the isolated construction site during dewatering, fish handling, holding and release, and monitoring with documentation would all be implemented.

Flumes would maintain streamflow and fish might move upstream or downstream through the flume. With the dam-and-pump method, coho salmon would not be able to move upstream or downstream through the work area until the dams have been removed. Flumes and isolation structures (e.g., dams) would be removed as soon as possible following backfilling of the trench. Overall, the presence of temporary physical structures (likely less than one up to about 4 days for flumed and dam-and-pump crossings based on typical conditions reported by Reid et al. 2004) would not cause meaningful delays to adult upstream migrating coho salmon resulting in unsubstantial effects to coho salmon individuals.

The diverted open-cut of the South Umpqua River could take about 14 days to complete. Because one channel would be open during the entire crossing, no passage of fish would be impeded and no fish removal would be required. Overall, the levels of suspended sediment and physical structures would not cause meaningful delays to adult upstream migrating coho salmon resulting in unsubstantial effects to coho salmon individuals.

Newcombe and Jensen's (1996) SEV scale includes avoidance behavior (SEV = 3), a behavioral effect that changes the activity patterns or alters the kinds of activity usually associated with an undisturbed environment (Muck 2010) and may indicate juvenile and/or adult coho in-stream movements would be affected. Likewise, an SEV score of 3 indicates a "measured change in habitat preference" in models developed by Anderson et al. (1996). SEV scores of 3 and higher due to elevated TSS concentrations are assumed to block or interfere with fish movements during durations of exposure to the suspended sediment downstream (provided in table 3.5.4-26).

Downstream distances at which SEV ≥ 3 during fluming or dam-and-pump construction in each 5th field watershed were provided in table 3.5.4-27.

Entrapment and Fish Salvage

Waterbody crossings using the "dry" crossing methods, flume or dam-and-pump, may result in some fish being entrapped in streams.

For a typical crossing, once streamflow is diverted through the flume pipe but before pipeline trenching begins, fish trapped in any water remaining in the work area between the dams would be removed and released using the *Fish Salvage Plan* (see appendix T). Salvage methods could include, seines, and/or dip nets and electrofishing (see section 3.5.4.4, Conservation Measures). Seining would be the primary method used to salvage fish but electrofishing methods may be used if all fish cannot be removed from the area potentially dewatered (see appendix T). All methods of capture and holding have risks of stress, injury, or mortality of fish. Fish inadvertently left within the dammed-off construction zone would be captured by either an ODFW biologist or a qualified consultant. Fish removal personnel would be approved by ODFW and NMFS for this listed species. Personnel who would handle and/or remove fish on federal lands would be approved by the Forest Service or the BLM or the removal would be done directly by agency personnel if approved by ODFW. Even with an approved biologist on site, some listed juvenile coho salmon fry are likely to suffer injury or mortality, but with the implementation of project conservation measures this impact would be minor. Overall, some listed juvenile coho salmon fry are likely to suffer injury or mortality but, with the implementation of project conservation measures, the numbers would be minor.

There are 89 waterbodies that would be crossed by flumed dry open-cut procedures, with an additional 22 waterbodies with bedrock streambeds that may necessitate blasting and/or use of mounted impact hammers (discussed above under *Acoustic Shock*) and require crossing with dam-and-pump construction. However, only eight of the streams with bedrock streambeds are known to support Oregon Coast coho and three others are assumed to be occupied by coho.

There are 43 streams (see table 3.5.4-2) known or assumed to support Oregon Coast coho that would be crossed by the Pipeline. There are 13 known streams that would be crossed in the Coos Bay Frontal-Pacific Ocean watershed; three known in the North Fork Coquille River; two known and six assumed streams in the East Fork Coquille River; no streams with coho presence known and one assumed would be crossed in the Middle Fork Coquille River; two streams known to have coho and three assumed in the Olalla Creek-Lookingglass Creek watershed; three streams known (not including the South Umpqua River) with coho in the Clark Branch-South Umpqua River watershed; three known and two assumed coho streams crossed in the Myrtle Creek watershed; three known in the Days Creek-South Umpqua River; and (not counting the South Umpqua River). There are no streams, known or assumed to be occupied that would be crossed in the Upper Cow Creek or Elk Creek watersheds.

Estimates of juvenile coho fry present in at crossing sites in streams were based on all rights-of-are 95 feet wide at each stream crossing within which coho would be salvaged. Numbers of juvenile coho potentially present or assumed to be present in the streams with crossed by dry open-cut (no blasting) are provided in table 3.5.4-29 and do not include numbers within streams with bedrock substrates that were provided in table 3.5.4-16. In the 23 waterbodies known or assumed to be inhabited by Oregon Coast coho that would be crossed by fluming, 768 juvenile coho fry could be displaced and or salvaged prior to construction which does not include the 287 juvenile coho fry that could be salvaged from streams with bedrock prior to blasting (see table 3.5.4-16). The estimates in table 3.5.4-29 are based on no fish being herded out of the work area prior to dewatering (see *Fish Salvage Plan* in appendix T) so the actual number that would be salvaged is expected to be much less.

TABLE 3.5.4-29

Worst-Case Estimates of Juvenile Coho Present or Assumed as Present at Streams Crossed by Dry Open-Cut (Fluming only, No Blasting Assumed) and Juveniles Salvaged Prior to Construction of the Pipeline Project within the Oregon Coast ESU

Subbasin and Fifth-Field Watersheds	Dry Open-Cut w/ Juvenile Coho Fry Present, Assumed	Juvenile Fry Present at Each Crossing a/	Total Juvenile Fry Present b/	Juvenile Fry Salvaged at Each Crossing c/	Total Juvenile Fry Salvaged d/
Coos					
Coos Bay-Frontal Pacific Ocean	7	63	440	63	440
Coquille					
North Fork Coquille River	3	37	111	37	111
East Fork Coquille River	4	40	160	40	160
Middle Fork Coquille River	0	N/A	0	N/A	0
South Umpqua					
Olalla Creek-Lookingglass Creek	4	6	24	6	24
Clark Branch-South Umpqua River	1	7	7	7	7
Myrtle Creek	3	7	21	7	21
Days Creek-South Umpqua River	1	5	5	5	5
Upper Cow Creek	0	N/A	0	N/A	0
TOTAL	**23**		**768**		**768**

a/ Juvenile Fry Present at Each Crossing based on Juveniles per Mile (see table 3.5.4-7) within a stream crossing length of 95 feet (worst case, see text).

b/ Total Juvenile Fry Present (worst case) = number of Juvenile Fry Present at Each Crossing multiplied by number of Dry Open-Cut crossings with Juvenile Coho Fry Present or Assumed.

c/ Juvenile Fry Salvaged at Each Crossing based on Juveniles per Mile (table 3.5.4-7) within a stream crossing length of 95 feet (worst case, see text).

d/ Total Juvenile Fry Salvaged (worst case) = number of Juvenile Fry Salvaged at Each Crossing multiplied by number of Dry Open-Cut crossings with Juvenile Fry Coho Present. The estimate is based on no fish being herded out of the work area prior to dewatering (see *Fish Salvage Plan*). The actual number that would be salvaged is expected to be much less.

Riparian Vegetation Removal and Modification

Vegetated areas adjacent to waterbodies have been classified/defined in different ways depending on the resource and/or management objective being analyzed. Analyses conducted for Oregon Coast coho have considered effects to riparian vegetation present within a 1SPTH buffer on either side of a waterbody on both federal and non-federal lands. This analysis area was determined in discussions with NMFS, FWS, and other federal agencies during Interagency Task Force meetings.

Riparian Reserves are areas that are managed to protect habitat for fish species, as well as other riparian-dependent plants and animals on federal lands (BLM and Forest Service lands). Riparian Reserves include areas that range in size from 1SPTH to 2SPTH buffers on either side of a waterbody, depending on the waterbody type. Analyses of coho salmon here do not consider effects to Riparian Reserves because those effects would be limited to certain federal lands and analyses provided below consider effects on all lands, hence the analysis of effects to Riparian Zones rather than to Riparian Reserves. This analysis considered all intermittent and perennial waterbodies crossed and adjacent to the Pipeline in the range of Oregon Coast coho and also included waterbodies that are not assumed to have coho present.

Aquatic resources could be affected as a result of removal of vegetation and habitat at the waterbody crossing sites as required for construction. Short-term, physical habitat disruption would occur during trenching activities. Long-term degradation of habitats could occur if the stream contours are modified in the area of the crossing; the flow patterns are changed; and if erosion of the bed, banks, or adjacent upland areas introduces sediment into the waterbody. Loss of riparian vegetation along the banks would reduce shade, potentially resulting in minor increases in water temperatures, remove an important source of terrestrial food for aquatic organisms, and decrease LW and the associated reduction in habitats, and potentially increase mass slope failures adjacent to waterbodies.

Much of the impact to coldwater anadromous and resident fisheries by past land uses have been alterations of riparian habitats by logging, road building, agriculture, or other developments such as residences and utility corridors. A total of 201.29 acres of vegetation within riparian zones one site-potential tree height wide (ranging from 164 feet wide for Days Creek-South Umpqua River watershed to 225 feet wide in Coos Bay Frontal-Pacific Ocean watershed) associated with waterbodies within range of the Oregon Coast coho ESU would be directly affected by all construction related activities. More than half of the affected vegetation (112.96 acres) would be within forested vegetation types with 16.86 acres of late successional-old growth forest and 45.82 acres of mid-seral forest would be removed within riparian zones (see table 3.5.4-30a). As discussed in section 3.5.4.2, Habitat, and data presented in table 3.5.4-10a and table 3.5.4-10b, the LW components of most aquatic habitats in watersheds occupied by Oregon Coast coho and crossed by the Pipeline are LW deficient and below benchmark conditions established by ODFW.

In forested habitats, conifer trees would be replanted within the construction right-of-way and TEWA outside of the 30-foot-wide maintenance corridor, which would revert to their pre-construction state over time. The 30-foot-wide maintenance corridor centered over the Pipeline would be maintained in an herbaceous/shrub state during the life of the project, assumed to be 50 years (see table 3.5.4-30b). Over the long-term, 4.55 acres through riparian LSOG forest and 11.44 acres through mid-seral forest would be maintained in an herbaceous/shrub state within riparian zones associated with Oregon Coast coho (see table 3.5.4-30b).

Pacific Connector would neck down to a 75-foot-wide construction right-of-way at most waterbody crossings, and maintain a setback between waterbody banks and TEWAs in forested areas. Following construction, Pacific Connector would implement measures to replant native trees and scrubs where they had been before in riparian areas, and would minimize vegetation maintenance by allowing the development of a riparian strip at least 25 feet wide to be permanently revegetated on private lands and 100 feet wide on federally-managed lands as measured from the edge of the waterbody. In forested areas, replanting of native trees would occur beyond the 25- and 100-foot-wide areas, respectively. Following planting, vegetation monitoring would occur for two to three years to ensure successful revegetation. If vegetation does not meet designated goals, additional planting would occur and monitoring would continue until the desired revegetation is achieved. Within the 30-foot-wide corridor, the plants would be maintained by periodic vegetation maintenance. As required by FERC's *Plan*, Pacific Connector consulted with the NRCS, BLM, and Forest Service regarding specific seeding dates and recommended seed mixtures for the project area (see appendix F). The recommendations have been incorporated into the Pipeline Project-specific ECRP (see appendix F). The ECRP describes the procedures that would be implemented to minimize erosion and enhance revegetation success for the entire Pipeline Project.

Overall, restricting the low-growth vegetation area to a small portion of the total riparian right-of-way clearing would allow much of ecological function of the riparian conditions relative to coho salmon needs (e.g., shade, future LW and organic input) to return more quickly. This would limit the overall long-term impacts of loss of riparian habitat to a small portion of each stream crossed, reducing future negative effects to coho salmon resources. Some limited intermediate term adverse effects to coho salmon habitat function would occur, primarily as a result of LW reduction. The effect of riparian vegetation removal on water temperature and LW are presented in the following subsections (after tables 3.5.4-30a and 3.5.4-30b).

A series of tables (M-2 through M-5, provided in appendix M) identify the areas (acres) of vegetation within riparian zones (1SPTH) affected by construction and operation of the Pipeline Project across or adjacent to waterbodies with expected Oregon Coast and SONCC coho presence, by 5th field watershed. The tables identify general vegetation (forested by age class/non-forested) within riparian zones that would be affected from the Pipeline crossing the waterbodies or from waterbodies adjacent to the Pipeline, as well as identify the acres of vegetation affected within the riparian zone that is federally designated critical habitat. Tables M-2 and M-4 identify areas (acres) of vegetation affected within Riparian Zones of waterbodies known or suspected to have Oregon Coast coho salmon presence, and tables M-3 and M-5 identify acres of vegetated affected within Riparian Zones of waterbodies known or suspected to have SONCC coho salmon presence.

Effects to waterbodies and Oregon Coast and SONCC coho due to removal of riparian vegetation and maintenance within the construction and operation corridor adjacent to but not crossed by the Pipeline Project would be similar to effects to riparian vegetation for streams crossed by the Pipeline:

- Loss of riparian vegetation along the banks would reduce shade potentially resulting in minor water temperatures increases.
- Decreased LW recruitment in streams and on adjacent uplands.
- A minor reduction in food for aquatic organisms.
- Potentially increase mass slope failures and/or erosion due to surface runoff adjacent to waterbodies that could increase sediment in the waterbody.

Where vegetation is cleared from the riparian zone of a waterbody not crossed but adjacent to the Pipeline, a vegetation buffer (of some width but less than 1SPTH) adjacent to the waterbody is expected to remain. Consequently, effects from the Pipeline would be less than those described for riparian zones and associated waterbodies that would be crossed. Riparian vegetation within 1SPTH that would be maintained in a herbaceous state within the 30-foot maintenance corridor during the life of the Pipeline is included in tables M-4 and M-5. The majority of riparian vegetation affected by the Pipeline is associated with waterbodies crossed by the right-of-way (61 percent with potential Oregon Coast coho presence and 81 percent with potential SONCC coho presence), not riparian vegetation associated with waterbodies adjacent to the right-of-way.

TABLE 3.5.4-30a

Total Terrestrial Habitat (acres) Affected/Removed (a/) by Construction within Riparian Zones (One Site-Potential Tree Height Wide) Adjacent to Perennial and Intermittent Waterbodies within Range of Oregon Coast Coho Crossed by the Pipeline Project

	Forest Habitat b/					Other Habitat b/						
Fifth-Field Watershed (Hydrologic Unit Code [HUC]) and Landowner	**Late Successional Old Growth Forest**	**Mid-Seral Forest**	**Regenerating Forest**	**Clearcut, Forest**	**Forest Total**	**Forested Wetland**	**Nonforested Wetland**	**Unaltered Nonforested Habitat**	**Agriculture**	**Altered Habitat**	**Other Total**	**Total Riparian Zone Impact (acres)**
Coos Bay Frontal Pacific Ocean (HUC 1710030403)												
BLM-Coos Bay District	2.57	0.29	3.9	0	**6.76**	0	0	0	0	1.91	**1.91**	**8.66**
Non-Federal	0.84	5.57	10.29	2.36	**19.06**	0	30.82	0	0	5.18	**36.01**	**55.07**
Watershed Total	**3.41**	**5.85**	**14.19**	**2.36**	**25.82**	**0**	**30.82**	**0**	**0**	**7.09**	**37.91**	**63.74**
North Fork Coquille River (HUC 1710030504)												
BLM-Coos Bay District	1.22	2.86	0.26	0	**4.34**	0	0.03	0	0	0.15	**0.19**	**4.53**
Non-Federal	0	1.91	1.1	0	**3**	0	0	0	0.25	0.28	**0.53**	**3.53**
Watershed Total	**1.22**	**4.76**	**1.36**	**0**	**7.34**	**0**	**0.03**	**0**	**0.25**	**0.44**	**0.72**	**8.06**
East Fork Coquille River(HUC 1710030503)												
BLM-Coos Bay District	0.25	0	1.16	0	**1.4**	0	0	0	0	0.4	**0.4**	**1.8**
Non-Federal	0	2.90	11.43	3.30	**17.63**	0	0.02	0	2.00	0.82	**2.84**	**20.47**
Watershed Total	**0.25**	**2.90**	**12.59**	**3.30**	**19.03**	**0**	**0.02**	**0**	**2.00**	**1.22**	**3.24**	**22.27**
Middle Fork Coquille River (HUC 1710030501)												
BLM-Coos Bay District	2.47	0.67	5.08	0	8.21	0	0	0	0	1.4	**1.4**	**9.62**
BLM-Roseburg District	0.96	2.25	0.1	0	3.31	0	0.01	0	0	0	**0.01**	**3.32**
Non-Federal	0.4	3.05	2.1	0.25	5.79	0.07	0	1.18	1.81	0.22	**3.27**	**9.06**
Watershed Total	**3.82**	**5.96**	**7.28**	**0.25**	**17.31**	**0.07**	**0.01**	**1.18**	**1.81**	**1.62**	**4.69**	**22.00**
Olalla Creek-Lookingglass Creek (HUC 1710030212)												
Non-Federal	1.40	2.50	1.24	0.18	**5.32**	0	0.60	0.73	0	0.29	**1.63**	**6.95**
Watershed Total	**1.40**	**2.50**	**1.24**	**0.18**	**5.32**	**0**	**0.60**	**0.73**	**0**	**0.29**	**1.63**	**6.95**
Clark Branch-South Umpqua River (HUC 1710030211)												
Non-Federal	0	5.49	1.27	0	**6.76**	0	0.28	20.61	0	0.51	**21.41**	**28.17**
Watershed Total	**0**	**5.49**	**1.27**	**0**	**6.76**	**0**	**0.28**	**20.61**	**0**	**0.51**	**21.41**	**28.17**
Myrtle Creek (HUC 1710030210)												
Non-Federal	3.78	7.03	0.44	0.08	**11.33**	0	0.20	6.88	3.41	0.70	**11.2**	**22.53**
Watershed Total	**3.78**	**7.03**	**0.44**	**0.08**	**11.33**	**0**	**0.20**	**6.88**	**3.41**	**0.70**	**11.2**	**22.53**

TABLE 3.5.4-30a (continued)

Total Terrestrial Habitat (acres) Affected/Removed (a/) by Construction within Riparian Zones (One Site-Potential Tree Height Wide) Adjacent to Perennial and Intermittent Waterbodies within Range of Oregon Coast Coho Crossed by the Pipeline Project

	Forest Habitat b/					Other Habitat b/						
Fifth-Field Watershed (Hydrologic Unit Code [HUC]) and Landowner	**Late Successional Old Growth Forest**	**Mid-Seral Forest**	**Regenerating Forest**	**Clearcut, Forest**	**Forest Total**	**Forested Wetland**	**Nonforested Wetland**	**Unaltered Nonforested Habitat**	**Agriculture**	**Altered Habitat**	**Other Total**	**Total Riparian Zone Impact (acres)**
Days Creek-South Umpqua River (HUC 1710030205)												
BLM-Roseburg District	0.36	0	0.24	0.09	**0.69**	0	0	0	0	0.11	**0.11**	**0.80**
Non-Federal	0.54	8.43	1.34	2.08	**12.39**	0	0.43	4.41	0	1.8	**6.64**	**19.03**
Watershed Total	**0.90**	**8.43**	**1.58**	**2.17**	**13.08**	**0**	**0.43**	**4.41**	**0**	**1.91**	**6.75**	**19.82**
Upper Cow Creek (HUC 1710030206)												
Forest Service-Umpqua National Forest	2.08	2.90	2.00	0	6.97	0	0.16	0	0	0.62	**0.78**	**7.75**
Watershed Total	**2.08**	**2.90**	**2.00**	**0**	**6.97**	**0**	**0.16**	**0**	**0**	**0.62**	**0.78**	**7.75**
All Fifth-Field Watersheds and Jurisdictions												
BLM-Coos Bay District	6.51	3.82	10.4	0	20.71	0	0.03	0	0	3.86	3.9	24.61
BLM-Roseburg District	1.32	2.25	0.34	0.09	4	0	0.01	0	0	0.11	0.12	4.12
Forest Service-Umpqua National Forest	2.08	2.90	2.00	0	6.97	0	0.16	0	0	0.62	0.78	7.75
Federal Subtotal	**9.91**	**8.97**	**12.74**	**0.09**	**31.68**	**0**	**0.20**	**0**	**0**	**4.59**	**4.8.0**	**36.48**
Non-Federal Subtotal	**6.96**	**36.88**	**29.21**	**8.25**	**81.28**	**0.07**	**32.35**	**33.81**	**7.47**	**9.80**	**83.53**	**164.81**
Overall Total	**16.86**	**45.82**	**41.95**	**8.34**	**112.96**	**0.07**	**32.55**	**33.81**	**7.47**	**14.40**	**88.33**	**201.29**

a/ Project components considered in calculation of habitat "Removed:" Pipeline Project construction right-of-way, temporary extra work areas, aboveground facilities, and permanent and temporary access roads (PAR, TAR).

b/ Habitat Types within Riparian Zones generally categorized as: Late Successional (Mature) or Old Growth Forest (coniferous, deciduous, mixed ≥80 years old); Mid-Seral Forests (coniferous, deciduous, mixed ≥40 but ≤80 years old); Regenerating Forest (coniferous, deciduous, mixed ≥5 but ≤40 years old); Clearcut Forests; Forested and Nonforested Wetland, Unaltered Nonforested Habitat (grasslands, sagebrush, shrublands), Agriculture and Altered Habitats (urban, industrial, residential, roads, utility corridors, quarries).

TABLE 3.5.4-30b

Total Terrestrial Habitat (acres) within the 30-foot-wide Corridor Maintained within Riparian Zones (One Site-Potential Tree Height Wide) on Federal and Non-Federal Lands within Range of Oregon Coast Coho Crossed by the Pipeline Project

Fifth-Field Watershed (Hydrologic Unit Code [HUC]) and Landowner	Forest Habitat b/					Other Habitat b/						Total Riparian Zone Impact (acres)
	Late Successional Old Growth Forest	Mid-Seral Forest	Regenerating Forest	Clearcut, Forest	Forest Total	Forested Wetland	Nonforested Wetland	Unaltered Nonforested Habitat	Agriculture	Altered Habitat	Other Total	
Coos Bay Frontal Pacific Ocean (HUC 1710030403)												
BLM-Coos Bay District	0.48	0.07	1.23	0	**1.78**	0	0	0	0	0.42	**0.42**	**2.20**
Non-Federal	0.28	1.09	2.22	0.69	**4.29**	0	5.47	0	0	0.73	**6.2**	**10.49**
Watershed Total	**0.75**	**1.17**	**3.46**	**0.69**	**6.07**	**0**	**5.47**	**0**	**0**	**1.15**	**6.62**	**12.68**
North Fork Coquille River (HUC 1710030504)												
BLM-Coos Bay District	0.30	0.91	0.02	0	**1.23**	0	0.01	0	0	0.02	**0.03**	**1.26**
Non-Federal	0	0.49	0.48	0	**0.97**	0	0	0	0.03	0.08	**0.11**	**1.09**
Watershed Total	**0.30**	**1.40**	**0.50**	**0**	**2.20**	**0**	**0.01**	**0**	**0.03**	**0.10**	**0.14**	**2.34**
East Fork Coquille River (HUC 1710030503)												
BLM-Coos Bay District	0.11	0	0.31	0	**0.42**	0	0	0	0	0	**0**	**0.42**
Non-Federal	0	0.73	2.78	0.93	**4.44**	0	0.01	0	0.23	0.22	**0.45**	**4.89**
Watershed Total	**0.11**	**0.73**	**3.09**	**0.93**	**4.86**	**0**	**0.01**	**0**	**0.23**	**0.22**	**0.45**	**5.31**
Middle Fork Coquille River (HUC 1710030501)												
BLM-Coos Bay District	0.80	0.17	0.81	0	**1.78**	0	0	0	0	0.75	**0.75**	**2.53**
BLM-Roseburg District	0.27	0.57	0.05	0	**0.89**	0	0	0	0	0	**0**	**0.89**
Non-Federal	0.14	0.97	0.46	0.06	**1.64**	0.03	0	0.27	0.57	0.04	**0.91**	**2.55**
Watershed Total	**1.22**	**1.71**	**1.32**	**0.06**	**4.31**	**0.03**	**0**	**0.27**	**0.57**	**0.79**	**1.66**	**5.97**
Olalla Creek-Lookingglass Creek (HUC 1710030212)												
Non-Federal	0.24	0.69	0.15	0.07	**1.15**	0	0.2	0.16	0	0.07	**0.44**	**1.59**
Watershed Total	**0.24**	**0.69**	**0.15**	**0.07**	**1.15**	**0**	**0.2**	**0.16**	**0**	**0.07**	**0.44**	**1.59**
Clark Branch-South Umpqua River (HUC 1710030211)												
Non-Federal	0	1.11	0.26	0	**1.37**	0	0.08	4.08	0	0.10	**4.26**	**5.62**
Watershed Total	**0**	**1.11**	**0.26**	**0**	**1.37**	**0**	**0.08**	**4.08**	**0**	**0.10**	**4.26**	**5.62**
Myrtle Creek (HUC 1710030210)												
Non-Federal	1.20	2.10	0.24	0	**3.53**	0	0.09	0.8	0.78	0.06	**1.73**	**5.26**
Watershed Total	**1.20**	**2.10**	**0.24**	**0**	**3.53**	**0**	**0.09**	**0.8**	**0.78**	**0.06**	**1.73**	**5.26**

TABLE 3.5.4-30b (continued)

Total Terrestrial Habitat (acres) within the 30-foot-wide Corridor Maintained within Riparian Zones (One Site-Potential Tree Height Wide) on Federal and Non-Federal Lands within Range of Oregon Coast Coho Crossed by the Pipeline Project

	Forest Habitat b/					Other Habitat b/						
Fifth-Field Watershed (Hydrologic Unit Code [HUC]) and Landowner	**Late Successional Old Growth Forest**	**Mid-Seral Forest**	**Regenerating Forest**	**Clearcut, Forest**	**Forest Total**	**Forested Wetland**	**Nonforested Wetland**	**Unaltered Nonforested Habitat**	**Agriculture**	**Altered Habitat**	**Other Total**	**Total Riparian Zone Impact (acres)**
Days Creek-South Umpqua River (HUC 1710030205)												
BLM-Roseburg District	0.06	0	0.08	0.02	**0.16**	0	0	0	0	0.09	**0.09**	**0.25**
Non-Federal	0	1.84	0.29	0.54	**2.67**	0	0.10	0.60	0	0.17	**0.88**	**3.54**
Watershed Total	**0.06**	**1.84**	**0.37**	**0.56**	**2.82**	**0**	**0.10**	**0.60**	**0**	**0.26**	**0.97**	**3.79**
Upper Cow Creek (HUC 1710030206)												
Forest Service-Umpqua National Forest	0.67	0.69	0.6	0	1.96	0	0.03	0	0	0.08	**0.11**	**2.07**
Watershed Total	**0.67**	**0.69**	**0.6**	**0**	**1.96**	**0**	**0.03**	**0**	**0**	**0.08**	**0.11**	**2.07**
All Fifth-Field Watersheds and Jurisdictions												
BLM-Coos Bay District	1.69	1.15	2.37	0	5.21	0	0.01	0	0	1.19	1.2	6.41
BLM-Roseburg District	0.33	0.57	0.13	0.02	1.05	0	0	0	0	0.09	0.09	1.14
Forest Service-Umpqua National Forest	0.67	0.69	0.60	0	1.96	0	0.03	0	0	0.08	0.11	2.07
Federal Subtotal	**2.69**	**2.41**	**3.10**	**0**	**8.22**	**0**	**0.04**	**0**	**0**	**1.36**	**1.40**	**9.62**
Non-Federal Subtotal	**1.86**	**9.02**	**6.88**	**2.29**	**20.06**	**0.03**	**5.95**	**5.91**	**1.61**	**1.47**	**14.98**	**35.03**
Overall Total	**4.55**	**11.44**	**9.99**	**2.31**	**28.27**	**0.03**	**5.99**	**5.91**	**1.61**	**2.83**	**16.38**	**44.63**

a/ Project components considered in calculation of habitat “Removed:” Pipeline Project construction right-of-way, temporary extra work areas, aboveground facilities, and permanent and temporary access roads (PAR, TAR).

b/ Habitat Types within Riparian Zones generally categorized as: Late Successional (Mature) or Old Growth Forest (coniferous, deciduous, mixed ≥80 years old); Mid-Seral Forests (coniferous, deciduous, mixed ≥40 but ≤80 years old); Regenerating Forest (coniferous, deciduous, mixed ≥5 but ≤40 years old); Clearcut Forests; Forested and Nonforested Wetland, Unaltered Nonforested Habitat (grasslands, sagebrush, shrublands), Agriculture and Altered Habitats (urban, industrial, residential, roads, utility corridors, quarries).

Water Temperature

Clearing the right-of-way would remove shading vegetation from uplands and riparian areas, exposing the land and water to increased sunlight, potentially resulting in direct increases in water temperatures. Additionally, indirect increases in stream water temperatures may occur as water flows over the warmer land surface and eventually reaches the waterbody (Beschta and Taylor 1988).

The effects of water temperature on salmonid life stages have been extensively reviewed by McCullough (1999), Richter and Kolmes (2005), and others. Maximum water temperatures ranging from 22 to 24°C (71.6 to 75.2°F) limit distribution of many salmonid species. No salmonids can survive water temperatures exceeding 25°C (77°F) for extended periods (Ice 2008). High water temperatures can cause migratory species (including anadromous salmonids) to delay upstream migration (Bjornn and Reiser 1991), can decrease survival of spawners by increasing metabolic rates (Ice 2008), can positively influence rates of embryo development and emergence, but can negatively influence DO concentrations, which limit rates of embryo development (Bjornn and Reiser 1991). High temperatures inversely influence solubility of oxygen in water (Ice 2008) so that introduction of organic matter with decomposition by microorganisms reduces dissolved oxygen exacerbated by high temperatures. Along with increased fines (suspended silt and clay) and decreased relative rate of oxygen input to water (reaeration) through reduction in stream flows (Ice 2008), can adversely affect various salmonid life stages. Coho upstream migration water temperature requirements are from 7.2 to 15.6°C (46.0 to 62.1°F), spawning requirements range from 4.4 to 9.4°C (42.9 to 52.9°F), and for incubation 4.4 to 13.3°C (42.9 to 61.9°F); preferred temperature is 12.1°C (60.8°F) and upper lethal temperatures range from 26.0 to 28.8°C (86.8 to 92.8°F), depending on previous acclimation temperatures (Bjornn and Reiser 1991).

Vegetative cover that provides shade, especially during summer, is one factor that regulates water temperature. Construction across waterbodies would necessitate removal of trees and riparian shrubs at the crossing locations. Available information on the effects of pipeline construction in other regions on water temperature has found no or immeasurable change. The total width of riparian area affected by shade tree removal would be small (less than 100 feet) relative to the length of any stream crossed. In one study, construction across two coldwater, fish-bearing streams in Alberta required removing forested riparian vegetation; water temperatures at construction sites and downstream did not increase above temperatures at control sites upstream from construction (Brown et al. 2002). In the Alberta study, the highest water temperature recorded was 66°F (19°C in August). In the New York study, the highest temperature was 79°F (26°C) sometime between August and October. Similarly, water temperatures measured at four coldwater streams in New York before and during pipeline construction and for three years following construction showed no short- or long-term effects on water quality parameters, including water temperature, even though such effects were expected because streambank vegetation had to be cleared, which reduced shading (Blais and Simpson 1997).

Another recent right-of-way clearing study in Oregon found little to no effect from existing and proposed right of clearing on coldwater Cascade mountain streams (Tetra Tech 2013). Monitoring of 22 existing cleared right-of-ways for transmission lines in the Cascade region along the upper North Santiam River averaging 244 feet wide found no significant temperature (peak daily average, and daily maximum) change across the clearings compared to existing uncleared areas on each of these streams. While temperature changes did occur across the clearing (average of peak daily maximum change 0.19°F/100 feet of stream), these increases were no different from the temperature changes in the uncleared wooded areas just upstream of these clearing. While these streams did retain some vegetation in the right-of-way, they were kept relatively low to ensure no issues with the power lines. Modeling of these streams using the SSTEMP (Bartholow 2002) estimated some relatively small increases, which were generally greatest for smallest streams. The model assumed all or most vegetation would be removed from banks over a 150-foot-wide projected clearing. The results for both existing (summer 2012) and projected worst-case (likely maximum summer air temperature) environmental conditions with very conservative shade assumptions (0 and 25 percent for entire 150-foot clearings) showed an average increase of about 1.1°F (median of about 0.4°F) in the modeled maximum and maximum daily mean temperature across the assumed future clearing of these 22 streams. The small size of the streams in this study affected the model results. All but 3 of the streams had flow less than one cfs and width less than 10 feet. The three larger streams had modeled maximum temperature changes ranging from 0.0 to 0.2°F. Most of these streams had relatively low to moderate temperatures (mean maximum about 55°F); therefore, these low temperature increases were generally not expected to affect fish resources (Tetra Tech 2013).

Following requests by the Forest Service, Pacific Connector had temperature models run by NSR on six different stream segments on NFS lands in the Umpqua River basin on tributaries to East Fork Cow Creek (five crossings) and on the upper Rogue River basin on Little Butte Creek (NSR 2009). While not all of these streams are in the range of Oregon Coast ESU coho salmon, they are suitably representative of likely temperature changes that could be expected of streams of similar characteristics (i.e., width, flow, slope, vegetation, etc.) in regions where the ESU is located using these model parameters. Of the three smallest streams (with base flows <0.1 cfs, widths ≤3 feet), modeled average temperature increases ranged from 1.0 to 8.6°C (1.8 to 15.4°F) right after construction. Because these streams were so small, they likely also would have temperatures reduced rapidly downstream of the clearing from ground water inflow and likely would have no measurable effects on streams they flow into downstream. The two five- and six-foot-wide streams would have estimated maximum increases ranging from 0.4 to 0.5°C (0.7 to 0.9°F), with maximum temperatures remaining at or below 15.6°C (60.1°F) in these two streams just downstream of the crossing. These temperatures would remain well within suitable range for salmonids. The largest stream (22 feet wide) estimated increase was estimated to be 0.02 to 0.1°C (0.04 to 0.2°F) depending on the temperature model. The modeled results, based on assumptions used about rate of vegetation regrowth, found that most temperature increases remained within the first five years, but were approaching pre-project temperatures within 10 years. Conditions at other streams along the pipeline route may vary from these due to site-specific differences, but these results may be fairly representative of changes that may occur at forested streams along the route. Overall results suggest that, other than the very smallest streams where fish resources would be limited, changes in temperature from vegetation removal are likely to remain small and immeasurable having unsubstantial effects on fish resources.

GeoEngineers (2017c) also used the SSTEMP model by Bartholow (2002) to estimate potential temperature effects within fourth-field watersheds where 15 proposed pipeline crossing locations along the whole route within the assumed 95-foot-wide construction corridor would be affected within the 30-foot maintenance corridor over the long term (see table 3.5.4-30b, above). A total of 12 of these are in the watershed range of the Oregon Coast coho salmon ESU and two are within the range of the SONCC coho salmon ESU. These sites are generally representative of watershed habitat conditions where project area coho salmon may be present along the Project route although not necessarily where coho salmon are directly present. The streams selected varied in size from 2 to 85 feet wide (average 29 feet), moderately large streams, with only eight of these having a less than 10-foot flowing width. Conditions modeled were based on conditions measured during late August 2010 and did not consider maximum potential air temperatures though they were likely representative of summer conditions. The average modeled increase for these 15 streams was 0.03°F, and the maximum increase among the streams was 0.03°F. Overall, these estimated changes are relatively low. They are lower than the NSR (2009) estimates for one comparable stream, but model conditions were slightly different. The GeoEngineers model assumed a 75-foot-wide clearing, whereas the NSR model assumed a 95-foot-wide clearing and other parameter differences that would contribute to the different results. The conclusion drawn by GeoEngineers (2017c) was that the magnitude of thermal impact caused by construction would not be expected to cause a thermal barrier to fish migration.

As a rule, the effect of water temperature of a non-fish-bearing tributary on water temperature of a fish-bearing receiving stream is determined as the weighted mean of the two water temperatures, weighted by respective volumes or in-stream flows. If T_1 = temperature of tributary with F_1 = flow rate, and T_2 = temperature of receiving stream with F_2 = flow rate, then the resulting water temperature T_R at the confluence of the two waterbodies would be:

$$T_R = (T_1 F_1 + T_2 F_2) / (F_1 + F_2).$$

For example, Hydrofeature N is an unnamed tributary to East Fork Cow Creek crossed at MP 111.01. Pipeline construction would increase the water temperature by 8.6°C (47.5°F) from its base temperature of 11°C (51.8ºF) (see NSR 2009). The water temperature would be increased to 19.6°C (67.3°F) but its reported summer base flow is 0.002 cfs. ODEQ measured water temperature within East Fork Cow Creek during September 1998, reported at 13.5°C (56.3°F). No in-stream flow data are available for East Fork Cow Creek but USGS (Gage 14309500) has measured flows in West Fork Cow Creek, reporting an average flow of 11.4 cfs during September. Using those data to illustrate how water temperatures would be combined by the weighted average, the resulting water temperature of Hydrofeature N and the receiving stream would be T_R = (19.6°C x 0.002 cfs + 13.5°C x 11.4 cfs) / (0.002 cfs + 11.4 cfs) = 13.501°C (56.302°F). The increase of water temperature in the receiving stream by the tributary water temperature would be immeasurable [in this illustration the increase would be 0.001°C (0.002°F)].

Pacific Connector has proposed supplemental riparian plantings as outlined in the ECRP (see appendix F) to help ensure that the core coldwater habitat temperature criteria are not exceeded at the maximum point of impact. This would include, as mitigation for loss of riparian shade vegetation, replanting the equivalent of 1:1 ratio for construction or 2:1 for permanent riparian vegetation loss (GeoEngineers 2017d).These measures are designed to speed up the rate of riparian area recovery and provide more effective shade immediately following construction. Much of the riparian area would be allowed to regrow from plantings with herbaceous plants (only 10 feet wide would be maintained without some growth) and conifer and other trees (all but 30-foot width). On small streams and to a lesser extent on larger streams, even 10- to 15-foot-high trees would supply shade, reducing solar heating effects on streams. Thus plantings and vegetation regrowth in riparian areas would help moderate potential temperature increases in the short-term (a few years). Pacific Connector would install supplemental transplanted trees on the Umpqua National Forest within the riparian areas of East Fork Cow Creek (i.e., 15 to 20 feet tall with full crowns) to increase riparian area canopy closure and placing LW and boulders to create micro-topography within the wetted stream channel (see the ECRP [appendix F]). Shading from transplanted vegetation and micro-topographic features incorporated into the final grading plan are likely to reduce the heat load enough to reduce the likelihood of measurable water temperature increases. Pacific Connector modeled the potential benefit of post project effective shade created by these mitigation measures on the Umpqua National Forest. The results of the 10-year post-project modeling time step were used to predict the benefits of the mitigation measures because the trees that would be transplanted provide at least the same shade values as predicted for this time step. The predicted water temperature changes are small, with less than a 0.3°C (0.5°F) change at the point of maximum impact, with no increase at the stream network scale (NSR 2009). Thus, based on the model, the slight effects of solar heating from clearing would gradually be reduced or completely eliminated over time, at most between 5 and 10 years. Inclusion of the measures improves the certainty that riparian area clearance and stream channel disturbance activities within the construction right-of-way would not cause measurable water temperature increases at the maximum point of impact or at the stream network scale.

Based on available information, it is anticipated that any changes in water temperature, related to 75-foot-wide right-of-way vegetation clearing[46] at waterbody crossings, are likely to be very small and undetectable through measurements, except for possibly the very smallest and often intermittent flowing streams. Any temperature changes that may occur would gradually be reduced or eliminated over time as most riparian vegetation, from plantings and natural vegetation growth, increases in size and thus increases stream shading. Adverse effects on coho salmon resources along the route would be unsubstantial due to limited distribution of any measurable changes to water temperature within the 48 waterbodies with confirmed or assumed presence of Oregon Coast coho.

Large Wood

Large logs provide in-stream hydraulic complexity, which contributes to habitat complexity and the formation and maintenance of pools, riffles and other habitats which are critical to salmonid spawning and juvenile rearing. As the size of individual logs or accumulations of logs increases, the size and stability of pools that are created also increase (Beschta 1983). Riparian forests that undergo harvesting of large trees take on secondary-growth characteristics and contribute lower quantities of woody debris than unmanaged, old-growth forests (Bisson et al. 1987). However, sufficiently wide, carefully managed riparian buffers that retain a full complement of ages, sizes, and species of native trees and vegetation can ensure adequate recruitment of LW to streams (Bisson et al. 1987; Murphy and Koski 1989).

Existing conditions associated with riparian vegetation within all 10 fifth-field watersheds in the range of the Oregon Coast coho salmon crossed by the Pipeline (see discussion related to table 3.5.4-10a and table 3.5.4-10b) are generally undesirable based on the ODFW-developed criteria (Foster et al. 2001). Streams in the watersheds are deficient in numbers of LW pieces per length of stream channel, in volume of LW, and in numbers of key pieces (60 cm or greater in diameter by 12 meters or greater in length) per unit of stream length. There are too few large conifers along most stream reaches and LW numbers, volume, and presence of key pieces tend to be below benchmark levels.

[46] It is expected riparian clearings on all flowing streams would be 75 feet wide, but if the rare case where clearing width could not be necked down, a 95-foot area temperature change would still be slight as addition clearing (about 20 percent) would unsubstantial

The Pipeline Project would remove 16.72 acres of LSOG forest and 45.75 acres of mid-seral forest within riparian zones in watersheds occupied by Oregon Coast coho (see table 3.5.4-30a), which would affect recruitment of LW at those sites. Of the total riparian forest affected (including clear-cut and regenerating forest stands, 28.01 acres would be removed in the Coos subbasin, 41.01 acres within the Coquille subbasin, and 43.10 acres within the South Umpqua subbasin.

Pacific Connector has proposed to use on-site mitigation for impacts to waterbodies by installing LW at agency- and land owner-approved and appropriate areas within the construction right-of-way across certain waterbodies (see section 3.5.4.4, Conservation Measures). The use of LW as a mitigation measure for impacts associated with in-stream construction has been documented as an effective means of creating in-stream habitat heterogeneity, reducing streambank erosion, reducing sediment mobilization (Bethel and Neal 2003), and enhancing local fish abundance (Scarborough and Robertson 2002). Placement of LW on the streambanks and in the streams can provide slight shade and increase bank stability, while vegetation is maturing following construction. Additionally, placement of LW in streams or on streambanks can provide habitat as substrate for benthic invertebrates, an important food source for salmonids, and also increase habitat for forage species with the creation of pools and enhancement of the salmonid rearing potential of an area (Cederholm et al. 1997; Slaney et al. 1997). Long-term losses of LW input would largely be mitigated through riparian replanting of conifers in the right-of-way as discussed under *Riparian Vegetation and Removal*, above. While there may be some reduction in total stream LW between short and long term, the amount would be relatively small considering the total area, at most 75 feet to 95 feet of channel, that would be initially affected; the 30-foot-wide maintenance corridor that would be absent trees during the Project; and mitigation and enhancements that would be implemented (see section 3.5.4.4, Conservation Measures). LW changes would result in minor intermediate-term adverse effects to Oregon Coast coho salmon habitat.

Streambank Erosion and Streambed Stability

The clearing and grading of the right-of-way during construction could increase erosion along streambanks resulting in higher turbidity levels in the waterbodies crossed. Alteration of the natural drainage ways or compaction of soils by heavy equipment near streambanks during construction may accelerate erosion of the banks, runoff, and the transportation of sediments into waterbodies. Streambank erosion, sedimentation, and higher turbidity levels related to the Project could affect aquatic resources, as discussed above. The degree of impact on aquatic organisms due to erosion would depend on sediment loads, stream velocity, turbulence, streambank composition, and sediment particle size.

The rootwad network of trees adjacent to stream supplies bank stability. Those within 25 feet of the stream are considered most important at providing the root source aiding in bank stability (WDNR 1997). To aid in maintaining this bank stability, Pacific Connector would cut most trees near the bank, except those in the trench line, at ground level leaving the root systems in place helping to maintain riparian stability. Roots would be removed over the trench line or from any stream banks that would need to be cut down or graded to accomplish the crossing.

To minimize these impacts, Pacific Connector would use temporary equipment bridges, mats, and pads to support equipment that must cross the waterbody (perennial, intermittent, and ephemeral if water is present) or work in saturated soils adjacent to the waterbody. Pacific Connector would also install sediment barriers, such as silt fence and straw/hay bales, across the right-of-way at the edge of waterbodies throughout construction except for short periods when the removal of these sediment barriers is necessary to dig the trench, install the pipe, and restore the right-of way. Practices to minimize streambank erosion are provided in Section 5.0 in the ECRP (see appendix F).

The FWS expressed concerns that more detailed site-specific information on bank material, streambed composition, shoreline vegetation, and other information is needed to adequately ensure that actions occurring at a stream crossing do not substantially increase streambank erosion and streambed instability. Pacific Connector, in response to these requests, has conducted an assessment of crossing conditions of all streams suitable for analysis based on the FWS risk matrix (GeoEngineers 2017d). The analysis results were addressed under *Suspended Sediment – Dry Open-Cut*, above. Briefly, GeoEngineers (2017d) rated 101 streams in the range of Oregon Coast coho based on the project impact potential at the crossing and the relative stream response potential at the crossing. Each crossing was rated as low, medium, or high for each of the two axes (all stream crossings were placed into one of nine categories, such as Low–Low, Low–Medium, and Medium–High). Crossing 43 of the streams would warrant application of typical construction practices; crossing 33 of the streams would warrant typical construction practices with BMPs for sensitive streambed, banks, or riparian revegetation conditions to be determined by Pacific Connector's EI during construction; crossing four streams would warrant typical construction practices with BMPs for sensitive streambed, banks, or riparian revegetation conditions to be selected by a qualified professional prior to construction based on site-specific information from pre-construction evaluation; crossing one stream would warrant typical construction practices with enhancement BMPs such as rootwad enhancement for bank stabilization. Pacific Connector would stabilize the construction site, including the streambanks, immediately following installation of the Pipeline. Pacific Connector would also install and maintain throughout construction sediment barriers, such as silt fence and straw/hay bales, to prevent sedimentation from surface runoff into a stream.

No crossing was rated as having both high risk of project impact potential (i.e., high risk of project impacts and high risk of site response potential) and high risk of stream and site response potential. In the range of Oregon Coast coho, Pipeline Project-typical BMPs would be applied to all streams while additional site-specific BMPs would applied to the other crossing depending on their rated category of risk. Stream crossings that are unstable can ultimately adversely affect aquatic resources through loss of local habitat and impacts to downstream habitat from the addition of highly unstable sediment increasing the recovery time of the specific site to stable conditions.

In addition, substrate characteristics and physical habitat features would be determined through pre-construction surveys, and the upper one foot of existing substrate would be replaced and other physical conditions matched during reconstruction after pipe installation. Clean spawning gravel would be top dressed as appropriate and composition would be based on pebble counts or other appropriate methods on a site-specific basis. Pacific Connector would make some exceptions to this in difficult-to-access areas, in which case native material comparable to the existing surface substrate would be used. Many of these actions would be determined prior to construction based on results of the pre-construction survey (see below) and determined by a qualified EI or suitably trained professional who would have the authority to select appropriate additional site-specific BMP construction methods, bank stability actions, revegetation types and methods to help reduce the risk of instability of the crossing and potential for future erosion (GeoEngineers 2017a).

A pre-construction survey would be conducted by a technically qualified team on all stream crossings to confirm and clarify conditions developed in the aforementioned matrix analysis. This team would be professionals qualified to assess terrestrial and aquatic habitat and the geotechnical and geomorphic conditions relative to construction across stream channels and ditches. Following these surveys, if significant changes were to occur to parameters of the risk matrix for a crossing, changes would be made to risk level and appropriate final methods of crossing and BMPs applied at each stream crossing. If any crossing is moved into the "high" project impact and "high" stream response risk matrix category, a site-specific crossing design would be developed for that site. Project construction would then move forward as described in these permit documents including implementation of special additional BMPs, as described in GeoEngineers (2017d, 2017e, and 2018a), depending on individual site conditions. For waterbodies evaluated as having Low to Moderate Project Impact Potential and Low Site or Stream Response Potential in the Risk Matrix Evaluation (the Blue management category, with Pacific Connector Project Typical Construction), BMPs potentially utilized for post-construction site restoration include seeding, planting, and hydromulch or erosion control blankets to minimize surface erosion while new vegetation becomes established, as outlined in the ECRP (see appendix F). Typical site revegetation and backfill would be used to address habitat issues at these sites.

For waterbodies evaluated as having Low to Moderate Project Impact Potential and Moderate Site or Stream Response Potential in the Risk Matrix Evaluation (the Yellow management category, having sensitive bed, bank or riparian vegetation conditions selected by the Environmental Inspector or Pacific Connector representative during construction), special, more robust BMPs (in addition to Project Typical BMPs) would include those targeting the streambed component (stratified backfill for high gradient streams, structural fill placement, bank graded/terraced to 3:1, geotextile reinforced slope, fiber rolls) and the streambank component (stream barbs/flow deflectors, toe rock placement, riprap placement, biotechnical "vegetation" riprap, tree revetments). As indicated by GeoEngineers (2018a), typical BMPs were developed for sites in the Yellow management category to address risks posed by bed and bank instability or degradation to existing high quality aquatic habitat. These site-specific BMPs were developed based on field observations of natural analog structures and widely accepted techniques for bank restoration, bed restoration, and aquatic habitat restoration techniques; typical designs of these BMPs are provided in Appendix B to GeoEngineers (2018a).

Waterbodies evaluated as having Low to Moderate Project Impact Potential and High Site or Stream Response Potential in the Risk Matrix Evaluation (the Orange management category, having sensitive bed, bank or riparian vegetation conditions selected by qualified professional prior to construction based on site-specific information from pre-construction evaluation) have the highest potential risk for short- and long-term channel stability. As described in GeoEngineers (2018a), site-specific restoration plans were developed for crossings that were assessed to be within the Orange management category based on the findings of the preconstruction surveys. The need for site-specific designs is due to more complex geomorphic or hydraulic features that increase risk of channel response to the pipeline or unique, high-value habitat features. Site-specific designs were developed using results of the preconstruction surveys, including geomorphic/hydraulic/habitat observations, topographic cross-sections, and profiles collected using a hand level and stadia rod. A written description of site-specific features and restoration priorities and design drawings are presented for each crossing in Appendix C to GeoEngineers (2018a).

For waterbodies evaluated as having High Project Impact Potential and Low to Moderate Site or Stream Response Potential in the Risk Matrix Evaluation (the Green management category, applying Project Typical BMPs with habitat enhancement BMPs), Pacific Connector would use Project Typical Construction BMPs (see above). Channels in this category typically are those that disturb a greater proportion of the existing floodplain or – in narrower streams – potentially disturb more varied aquatic habitat. During site restoration, however, particular effort would be made for opportunistic habitat enhancement BMPs as detailed from observations obtained during the pre-construction survey. These enhancements could include riparian planting to improve existing habitat conditions in the floodplain, placement of large wood or rock to improve in-stream habitat, or modification of existing riprap to improve habitat. A number of the typical BMPs included in Appendix B to GeoEngineers (2018a) were designed to maintain or enhance the aquatic habitat present in the stream. These structures will often act to create complexity in the channel by scouring pools and sorting gravels as well as by providing refugia for juvenile fish. Site-specific restoration plans are provided in Appendix C (GeoEngineers 2018a).

As a follow-up measure to help ensure crossing actions would not adversely affect stream bank and channel structure, Pacific Connector would monitor stream crossings to ensure long-term success of the restoration, maintenance of fish passage, and to identify channel erosion, scour or migration that could destabilize the site or expose the pipeline. As requested by FERC, Pacific Connector developed a monitoring plan (GeoEngineers 2018a) following consultation with a representative from FWS and NMFS (Castro 2015). The monitoring plan would be customized, where necessary, to address risks of stream crossings identified in the Risk Analysis and those identified in subsequent preconstruction surveys.

Monitoring would consist of:

- Annual visits to all stream crossings, regardless of risk level, as part of Pacific Connector's monitoring of pipeline integrity. These visits would be completed by Pacific Connector staff and would note any obvious signs of channel erosion, pipeline exposure, or major shifts in restoration elements. Potential problem areas would be subsequently visited by Pacific Connector and a geoprofessional.
- Aerial reconnaissance would be completed annually for the life of the Pipeline and stream crossings would be reviewed for major landscape changes such as channel migration and excessive erosion. Potential problem areas would be subsequently visited by Pacific Connector and a geoprofessional.
- Quarterly site visits to all sites in the Orange management category (sites with low-moderate project impact potential and high site or stream response potential, see GeoEngineers 2018a) for 2 years after construction to monitor revegetation success, structural stability of the restoration elements, any changes to fish passage potential resulting from the Pipeline, evidence of channel migration, erosion, head-cutting, or other stream channel movement that could influence stream or pipeline stability. Field measurements would be taken to monitor adjustments to the channel profile and cross-sectional area.
- Annual site visits to 15 percent of all sites in the Blue management category (sites with low-moderate project impact potential and low site or stream response potential) and 100 percent of all sites in the Yellow management category (sites with low-moderate project impact potential and moderate site or stream response potential, see GeoEngineers 2018a)

for 2 years after construction to monitor revegetation success, structural stability of the restoration elements, any changes to fish passage potential resulting from the Pipeline, evidence of channel migration, erosion, head-cutting, or other stream channel movement that could influence stream or pipeline stability. Field measurements would be taken to monitor adjustments to the channel profile and cross-sectional area.

- Annual site visits to 50 percent of the sites in the Yellow and 100 percent of sites in the Orange management category (see GeoEngineers 2018a) by a geo-professional in Years 3, 5, 7, and 10 to monitor revegetation success, structural stability of the restoration elements, any changes to fish passage potential resulting from the project, evidence of channel migration, erosion, head-cutting, or other stream channel movement that could influence stream or pipeline stability. Field measurements would be taken to monitor adjustments to the channel profile and cross-sectional area.
- Observations would be made during all site visits on the effects of cattle/elk browsing on restoration success, and of impacts associated with recreational use.
- Revegetation planning along the right-of-way is detailed in the ECRP. The ECRP describes monitoring and performance standards for revegetation.
- Records would be maintained annually to document any significant hydrologic events (flow or rainfall) that occur in between site visits. This shall be done to better understand the site response to moderate or large flood events. As gauging stations are extremely limited over the majority of the crossings along the Pipeline route, rainfall records would be used to identify the potential flooding that may occur in between scheduled monitoring events. These climatic events would be considered during annual monitoring when evaluating site response.
- Unscheduled site visits may be completed at stream crossings on BLM and Forest Service jurisdiction following localized rainfall events exceeding a 25-year rainfall intensity to monitor revegetation success, structural stability of the restoration elements, any changes to fish passage potential resulting from the Pipeline, evidence of channel migration, erosion, head-cutting, or other stream channel movement that could influence stream or pipeline stability. Field measurements would be taken to monitor adjustments to the channel profile and cross-sectional area.
- Annual reporting in Years 1, 2, 3, 5, 7, and 10 following construction would be provided to outline observations of stream crossings and any remedial action taken to restore site conditions.
- Monitoring frequency and locations may be modified in response to demonstrating site restoration success in the Annual Monitoring reports.

Overall, these actions would reduce potential adverse effects from bank and bed stability to discountable levels to listed coho salmon.

Crossing of Unstable Slopes

Potential impact to waterbodies by deep-seated landslides and shallow-rapidly moving landslide hazards on unchannelized slopes is difficult to evaluate. Slope failure near the waterbody during Pipeline operation could result in soil and sedimentation falling into the waterbody. Pacific Connector evaluated all likely unstable areas during selection of the proposed route, and moved the route as necessary to areas considered to have low risk (GeoEngineers 2017k), which are pending access with landowner permission to complete field reconnaissance to assess potential risk to the proposed pipeline. They are located near Steinnon Creek between MPs 24BR and 25BR.

Aquatic Habitat

There also are potential indirect effect to aquatic habitat from increased suspended sediment from stream crossings. The same approach utilizing TSS concentration and exposure to evaluate levels of risk to fish (Newcombe and Jensen 1996) was applied to quantifying effects of sediment on fish habitat, termed HADD of habitat by Anderson et al. (1996). HADD risk includes concentration and exposure to sediment along with sensitivity of the habitat affected. Most likely, suspended sediment would increase embeddedness of spawning gravels with increasing habitat effects closer to the construction location.

Anderson et al. (1996), utilizing the approach of Newcombe and Jensen (1996), used sediment concentration and duration to model the level of adverse effects to fish habitat based on empirical studies.

Anderson et al. (1996) described five SE ranks to habitat:

- SE 3: Measured change in habitat preference.
- SE 7: Moderate habitat degradation measured by a change in the invertebrate community.
- SE 10: Moderately severe habitat degradation as defined by measurable reductions in the productivity of habitat for extended periods (months) or over a large area (kilometers).
- SE 12: Severe habitat degradation as measured by long-term (years) alterations in the ability of existing habitats to support fish or invertebrates.
- SE 14: Catastrophic or total destruction of habitat in the receiving environment.

The Anderson et al. (1996) HADD model utilizes the same form as the Newcombe and Jensen (1996) models, that is:

$$z = a + b (\log_e x) + c (\log_e y)$$

where z = SE score, x = duration of exposure in hours, and y = concentration of suspended sediment in mg/l. However, constants a, b, and c in Newcombe and Jensen's Model 1 for juvenile and adult salmonids (a=1.0642, b=0.6068, and c=0.7384) differ in the Anderson et al., (1996) multivariate model for SE to habitat (a=0.032, b=1.008, and c=0.978). As a consequence, for any given duration of exposure (from 2 hours to 6 hours, see table 3.5.4-27), the TSS concentration that would produce a SEV = 3 in the Newcombe and Jensen Model 1 is less than the TSS concentration that would produce a SE = 3 in the Anderson et al. HADD habitat model. Because of nonlinearities in both models, the TSS concentration that would produce a SEV = 7 in the Newcombe and Jensen Model 1 is more than the TSS concentration that would produce a SE = 7 in the Anderson et al. HADD habitat model. The SEV and SE scores are more closely aligned at lower TSS concentrations than at higher concentrations for any given duration of exposure but remain fairly similar in the range of 7.

Based on the models for suspended sediment concentration and duration of exposure discussed above, estimates were made for effects to habitat of Oregon Coast coho salmon. Calculated values less than SEV 7 would likely be considered to have little or no substantial effect to functional habitat, while those equal to or greater than SEV 7 (which are similar to SE values less than 7) likely would be substantial relative to changes in functional habitat conditions for coho salmon.

In this BA, similar levels of effect due to TSS concentrations and durations of exposure are assumed to apply to coho salmon.

During a failure of dry open-cut construction, TSS concentrations of up to 361 mg/l over background TSS concentrations could last for 6 hours (see table 3.5.4-27). If that same concentration is applied in the Anderson et al. HADD model with duration of 6 hours, the SE score is >7 but ≤8, (although some stream crossing may be as high as SE of 8), indicating slightly more damage to habitat than "moderate habitat degradation measured by a change in the invertebrate community." Values in table 3.5.4-27 are based on average of watershed streams and some streams may have values of SE greater than 7. To ensure SEV or SE scores less than 7, in-stream work to repair a failed containment structure would likely have to be restricted to less than 4 hours. Thus, unless crossing failures occur in these stream crossings, there would be no substantive adverse effects to coho salmon habitat from sediment generated during stream crossings.

Freshwater Stream Invertebrates

Substrates downstream from in-stream construction sites could be impacted by sediments. Mayflies, caddisflies, and stoneflies prefer large substrate particles in riffles and are adversely affected by fine sediment deposited in interparticulate spaces (Cordone and Kelley 1961; Waters 1995; Harrison et al. 2007). Fish and benthic macroinvertebrate abundance downstream of pipeline construction sites have been reported as short-term reductions following construction-generated suspended sediment (Reid and Anderson 1999). Macroinvertebrate abundance and community composition are highly related to the degree to which substrate particles are embedded by fine material (Birtwell 1999).

Fish emigrate from construction sites and benthic taxa drift downstream to sites where sediment deposition has not affected habitat suitability (Reid and Anderson 1999). In Ontario, stream crossing construction using fluming produced less turbidity and sediment concentrations downstream than construction by wet open cutting streams; wet open cutting resulted in a significant decrease in aquatic invertebrates downstream three days post-construction (Baddaloo 1978 cited in Gartman 1984). One year after construction there were no significant differences in benthos numbers. Reid et al. (2008) summarized the results of nine wet open-cut pipeline stream crossing studies found similar results and noted all measured effects to downstream stream invertebrate population abundance or diversity (six of nine studies) were less than a year in duration with three studies having no measured effects on invertebrate abundance. In general, the percentage of type of stream benthos and invertebrate taxa affected by construction of the Pipeline would be in proportion to their abundance during the season of construction, which is likely to be relatively high as crossings would occur during the summer growing season.

Rapid colonization by benthic organisms of disturbed substrate following pipeline construction has been demonstrated elsewhere. In Pennsylvania, samples taken before and 30 days after pipeline construction revealed rapid recolonization of the disturbed and newly-exposed stream substrate by benthic macroinvertebrates (Gartman 1984). Similarly, the number and diversity of aquatic invertebrate taxa in coldwater streams in New York State were unchanged two to four years following pipeline construction from those measured prior to construction (Blais and Simpson 1997). Additionally, most studies of effects on stream invertebrates are based on wet open-cut crossings, which normally have much higher suspended sediment concentrations than the isolated dry stream crossing methods that would be used by the proposed Pipeline Project. Therefore, the overall level of effect of the pipeline crossings on freshwater stream invertebrates, unless crossing sealing failures occur, would be even less than that noted by literature and would not result in substantial reduction in growth or survival of listed coho salmon individuals.

Hydrostatic Testing

Water would be required on a one-time basis near the end of construction to hydrostatically test the pipeline. Potential impacts associated with hydrostatic testing include entrainment of fish, reduced downstream flows, and impaired downstream uses if test water is withdrawn from surface waters, and erosion, scouring, and a release of chemical additives occur as a result of test water discharge. Pacific Connector would obtain its hydrostatic test water from commercial or municipal sources or surface water rights owners, the sources of which are lakes, impoundments, and streams.

There are seven freshwater body locations within the range of the Oregon Coast coho ESU where water would be withdrawn for hydrostatic testing and/or dust control. Oregon Coast coho are present at four of these crossing locations: Coos River, East Fork Coquille River, Ollalla Creek, and South Umpqua River. An estimated total of 14.7 million gallons would be withdrawn from the seven locations.

There are 19 proposed hydrostatic test break sections that are within range of Oregon Coast coho ESU. Of those, 10 hydrostatic test break sections are within 0.5 mile of a waterbody with known Oregon Coast coho habitat. Distances separating test break from waterbodies range from 100 feet (Monkey Ranch Gulch) to over 2,000 feet. There may be some risk of discharged hydrostatic test water accidentally entering the waterbodies with designated critical habitat. Pacific Connector developed a *Hydrostatic Test Plan* (see appendix U) in consultation with the BLM and Forest Service as well as the Center for Lakes and Reservoirs and Aquatic Bioinvasion Research and Policy Institute (Portland State University) and ODEQ. This Plan outlines the general hydrostatic testing process and describes the BMPs to minimize or avoid potential effects that could result from hydrostatic testing, including accidental release of test water. One of the purposes of the plan was to develop BMPs to prevent the potential transfer of invasive species and pathogens from one watershed to another.

The discharge volume at each site ranges from about 0.2 to 3.3 million gallons at rates ranging from several hundred to several thousand gallons per minute. Total water used for all project testing would be about 65 million gallons, with about half from impoundments or lakes, and the rest from streams, including Coos River, East and Middle Forks Coquille Rivers, Ollalla Creek, South Umpqua River, Rogue River, , Klamath River and Lost River. Estimates of potential water intake amounts from streams indicate flows below intake would be reduced by less than ten percent of instantaneous flow based on typical monthly flows (cfs) during the month of withdrawal for all but one potential locations (Middle Fork Coquille River MP 50.3 at 35 percent) in the range of Oregon coast coho ESU during withdrawal (duration about 6 to 11 days at each potential location) (Ambrose 2018). Within the range of Oregon Coast ESU of coho salmon, there are eight potential water sources. This includes five streams: Coos River, East and Middle Forks Coquille River, Ollalla Creek, and South Umpqua River while the other sources are water district sources. There are some other sites under consideration but these options have not been finalized. Final selection of intake rates and sites would be reviewed by ODFW and ODWR prior to testing, so that potential effects fish habitat from flow reductions would be unlikely.

Pacific Connector would minimize the potential effects of hydrostatic testing on these watersheds by adhering to the measures in its *Hydrostatic Test Plan* (see appendix U), including screening intake hoses to prevent the entrainment of fish and other aquatic organisms, meeting NMFS screening criteria, and regulating the rate of withdrawal to avoid adverse impact on aquatic resources or downstream flows. Where test water cannot be returned to its withdrawal source, the water would be treated with a mild chlorine treatment and discharged to an upland location (at least 150 feet from streams with no direct discharge features) through a dewatering structure at a rate to prevent scour and erosion and to promote infiltration. Pacific Connector would obtain all necessary appropriations, withdrawal, and discharge permits through the OWRD. With the implementation of the *Hydrostatic Test Plan* and BMPs, and obtaining required permits, adequate measures would be in place to prevent direct or indirect effects to Oregon Coast coho salmon that may be in these stream systems.

One of the responsibilities of the EI is to oversee and confirm the activity to be in compliance with the requirements of FERC's *Plan* and *Procedures* and all other environmental permits and approvals, including the multiple plans comprising the POD (see section 4.0 in the ECRP in appendix F). For example, this would include compliance with the Oregon Water Resources water appropriation Limited Use license permit conditions, which specify water withdrawal rates and volumes from specific sources. The EI would document that these permit conditions are followed and oversee that contractor's water withdrawal pumps used to withdraw surface water would be screened according to NMFS screening criteria to prevent entrainment of aquatic species. When pumping water from a source, the pump head would be submerged and maintained on average at the center of the water column so as to prevent sucking in sediments and/or algae lying at the water level surface or sediments resting on the bed of the waterbody. The EI would also work with contractors so that the targeted ramping rate would be managed such that there is no significant decrease of river flows.

<u>Aquatic Nuisance Species</u>

NAS are aquatic species that degrade aquatic ecosystem function and benefits, in some cases completely altering aquatic systems by displacing native species, degrading water quality, altering trophic dynamics, and restricting beneficial uses (Hanson and Sytsma 2001). Currently, there are 180 reported NAS in Oregon, of which 134 are documented within the USGS hydrologic basins crossed by the Pipeline (USGS 2017).

In the riverine environments crossed by the Pipeline, largemouth bass and smallmouth bass, introduced as recreational species, prey on juvenile sockeye, coho, and Chinook salmon (Tabor et al. 2007). Management priorities in Oregon concentrate on the NAS whose current or potential impacts on native species and habitats, and economic and recreational activity in Oregon, are known to be significant (Hanson and Sytsma 2001). Some of the major potential freshwater invasive species are mussels including the zebra and quagga mussels (*Dreissena polymorpha*, and *Dreissena rostriformis bugenisis*), as well as Chytrid fungus and other species of concern.

Management priorities in Oregon concentrate on the species whose current or potential impacts on native species and habitats and economic and recreational activity in Oregon are known to be significant, known as aquatic nuisance species (Hanson and Sytsma 2001).

Pacific Connector has developed BMPs and guidelines to avoid the potential spread of the aquatic invasive species and pathogens of concern (see *Hydrostatic Test Plan*, appendix U) in consultation with the BLM and Forest Service as well as the Center for Lakes and Reservoirs and Aquatic Bioinvasion Research and Policy Institute. If determined to be feasible for hydrostatic testing requirements, all water used in hydrostatic testing would be returned to its withdrawal source location after use; however, cascading water from one test section to another to minimize water withdrawal requirements may make it impractical to release water within the same watershed where the water was withdrawn. If it is not possible to return the water to the same water basin from where it was withdrawn, Pacific Connector would employ an effective and practical water treatment method (chlorination, filtration, or other appropriate method) to disinfect the water that would be transferred across water basin boundaries. The hydrostatic test water would be treated after it is withdrawn and prior to hydrostatic testing.

As explained in the *Hydrostatic Test Plan*, Pacific Connector proposes to use a treatment of 2 ppm or 2 mg/l of free chlorine residual with a detention time of 30 minutes to treat all non-municipal surface waters that would be used as a water source for hydrostatic testing purposes. Chlorinated water would be released according to the ODEQ criteria to prevent water quality impacts, potential effects to aquatic species, and to minimize potential impacts to sensitive areas. These procedures would also be used for equipment used between waterbodies, and would include the inspection and cleaning of waterbody crossing equipment including flume pipes, pumps hoses, screens, or other materials and equipment that may be moved from waterbody to waterbody crossings to ensure it is free of dirt, grease, oil or other pollutants prior to installation and it would be steam-cleaned, if necessary. Additional supplemental invasive species protective actions for cleaning of equipment used among water bodies was developed by ODFW specifically for this project and have been incorporated by Pacific Connector in their *Hydrostatic Test Plan*.

Some items in the *Hydrostatic Test Plan* (appendix U) that would aid in ensuring invasive aquatic species are not transported between streams, including preventing the spread of quagga and zebra mussels, New Zealand mudsnail, and aquatic plant invasion, are:

- Clean all aquatic plants, animals, and mud from vehicles, boats, motors or trailers and discarding the debris in the trash. Rinsing, scrubbing, or pressure washing should occur away from storm drains, ditches, or waterways.
- Drain live wells, bilge, and all internal compartments.
- Dry equipment including boats between uses, if possible (leaving compartments open and sponging out standing water).
- Scrub or pressure wash life jackets, waders, boats, landing nets, and other gear that comes in contact with the water.
- Clean and sanitize as needed which may include heated power wash before moving establishing sanitizing areas away from areas where it may enter surface water including use of bleach solution and run through portable pumps for 10 minutes.
- Inspect everything for signs of aquatic invasive species before launching and before leaving.

<u>Mobilization of Contaminated Substances</u>

The Forest Service reported that naturally occurring mercury exists in the vicinity of the Mars Fraction lode claim located near MP 108.7 (GeoEngineers 2017k). Naturally occurring mercury is present in the disrupted soil regolith and underlying bedrock strata throughout the upper reaches of the East Fork Cow Creek watershed. Geochemical analysis of six soil samples collected along a 2,000-foot section of a previously proposed route that crossed partly through the historic Thomason mining claims near the East Fork Cow Creek has been determined to have very low concentrations of natural-occurring mercury mineralization (GeoEngineers 2017k). The Pipeline location subsequently was rerouted approximately 2.500 feet from where the samples were taken. GeoEngineers (2017k) stated that the soils underlying the currently proposed crossing of the East Fork Cow Creek are unlikely to have concentrations of naturally occurring mercury exceeding those measured in samples obtained from the previous crossing location and most likely will have lower levels.

Pacific Connector developed the ECRP with a number of temporary and permanent erosion control measures to minimize the potential for sediment to enter wetlands or waterbodies (see appendix F). As described in Attachment 1 to the *Contaminated Substances Discovery Plan* (Appendix E of the POD [appendix B to this BA]), the temporary or short-term erosion control measures/BMPs are to be employed throughout the construction phase and would be routinely monitored by an EI or authorized company representative.

The following recommendations were developed by the Forest Service in consultation with ODEQ. They were also discussed and agreed upon at the February 2, 2010 meeting to review the *Contaminated Substances Discovery Plan*:

- Within Riparian Reserves for all hydrologic features crossed by the pipeline between MP's 109 and 110 (figure 5, *Contaminated Substances Discovery Plan*) provide 100 percent post-construction ground cover on all disturbed areas. Wood fiber is the preferred material. In addition, construct water bars at 50-foot intervals.
- At hydrologic features G, J, and K (figure 5, *Contaminated Substances Discovery Plan*) assure that erosion control measures are in place before the fall rains and monitor for rilling, gullying and other forms of active erosion that may transport sediment into the aquatic environment. If rilling or gullying is occurring that may result in sediment transport into the aquatic environment, improve erosion control measures to preclude sedimentation.
- Inspect the construction corridor for sedimentation after each significant storm event (which would be more frequently than a bank-full event) or whenever there is a visual sediment plume downstream. If the sediment source is originating from the pipeline corridor, improve erosion control measures to preclude sedimentation.

The summary of the report in Attachment 1 to the *Contaminated Substances Discovery Plan* (Appendix E of the POD [appendix B to this BA]) states that the proposed pipeline construction activities within the upper East Fork Cow Creek watershed are not anticipated to disturb and expose soils and bedrock strata that contain more than low amounts of natural occurring mercury mineralization, and any sediment that is generated is not likely to reach the aquatic environment due to implementation of short-term and permanent mitigation measures outlined in Pacific Connector's ECRP and as listed in Attachment 1 to the *Contaminated Substances Discovery Plan*. Also, Galesville Dam, approximately 18 miles downstream of the crossing and at the boundary of Upper Cow Creek watershed, is a complete barrier to fish passage and the Oregon Coast coho salmon no longer occur in this watershed.

Fuel and Chemical Spills

Fisheries habitats could be adversely affected if petroleum products of a substantial quantity were accidentally discharged into aquatic environments. Such materials are toxic to algae, invertebrates and fish. Of the products likely to be present during construction, data compiled from a wide range of sources indicate that diesel fuels and lubricating oils are considerably more toxic to aquatic organisms than other, more volatile products (gasoline) or heavier crude oil (Markarian et al. 1994). Release of diesel fuel in freshwater habitats significantly reduced aquatic invertebrate densities and species richness at least 3 miles downstream but invertebrate densities recovered within a year (Lytle and Peckarsky 2001). Impacts to aquatic habitats that primarily affect aquatic substrates—hence spawning, incubating and rearing habitats—can remain for much longer periods (Markarian et al. 1994).

Equipment used for construction across waterbodies could potentially release hydraulic fluid comprised of a variety of compounds, the most common of which are mineral oil-based, organophosphate esters and polyalphaolefins (HHS 1997). Release from machinery can occur through faulty seals, hoses, sumps and reservoirs, or general system failure. Components of mineral oil and polyalphaolefins do appear to bioaccumulate in animals whereas larger molecular constituents in organophosphate esters can concentrate in fish, primarily partitioning in fat tissue (HHS 1997). In general, toxicity of organophosphate esters is greater than either mineral oil or polyalphaolefin-based hydraulic fluids when inhaled, ingested, and in contact with the skin for humans. Toxicities have not been clearly described for aquatic invertebrates or fish and would be dependent on specific chemical components (HHS 1997).

To minimize the potential for spills and any impacts from such spills, Pacific Connector's SPCCP (see appendix L) would be implemented. In general, hazardous materials, chemicals, fuels, and lubricating oils would be not be stored, nor would refueling operations or concrete coating activities be conducted within 100 feet (150 feet on BLM and Forest Service lands) of a wetland or waterbody in accordance with FERC's Procedures (see appendix C) and the SPCCP (see appendix L) except where no reasonable location is possible and additional containment steps have been taken. The SPCCP would be updated with site-specific information prior to construction. Adherence to these plans and procedures would prevent substantial adverse effects to the listed Oregon Coast coho salmon from Project-related oil product uses.

Effects to Hyporheic Exchange

The hyporheic zone is defined by the extent of surface-subsurface mixing, the hyporheic exchange that moves surface water into the surrounding alluvium and back to the river again through the porous sediment surrounding a river (Tonina and Buffington 2009). The downwelling flows of surface water supply the wetted hyporheic zone with dissolved oxygen, which sustains organisms in the aerobic environment but decomposition of organic materials in the hyporheic zone may deplete oxygen concentrations in return flows to the surface (Findlay et al. 1993; Tonina and Buffington 2009). Alternatively, nutrient enrichment to surface waters occurs with hyporheic exchange by upwelling flows (Valett et al. 1990). For example, hyporheic flow is important for surface water/groundwater interactions that influence bull trout spawning sites and use of other habitats (e.g., juvenile rearing, migration) (FWS 2005g) and presumably those of other salmonids.

GeoEngineers (2017j) developed a ranking procedure to qualitatively evaluate site conditions at waterbody crossings and the probable influence on hyporheic flow and whether a stream channel will have an active and functional hyporheic zone. The procedure assigns a value of 1 to 5 for different criteria: alluvial vs. bedrock substrate, substrate sediment size, stream flow period, presence of an upstream drainage basin, and channel gradient vs. percent drainage area contribution to the fifth-field HUC upstream from the pipeline crossing. The procedure includes weighting factors emphasizing importance of some criteria over the others. In the range of Oregon Coast coho, there was a total of 7 stream crossings evaluated in the Coos subbasin, 37 evaluated in the Coquille subbasin, and 67 stream crossings evaluated in the South Umpqua subbasin. None of the crossings in the Coos subbasin and only 1 crossing in the Coquille subbasin (Middle Fork Coquille River watershed) was evaluated as having high sensitivity to hyporheic zone alteration. Further, 8 crossings in the South Umpqua subbasin (2 in Myrtle Creek, 3 in Clark Branch-South Umpqua River, and 1 each in the remaining three watersheds crossed) were evaluated as having high sensitivity to hyporheic zone alteration. In all, 30 stream crossings in the three subbasins had moderate sensitivities and the remaining 62 crossings scored low sensitivity to hyporheic zone alteration.

Construction of the pipeline using dry open cut construction would require removal of native streambed and bank material from the stream. The subsequent burial of the pipeline would involve replacing those native materials back in the streambed and stream banks. At crossings with steep natural stream banks (e.g., slopes steeper than 3H:1V [horizontal to vertical]), additional stabilization measures such as compaction of backfill may be required that could locally alter stream bank permeability from pre-construction conditions. Removal and replacement of native stream material has the potential to locally disrupt the structure and organization of the hyporheic zone in the immediate area of the pipeline crossing. However, such alterations would be expected to be minimal relative to adjacent unaffected streambed and stream banks and could either increase or decrease permeability over an extremely narrow segment of a stream channel, up to 12 feet in width at the maximum trench width. Local disruption of hyporheic function by construction and presence of the pipeline would not be expected to result in measurable effects to dissolved oxygen and/or nutrient enrichment and would not adversely affect coho.

BMPs that reduce the potential impacts to the hyporheic zone include the following:

- Native material that is removed from the pipeline trench during excavation across stream channels would be used to backfill once the pipe is in place in order to minimize potential changes to preconstruction permeability.
- Trench plugs would be installed at the base of slopes adjacent to wetlands and waterbodies and where needed to avoid draining of wetlands or affecting the original wetland or waterbody hydrology.

While the potential impact of pipeline construction on hyporheic exchange is considered to be low at all stream crossings considering the proposed construction methods, Pacific Connector proposes these additional measures to further reduce the potential for even localized impacts to water quality from hyporheic exchange at the stream crossings identified as having high hyporheic sensitivity (Appendix A to GeoEngineers 2017j):

- Document streambed stratigraphy prior to construction if possible, or if not possible, during construction to aid in site restoration. Such documentation would be conducted by staff trained in recognizing and observing river channel processes. If done during construction, this may be performed by the EI after receiving suitable training.

- Segregate active streambed gravels and cobbles from underlying streambed materials (including fractured bedrock) to their natural depth and replace gravels/cobbles to this natural pre-construction depth.
- Below active stream gravels, replace native material in a manner to match upstream and downstream stratigraphy and permeability to the maximum extent practicable.

Runoff from Permanent, Temporary, Existing Access Roads (PARs, TARs, EARs), TEWAs, and Culvert Installation

Runoff from PARs, TARs, EARs, TEWAs, and culvert installation can result in sediment delivery affecting stream supporting Oregon Coast coho. Pacific Connector proposes to construct three new TARs and four new PARs within the range of Oregon Coast coho (table 3.5.4-31). Potential for sediment delivery to streams following construction of the roads was evaluated by applying sediment and drainage assessment components of the WARSEM (Dube et al. 2004) which has been previously applied in Oregon (Surfleet et al. 2011). Specific WARSEM components have been used to evaluate levels of risk for delivery of sediment to streams nearest each TAR and PAR as well as nearest streams supporting ESA-species. Two TARs have low risks of sediment delivery to any stream but only one TAR has a low risk of delivery to an ESA stream – North Fork Little Butte Creek which supports Oregon Coast coho with designated critical habitat. None of the other proposed TARs and PARs have any risk of sediment delivery to streams closest to new road sites.

Similar risk analyses were conducted for portions of EARs that are known to occur within 1SPTH of streams with designated critical habitat for coho and other streams known or assumed to provide habitat for coho in the two ESUs. Finally, TEWAs that are proposed within 1SPTH of critical habitat for coho were evaluated for risks of sediment delivery to coho critical habitat. BMPs)proposed by Pacific Connector that would be applied to PARs, TARs, EARs, and TEWAs to prevent sediment delivery in coho critical habitats and other coho-bearing streams are summarized from the ECRP (appendix F).

The risk analysis utilizes four modelling components required for sediment and drainage assessment as applied in WARSEM. The components that were evaluated for each TAR/PAR include:

- Dominant lithology – information source: Oregon Department of Geology and Mineral Industries, Oregon Geologic Data Compilation 6 (OGDC-6 geodatabase) available from http://www.oregongeology.org/sub/ogdc/index.htm. Dominant lithology coinciding with locations of each PAR or TAR was evaluated at each location.
- Road gradient – evaluated gradient at each PAR or TAR on topographic map using contour lines (rise divided by run) if road gradient >5 percent grade. If less than 5 percent, gradient was noted as 0 – 5 percent.
- Annual rainfall – information source: Western Regional Climate Center, Western U.S. Climate Historical Summaries available from https://wrcc.dri.edu/Climsum.html. Annual rainfall at each location was evaluated by adjusting the average total precipitation for snowfall during the period of record for National Weather Station closest to each PAR or TAR.

- Delivery – evaluated closest distance of each PAR or TAR to any stream segment (perennial or intermittent, using National Hydrography Dataset, available at https://nhd.usgs.gov/data.html) and to each stream segment supporting ESA-listed fish using ODFW Oregon Fish Habitat Distribution Data available at https://nrimp.dfw.state.or.us/nrimp/default.aspx?pn=fishdistdata. In addition, distances of nonforested and forested vegetation intervening between road and stream segment were measured using GIS.

Technical documentation (Appendix A) in Dube et al. (2004) was used to evaluate levels of risk for erosion and sediment delivery contributed by each of these four site-specific components at each proposed PAR or TAR.

In addition to site-specific conditions, Pacific Connector has specified road lengths and widths for each proposed PAR or TAR. Although road surfacing has not been specified, Pacific Connector has proposed surfacing enhancements as necessary in Section 2.3 of the *Transportation Management Plan* (see POD [appendix B to this BA]). Road length, width, and surfacing are required components for use in WARSEM as well as daily average traffic volume, which is currently unknown but may be hypothesized using categorical traffic levels in technical documentation for WARSEM (Appendix A, in Dube et al. 2004) and a road age factor which is irrelevant to the evaluation of risk for sediment production since none of the proposed roads have been constructed.

The following components required for WARSEM cannot be evaluated for the PARs and TARs:

- Road prism geometry
- Cutslope height
- Cutslope cover
- Drainage ditch width
- Drainage ditch condition

WARSEM estimates the average annual amount of road surface erosion that is delivered to a stream from each road segment modeled by using calculations based on empirical relationships derived from road erosion research (Dube et al. 2004). The model uses the following formulas to calculate road surface erosion and delivery to a stream:

Total Sediment Delivered to a Stream from each Road Segment (in tons/year) = (Tread & Ditch Sediment + Cutslope Sediment) x Road Age Factor

Tread & Ditch = Geologic Erosion Factor x Tread Surfacing Factor x Traffic Factor x Segment Length x Road (Tread + Ditch) Width x Road Gradient Factor x Rainfall Factor x Delivery Factor

Cutslope = Geologic Erosion Factor x Cutslope Cover Factor x Segment Length x Cutslope Height x Rainfall Factor x Delivery Factor

New TARs and PARs. Some of the relevant information used to derive various "Factors" necessary for WARSEM are provided in the tables, below. Percent gradient at locations of proposed TARs and PARs and the associated Road Slope Factor is provided in table 3.5.4-31. The gradient of a road segment influences the erosion rate. Three Road Slope Factors are used in

WARSEM and apply to gradients estimated in table 3.5.4-31. The steepest gradient estimated for any proposed road was 20 percent for TAR-101.70 which corresponds to a Road Slope Factor of 2.5. Except for that road, the other the proposed road locations are on relatively flat terrain with gradients estimated from zero to 5 percent and Road Slope Factors of 0.2.

TABLE 3.5.4-31

Location and Physical Characteristics for Proposed TARs and PARs in Range of Oregon Coast Coho

Road Identification	Fifth Field Watershed	Latitude	Longitude	Length (feet)	Width (feet)	Surface Area (acres)	Gradient (Road Slope Factor) a/
TAR-27.06	North Fork Coquille River	43°10'36.344"N	124°1'37.944"W	1,500	20	0.69	0 to 5% (0.2)
TAR-29.92	East Fork Coquille River	43°9'28.876"N	123°59'25.81"W	2,249	16	1.03	0 to 5% (0.2)
TAR-88.69	Days Creek-South Umpqua River	42°59'17.891"N	123°5'57.096"W	416	20	0.19	0 to 5% (0.2)
TAR-94.81	Days Creek-South Umpqua River	42°55'55.686"N	123°2'14.79"W	114	20	0.05	0 to 5% (0.2)
TAR 101.70	Days Creek-South Umpqua River	42°51'29.524"N	123°0'11.673"W	1,517	25	0.69	20% (2.5)
PAR-15.07	Coos Bay-Frontal Pacific Ocean	124°8'11.584"N	43°20'13.082"W	258	25	0.15	0 to 5% (0.2)
PAR-29.48	East Fork Coquille River	123°59'44.13"N	43°9'23.464"W	85	25	0.04	0 to 5% (0.2)
PAR-48.58	Middle Fork Coquille River	123°42'58.591"N	43°3'2.731"W	222	25	0.13	0 to 5% (0.2)
PAR-59.58	Olalla Creek-Lookingglass Creek	123°31'13.339"N	43°4'46.221"W	105	25	0.07	0 to 5% (0.2)
PAR-71.46	Clark Branch-South Umpqua River	123°19'41.662"N	43°3'13.832"W	692	25	*0.84*	0 to 5% (0.2)
PAR-80.03	Myrtle Creek	123°11'35.585"N	43°3'6.44"W	92	25	0.05	0 to 5% (0.2)
PAR-94.66	Days Creek-South Umpqua River	123°2'26.5"N	42°55'58.579"W	501	25	0.29	0 to 5% (0.2)

a/ Road Slope Factors: 0.2 for gradients of <5%; 1.0 for gradients of 5-10%; 2.5 for gradients >10%. See Table A-6, Appendix A, Dube et al. 2004

Erodibility of a road segment is related to soil characteristics at the site location which are related to the parent lithology and weathering. Relative erodibility for different rock types of different geologic ages that are associated with proposed TARs and PARs are provided in table 3.5.4-32 as the Geologic Erosion Factor corresponding to each lithology. The highest Geologic Erosion Factor (5) is associated with Quaternary and Tertiary volcanic ash and tuff as well as with weathered granite and other intrusive rocks. Deeply weathered sedimentary rocks that degrade to silt and sand also have the highest Geologic Erosion Factor (5). Weathered schist or gneiss from the Tertiary and older formations have moderate Geologic Erosion Factor (2), and others in table 3.5.4-32 have low Geologic Erosion Factor (1).

Rainfall strongly influences erosion and sediment transport. Instead of using the PRISM climatic model as applied in WARSEM), data from NWS cooperating stations closest to each proposed TAR and PAR were used to evaluate average annual rainfall (average monthly precipitation adjusted for average monthly snowfall, described in Equation 6, Appendix A, Dube et al. 2004) for each station's period of record. That information is provided in table 3.5.4-32. A Rainfall Factor, derived from the average annual rainfall at the closest NWS station, is computed from Equation 7, Appendix A, Dube et al. (2004) and provided in table 3.5.4-32. In general, average annual rainfall and Rainfall Factors for proposed TARs and PARs decline with distance along the Pipeline route from west to east.

TABLE 3.5.4-32

Surface Lithology and Average Annual Total Rainfall Estimated at the National Weather Service Station (NWS) Closest to Each Proposed TAR and PAR in Range of Oregon Coast Coho.

Road Identification	Dominant Lithology a/	Geologic Erosion Factor b/	Closest NWS Station (NWS Number) c/	Period of Record	Station Distance to Road (miles)	Average Annual Rainfall d/ (inches)	Rainfall Factor e/
TAR-27.06	Quaternary fluvial terrace deposits	high (5)	Dora 2 W (352370)	1969-1999	1.4	59.15	**7.3**
TAR-29.92	Quaternary fluvial terrace deposits	high (5)	Dora 2 W (352370)	1969-1999	0.6	59.15	7.3
TAR-88.69	Jurassic granitic plutonic rocks	high (5)	Myrtle Creek 8 NE (355891)	1980-2007	7.4	38.74	3.9
TAR-94.81	Quaternary fluvial terrace deposits	high (5)	Riddle 2 NNE (357169)	1961-1990	15.9	30.18	2.7
TAR 101.70	Triassic/Jurassic serpentinite melange	low (1)	Riddle 2 NNE (357169)	1961-1990	18.9	30.18	2.7
PAR-15.07	Quaternary alluvium and estuarine sediments	high (5)	Fairview 4NE (352775)	1974-2016	7.8	66.51	8.7
PAR-29.48	Eocene mudstone and turbidite sandstone	low (1)	Dora 2 W (352370)	1969-1999	0.7	59.15	7.3
PAR-48.58	Eocene marine sedimentary rocks	low (1)	Reston (357112)	1909-2004	7.4	48.8	5.5
PAR-59.58	Quaternary fluvial terrace deposits	high (5)	Upper Olalla 1N (358788)	1978-2016	3.4	40.52	4.1
PAR-71.46	Jurassic/Cretaceous semischist and phyllite	moderate (2)	Myrtle Creek 8NE (355891)	1980-2007	8.3	38.74	3.9
PAR-80.03	Jurassic mafic composition lithologies	low (1)	Myrtle Creek 8NE (355891)	1980-2007	2.5	38.74	3.9
PAR-94.66	Quaternary surficial deposits	high (5)	Myrtle Creek 8NE (355891)	1980-2007	12.4	38.74	3.9

a/ Dominant Lithology evaluated from Oregon Department of Geology and Mineral Industries, Oregon Geologic Data Compilation 6. Available from http://www.oregongeology.org/sub/ogdc/index.htm.

b/ Geologic Erosion Factor surmised from Figure A-1 and Table A-1 in Appendix A, Dube et al. 2004.

c/ Closest NWS Station (with Cooperator Number) based on coordinates provided in individual station data, available from Western Regional Climate Center, Western U.S. Climate Historical Summaries (available from https://wrcc.dri.edu/Climsum.html).

d/ Average Annual Rainfall derived from average monthly precipitation adjusted for average monthly snowfall, described in Equation 6, Appendix A, Dube et al. (2004).

e/ Rainfall Factor derived from the average annual rainfall at the closest NWS station, computed using Equation 7, Appendix A, Dube et al. (2004).

The Delivery Factor is a key component of WARSEM and subsequent estimation of risks by erosion and road-generated sediments to aquatic resources. Sediment transport is dependent on the slope of the hillside, infiltration capacity of the soils, volume and depth of runoff water, and obstructions on the hillside (e.g., effectiveness of vegetative buffers at trapping sediment) that would slow runoff water and trap the sediment (Dube et al. 2004). While roads farther than 200 feet from a stream are assumed not to deliver sediment to streams unless a gully exists that allows for transport of sediment from the road to the stream, roads within 100 to 200 feet of a stream are assumed to allow for delivery of 10 percent of produced sediment; roads less than 100 feet from a stream allow for delivery of 35 percent of produced sediment, and drainage from a road to a stream allows for 100 percent of produced sediment (see Table A-10, Appendix A, Dube et al. 2004).

This simplified scheme identifies four levels for the Road Delivery Factor in WARSEM: 0, 10, 35, and 100 (see table 3.5.4-33). Although vegetation characteristics are not factors in WARSEM, distances through nonforested and forested vegetation that intervene between each proposed road and the closest stream (and closest stream supporting ESA species) are included in table 3.5.4-33. The highest Road Delivery Factor in table 3.5.4-33 is 100 (indicating delivery of 100 percent of sediment produced by the new road) for PAR-15.07 which crosses Laxstrom Gulch, a tributary to Stock Slough and a waterbody that supports Oregon Coast ESU coho which is designated critical habitat for the ESU. PAR-71.46 also crosses an intermittent tributary to the South Umpqua River (Road Delivery Factor = 100), but the tributary does not support ESA-listed species. None of the other TARs and PARs are less than 100 feet from any stream that supports Oregon Coast coho.

TABLE 3.5.4-33

Estimated Risks for Sediment Delivery to Any Closest Stream and Closest Stream with ESA Species from Each Proposed TAR and PAR in Range of Oregon Coast Coho with Distances of Vegetation Intervening between Road and Stream

Road ID	Closest Stream (distance)	Flow a/	Intervening Vegetation (distance)	Road Delivery Factor b/	Closest ESA Stream (distance)	Intervening Vegetation (distance)	Road Delivery Factor b/
TAR-27.06	Middle Creek c/ (109 ft)	P	Nonforested (30 ft) Forested (73 ft)	10	Middle Creek c/ (109 ft)	Nonforested (30 ft) Forested (73 ft)	10
TAR-29.92	East Fork Coquille R. c/ (360 ft)	P	Nonforested (260 ft) Forested (100 ft)	0	East Fork Coquille R. c/ (360 ft)	Nonforested (260 ft) Forested (100 ft)	0
TAR-88.69	Days Creek c/ (132 ft)	P	Nonforested (0 ft) Forested (132 ft)	10	Days Creek c/ (132 ft)	Nonforested (0 ft) Forested (132 ft)	10
TAR-94.81	Lick Creek (105 ft)	P	Nonforested (70 ft) Forested (35 ft)	10	Lick Creek (105 ft)	Nonforested (70 ft) Forested (35 ft)	10
TAR 101.70	Trib. to Stouts Creek (220 ft)	I	Nonforested (120 ft) Forested (100 ft)	0	Stouts Creek (7,200 ft)	Nonforested (2800 ft) Forested (4400 ft)	0
PAR-15.07	Laxstrom Gulch c/ (0 ft)	P	None	100	Laxstrom Gulch c/ (0 ft)	None	100
PAR-29.48	Trib. E. Fk. Coquille R. (300 ft)	P	Nonforested (40 ft) Forested (260 ft)	0	East Fork Coquille R. c/ (600 ft)	Nonforested (430 ft) Forested (170 ft)	0
PAR-48.58	Deep Creek (103 ft)	I	Nonforested (40 ft) Forested (260 ft)	0	None	N/A	N/A
PAR-59.58	Trib. to Olalla Creek (270 ft)	P	Nonforested (270 ft) Forested (0 ft)	0	Olalla Creek c/ (1,180 ft)	Nonforested (1180 ft) Forested (0 ft)	0
PAR-71.46	Trib. to So. Umpqua R. (0 ft)	I	Nonforested (270 ft) Forested (0 ft)	100	South Umpqua River c/ (275 ft)	Nonforested (160 ft) Forested (115 ft)	0
PAR-80.03	Trib. to North Myrtle Ck. (490 ft)	I	Nonforested (4900 ft) Forested (0 ft)	0	School Hollow c/ (2,215 ft)	Nonforested (2215 ft) Forested (0 ft)	0
PAR-94.66	South Umpqua River c/ (320 ft)	P	Nonforested (60 ft) Forested (260 ft)	0	South Umpqua River c/ (320 ft)	Nonforested (60 ft) Forested (260 ft)	0

a/ Flow: P = Perennial, I = Intermittent/Ephemeral
b/ Road Delivery Factor: in WARSEM = 0, 10, 35, and 100 see Table A-10, Appendix A, Dube et al. (2004).
c/ Supporting Oregon Coast ESU Coho and Critical Habitat

The products of three site-specific erodibility factors - Road Slope, Rainfall, and Geologic Erosion factors – are provided in table 3.5.3-31. The product of the three factors represents a calculated level of risk for erosion from each road's surface and has been ranked as Low (product <1), Moderate (product from 1 to 5), and High (product >5). The largest three factor product is 8.7 for PAR-15.07 due to a high Rainfall Factor and high Geologic Erosion Factor. Table 3.5.4-34 also includes the Road Delivery Factor for any stream closest to each proposed road. The four factor products (including the three Site Erodibility Factors and Road Delivery factor for any closest stream) have been ranked as None (product of 0), Low (product >0 to 20), Moderate (product >20 to 50), and High (product >50).

The risk analysis indicates there are two PARs (PAR-15.07 and PAR-71.46) with high risks of sediment delivery to any stream but only one PAR (PAR-15.07) has a high risk of sediment delivery to an ESA stream with critical habitat (Laxstrom Gulch). Three TARs (TAR-27.06, TAR-88.69, and TAR-94.81) have a moderate risk of sediment delivery to any stream and two of them have same moderate risk of delivery to ESA streams that support Oregon Coast coho with designated Critical Habitat (Middle Creek and Days Creek).

TABLE 3.5.4-34

Summary of New Road Erosion Risks and Risks of Sediment Delivery to any Stream and ESA Stream Closest to Proposed TARs and PARs in Range of Oregon Coast Coho

	New Road Site Erodibility Factors					Any Stream Closest to New Road			ESA Stream Closest to New Road		
Road Identification	**Road Slope Factor a/**	**Rainfall Factor b/**	**Geologic Erosion Factor b/**	**Three Factor Product**	**Road Erosion Risk**	**Road Delivery Factor c/**	**Four Factor Product with Delivery**	**Risk of Sediment Delivery to Any Stream**	**Road Delivery Factor c/**	**Four Factor Product with Delivery**	**Risk of Sediment Delivery to ESA Stream**
TAR-27.06	0.2	7.3	5	7.3	High	10	73	Moderate	10	73	Moderate
TAR-29.92	0.2	7.3	5	7.3	High	0	0	None	0	0	None
TAR-88.69	0.2	3.9	5	3.9	Moderate	10	39	Moderate	10	39	Moderate
TAR-94.81	0.2	2.7	5	2.7	Moderate	10	27	Moderate	10	27	Moderate
TAR-101.70	2.5	2.7	1	6.8	High	0	0	None	0	0	None
PAR-15.07	0.2	8.7	5	8.7	High	100	870	High	100	870	High
PAR-29.48	0.2	7.3	1	1.5	Moderate	0	0	None	0	0	None
PAR-48.58	0.2	5.5	1	1.1	Moderate	0	0	None	N/A		N/A
PAR-59.58	0.2	4.1	5	4.1	Moderate	0	0	None	0	0	None
PAR-71.46	0.2	3.9	2	1.6	Moderate	100	156	High	0	0	None
PAR-80.03	0.2	3.9	1	0.8	Low	0	0	None	0	0	None
PAR-94.66	0.2	3.9	5	3.9	Moderate	0	0	None	0	0	None

a/ Slope Erosion Factors from table 3.5.4-31.
b/ Rainfall Factor and Geologic Erosion Factor from table 3.5.4-32.
c/ Road Delivery Factor from table 3.5.4-33.

EARs. A similar analysis was conducted for EARs that could potentially be utilized during project construction, accessing the construction right-of-way and other project components. The following analysis is limited to segments of EARs that are within 1SPTH from streams within range Oregon Coast coho, including designated critical habitats. EARs include federally-managed roads located on federally-managed lands and privately-owned lands that would be used/authorized during timber removal, construction, and operations to access the construction and operational right-of-way.

There are 79 EAR segments with dirt surfaces and 93 segments with gravel surfaces within 1 SPTH of streams in range of Oregon Coast coho. Of those, only eight segments with dirt surface EARS and 10 with gravel surfaces are within 1 SPTH riparian zones of streams with critical habitat for Oregon Coast coho. Risk estimates for sediment delivery from each of those EARs to 14 streams with critical habitat in range of Oregon Coast coho are summarized in table 3.5.4-35 utilizing the same data sets and factors (Road Slope Factor, Rainfall Factor, Geologic Erosion Factor, and Road Delivery Factor) described above for streams closest to new proposed TARs and PARs. In addition, the Road Surface Factor (1 for dirt, 0.5 for gravel) is included in a Five Factor Product is assumed to represent a level of risk for erosion from each road's surface and has been ranked as Low (product <10), Moderate (product from 10 to <100), and High (product >100) in table 3.5.4-35.

The largest five factor product in table 3.5.4-35 is 605 for the EAR associated with Wallanch Slough due to its dirt surface, high Rainfall Factor, high Geologic Erosion Factor, and direct delivery of sediment assumed since the road crosses Wallanch Slough, apparently over a structure downstream from the pipeline crossing. EARs crossing Laxstrom Gulch, also in the Coos Bay Frontal-Pacific Ocean Watershed, Steele Creek in the North Fork Coquille River Watershed, and South Fork Elk Creek in the East Fork Coquille Watershed pose high risks for sediment delivery to those streams with critical habitat for Oregon Coast coho. However, unlike newly developed Project roads (e.g., PARs and TARs), to varying degrees the sediment delivery risk from these roads to critical habitat already exists independent of Project actions.

TABLE 3.5.4-35

Summary of New Road Erosion Risks and Risks of Sediment Delivery to Streams with Coho Critical Habitat by Existing Dirt and Gravel Surfaced Roads within 1 SPTH in Range of Oregon Coast Coho

Watershed and Critical Habitat with EAR	Number of EARs	Road Surface	Total Road Length (miles)	Road Surface Factor a/	Road Slope Factor b/	Rainfall Factor c/	Geologic Erosion Factor d/	Road Delivery Factor e/	Five Factor Product	Risk of Sediment Delivery to Critical Habitat
Coos Bay Frontal-Pacific Ocean										
Wallanch Slough	1	Dirt	0.29	1	0.2	6.0	5	100	605	High
Coos River	1	Dirt	0.04	1	0.2	6.0	5	35	212	High
Coos River	1	Gravel	0.03	0.5	0.2	6.0	5	35	106	High
Vogel Creek	1	Dirt	0.56	1	0.2	6.0	5	35	212	High
Laxstrom Gulch (adjacent)	1	Gravel	0.05	0.5	0.2	9.7	5	100	434	High
North Fork Coquille River										
Steele Creek (not crossed)	1	Gravel	0.29	0.5	1.0	5.5	1	100	275	High
North Fork Coquille River	1	Gravel	0.08	0.5	0.2	5.5	5	35	96	Moderate
Middle Creek	1	Gravel	0.35	0.5	0.2	5.5	5	35	96	Moderate
East Fork Coquille River										
South Fork Elk Creek	2	Dirt	0.10	1	0.2	5.5	1	100	110	High
Olalla Creek-Lookingglass Creek										
Olalla Creek	1	Dirt	0.10	1	0.2	3.0	5	35	105	High
Clark Branch-South Umpqua										
Willis Creek	2	Dirt	0.15	1	0.2	2.0	5	35	69	Moderate
Myrtle Creek										
Bilger Creek	1	Gravel	0.19	0.5	0.2	2.9	6	35	50	Moderate
Days Creek-South Umpqua River										
Fate Creek	1	Gravel	0.05	0.5	0.2	2.0	5	35	34	Moderate
Days Creek	1	Gravel	0.06	0.5	0.2	2.0	5	10	10	Moderate
Saint John Creek	2	Gravel	0.34	0.5	1.0	2.9	1	35	50	Moderate

a/ Road Surface Factors: 0.5 for gravel, 1.0 for dirt. See Table A-3, Appendix A, Dube et al. 2004

b/ Road Slope Factors: 0.2 for gradients of <5%; 1.0 for gradients of 5-10%; 2.5 for gradients >10%. See Table A-6, Appendix A, Dube et al. 2004

c/ Rainfall Factor derived from the average annual rainfall at the closest NWS station, computed using Equation 7, Appendix A, Dube et al. 2004.

d/ Geologic Erosion Factor surmised from Figure A-1 and Table A-1 in Appendix A, Dube et al. 2004 based on Dominant Lithology evaluated from Oregon Department of Geology and Mineral Industries, Oregon Geologic Data Compilation 6. Available from http://www.oregongeology.org/sub/ogdc/index.htm.

e/ Road Delivery Factor: Distance from stream, >200 feet = 0, 100 to 200 feet = 10, <100 feet = 35, and direct delivery = 100. See Table A-10, Appendix A, Dube et al. 2004.

TEWAs. Distances of TEWAs to waterbodies within 1 SPTH of designated critical habitat for Oregon Coast coho were measured using GIS and digitized waterbody streambanks and TEWA polygons. Consequently, distances could change once boundaries of TEWAs are surveyed on the ground. From these estimates, there are 26 waterbodies with a total of 77 TEWAs within 1 SPTH of critical habitat for Oregon Coast coho, totaling 31.98 acres. Of those, 37 TEWAs are within 50 feet of the designated critical habitat (summarized from table 3.5.4-36).

TABLE 3.5.4-36

Individual TEWAs within One Site-Potential Tree Height of Streams with Critical Habitats in Watersheds within Range of Oregon Coast Coho

Watershed	Critical Habitat	TEWA ID	Distance (feet) to Critical Habitat	TEWA Area (acres) in 1 SPTH
Coos Bay Frontal-Pacific Ocean	Coos Bay	TEWA 0.10	102	4.13
		TEWA 1.36-N	175	0.10
	Kentuck Slough	TEWA 3.07-N	84	0.86
		TEWA 3.07-W	229	0.78
		TEWA 3.55-N	115	5.12
	Willanch Slough	TEWA 8.27-N	25	0.15
	Johnston Creek	TEWA 8.35-W	211	0.14
		TEWA 8.44-W	83	0.17
	Coos River	TEWA 10.71-W	71	0.07
	Vogel Creek	TEWA 11.53-N	0	1.78
		TEWA 11.33-W	114	1.10
	Laxstrom Gulch	TEWA 14.73-N	36	0.65
	Stock Slough	TEWA 15.07-W	73	0.17
		TEWA 15.12-W	0	0.14
		TEWA 15.12-N	0	0.44
		TEWA 15.26-W	0	0.19
North Fork Coquille River	Steinnon Creek	TEWA 24.32-W	5	0.19
		TEWA 24.26-N	168	0.06
		TEWA 24.26-W	239	0.03
	North Fork Coquille River	TEWA 22.59-N	67	0.17
		TEWA 23.01-W	54	0.28
		TEWA 23.09-W	100	0.24
	Middle Creek	TEWA 26.96-W	132	0.17
		TEWA 27.05-W	60	0.40
East Fork Coquille River	East Fork Coquille River	TEWA 29.61-N	31	0.20
		TEWA 29.78-W	19	0.42
		TEWA 29.87-W	44	0.36
		TEWA 29.87-N	60	0.30
	South Fork Elk Creek	TEWA 34.41-W	70	0.17
		TEWA 34.47-W	54	0.17
Olalla Creek-Lookingglass Creek	Olalla Creek	TEWA 58.56-N	175	0.07
		TEWA 58.65-W	15	0.44
		TEWA 58.79-W	28	0.34
		TEWA 58.79-N	57	0.19
	McNabb Creek	TEWA 60.44-N	0	0.04
		TEWA 60.35-W	19	0.13
		TEWA 60.52-N	63	0.03
		TEWA 60.54-W	174	0.02
Clark Branch-South Umpqua	Kent Creek	TEWA 63.93-N	27	0.12
		TEWA 63.93-W	25	0.10
		TEWA 63.99-N	151	0.21
		TEWA 63.99-W	26	0.17
	Rice Creek	TEWA 65.58-N	27	0.13
		TEWA 65.76-W	76	0.20
	Willis Creek	TEWA 66.89-N	12	0.32
		TEWA 66.89-W	24	0.44
		TEWA 66.97-W	90	0.12
	South Umpqua River	TEWA 71.24	0	0.22
		TEWA 71.31	0	0.22

TABLE 3.5.4-36 (continued)

Individual TEWAs within One Site-Potential Tree Height of Streams with Critical Habitats in Watersheds within Range of Oregon Coast Coho

Watershed	Critical Habitat	TEWA ID	Distance (feet) to Critical Habitat	TEWA Area (acres) in 1 SPTH
Myrtle Creek	Bilger Creek	TEWA 76.31-N	105	0.06
		TEWA 76.36-N	38	0.06
		TEWA 76.36-W	14	0.98
		TEWA 76.41-W	103	0.03
		TEWA 76.41-N	146	0.22
	North Myrtle Creek	TEWA 78.99-W	31	0.13
		TEWA 79.14-W	80	0.17
		TEWA 79.13-N	70	0.11
	South Myrtle Creek	TEWA 81.16-N	70	0.17
		TEWA 81.21-W	92	0.15
Days Creek-South Umpqua	Fate Creek	TEWA 88.29-N	24	0.10
		TEWA 88.26-W	32	0.28
		TEWA 88.49-W	104	0.06
		TEWA 88.49-N	35	0.53
		TEWA 88.52-W	56	0.40
	Days Creek	TEWA 88.53-N	83	0.21
		TEWA 88.52-W	54	0.28
		TEWA 88.61-W	121	0.50
		TEWA 88.62-N	67	0.28
	Saint John Creek	TEWA 92.62	40	0.62
		TEWA 92.57-N	33	0.25
		TEWA 92.57-W	34	0.18
		TEWA 92.63-W	5	0.52
		TEWA 92.62-N	5	0.33
	South Umpqua River	TEWA 94.69-N	0	1.02
		TEWA 94.69-W	0	0.52
		TEWA 94.73-W	0	0.12
		TEWA 94.69-N	0	1.02
		TEWA 142.51-W	45	0.38
		TEWA 142.58-W	18	0.12
		TEWA 142.58-N	46	0.12
	NF Little Butte Creek	TEWA 145.58-N	40	0.14
		TEWA 145.58-W	50	0.16
		TEWA 145.70-W	85	0.31
		TEWA 145.70-N	65	0.28

Risk estimates for sediment delivery from each of TEWAs similar to that described above for TARs, PARs, and EARs were not conducted since the procedures in WARSEM modeling did not appear appropriate for application with TEWAs except for the road delivery factor (distance from a TEWA to a stream. All but three TEWAs within 1 SPTH of waterbodies with designated critical habitat for Oregon Coast coho are closer than 200 feet to streams, 15 TEWAs within 1 SPTH of waterbodies with designated critical habitat are < 200 feet but >100 feet to streams, and 75 TEWAs within 1 SPTH of waterbodies with designated critical habitat are <100 feet from the streams; 11 of those TEWAs appear to overlap with the waterbodies and consequently provide direct delivery of sediment. TEWAs, within each of those distance categories represent various levels of risks for sediment delivery to designated critical habitats; the TEWAs that overlap waterbodies have the highest risks (11 in range of Oregon Coast coho) of waterbodies with designated critical habitat for erosion and sediment delivery followed by other TEWAs that <50 feet but do not overlap critical habitat (66 in range of Oregon Coast coho) based on the sediment delivery distance categories in WARSEM (Table A-10, Appendix A, Dube et al. 2004).

Erosion of new road surfaces, existing road surfaces, and exposed surfaces of TEWAs within 1 SPTH has the potential for sediment delivery to streams and could lead to adverse effects on fish and fresh water benthic invertebrates similar to those described above. As discussed in Section 2.3 of Pacific Connector's *Transportation Management Plan* (see POD [appendix B to this BA]), Pacific Connector would perform road surfacing structural capacity assessments and place additional road surfacing (aggregate or bituminous as appropriate) as needed for the planned use to minimize the potential for both road-related and off-road resource damage. In WARSEM modeling, the Road Tread Surfacing Factor is 1 for roads with native materials surface but is 0.2 for a gravel (aggregate) surface and 0.03 for an asphalt (bituminous) surface. Application of surfacing materials to any of the new TARs and PARs in table 3.5.4-34 with low to high risks of sediment delivery to streams would decrease levels of erosion and quantities of sediment delivered. Surfaces of all new PARs would be graveled thereby decreasing their erosion potential. Further, PARs and TARs would meet land-managing agencies' engineering design and road management standards consistent with the intended use of the road and all applicable agency BMPs; all applicable agency BMPs for erosion control would be implemented. In addition, Pacific Connector would install appropriate erosion and sediment control BMPs along the access roads as determined necessary by Pacific Connector's EI in cooperation with applicable agency officials. All land-managing agency roads are subject to short-term traffic restrictions and/or closures due to seasonal or unusual weather conditions, user safety or when necessary to prevent facility or resource damage.

Culvert Installation. Pacific Connector's ECRP also identifies mitigation measures that may be required to minimize potential impacts to existing culverts prior to access road use, to allow safe construction equipment travel and prevent damage to the culverts. Pacific Connector has completed an assessment to identify where proposed road improvements or where new permanent or temporary access roads would cross waterbodies and culvert installations would be required. The assessment used Pacific Connector's wetland survey data where access was available. Where access was not available, the assessment used FWS' NWI data, USGS NHD data, ODF statewide streams data, LiDAR data, and aerial photography to interpret waterbody crossings. Identified waterbody crossings were also correlated with Pacific Connector's preliminary access road improvement plans that were completed to evaluate improvements necessary to accommodate trucks hauling pipe (Dyer Partnership 2015). The access road improvement plans (Dyer Partnership 2015) were based on field investigations and identified locations where new culverts or culvert extensions would be necessary.

The new culverts needed to cross waterbodies are located on small intermittent headwater streams where there is no fish presence. The measures outlined in Pacific Connector's Culvert Crossing Best Management Practices (see Attachment F to the ECRP in Appendix F of the POD [appendix B to this BA]) and appropriate erosion control and revegetation measures outlined in the ECRP would be implemented during any road improvement activities. As indicated in the Culvert Crossing BMP, prior to construction, existing culverts would be investigated along all private roads and federally authorized roads (i.e., BLM and Forest Service) identified for access to the construction right-of-way. These investigations would occur on access roads where Pacific Connector is authorized to be and/or where Pacific Connector has negotiated an access use agreement or easement. The investigation would determine the condition and integrity of existing culverts and identify any location that may require mitigative measures to ensure construction activities do not damage or impair the existing function of the culverts. Mitigative measures may be required prior to access road use to allow safe construction equipment travel and prevent damage to the culverts. In select locations, replacement and/or modification of a culvert may be necessary. As noted above, Pacific Connector has completed an assessment to identify where proposed road improvements would cross waterbodies and culvert installations would be required. The new culverts identified are located on small intermittent headwater streams where there is no fish presence.

Runoff from Facility Surfaces

There are 25 contractor and pipe storage yards, rock source and disposal sites, six new TARs, four new PARs, and nine aboveground facilities within the range of Oregon Coast coho. Five of the yards (North Spit Dock, Weyerhaeuser Cove Pipe Yard, Menasha, K-2, and Brunell) border on Coos Bay and another (Millington 1) borders Isthmus Slough, all designated critical habitat for coho. Several other proposed yards border or are close (<100 feet) to waterbodies inhabited by Oregon Coast coho. They include the Coquille Yard on the Coquille River and the Roth Yard on the South Umpqua River. None of the rock source and disposal sites are near waterbodies inhabited by coho although one new PAR is close to Boone Creek and one TAR is near Middle Creek in the North Fork Coquille River watershed. Only one aboveground facility, a mainline block valve at Boone Creek Road (Coos Bay-Frontal Pacific Ocean Watershed), is close to a waterbody (Boone Creek) with critical habitat for Oregon Coast coho. The Jordan Cove Meter Station at MP 0.00 is within 440 feet of Jordan Cove.

Stored materials at the yards may include: construction mats, fencing materials, fuel and lubricants, stormwater control materials (straw bales, erosion control fabric, silt fence materials, etc.), and other construction materials. The yards would also be used for contractor office trailers and employee parking facilities. Although the yards are previously disturbed industrial sites, there is some unknown level of risk that stored materials and surface runoff could enter Oregon Coast coho critical habitat.

Pacific Connector has consulted with the BLM, the Forest Service, and the NRCS regarding erosion control and revegetation specifications. Other appropriate agencies have been consulted as well. The Oregon Department of Agriculture Noxious Weed Control Program, as well as the BLM and the Forest Service, have been contacted regarding recommendations for the prevention and spread of noxious weeds with those incorporated into the Pipeline Project-specific ECRP. Pursuant to FERC's *Procedures* (see section IV.A), Pacific Connector has prepared an SPCCP for the Pipeline, which includes identifying all potential spill hazards at the facility (including oil) and lists the appropriate response actions and contacts for facility and emergency response personnel. All station technicians would be trained for proper handling, storage, disposal, and spill response of hazardous fluids.

Operation and Maintenance Activities

Once the Pipeline is installed, maintenance would include activities such as aerial inspections, gas flow monitoring, visual inspection of surrounding vegetation for signs of leaks, and integrity management, which includes smart pigging to investigate the interior surface of the pipe for any signs of stress cracking, pitting, and other anomalies (see the ECRP in appendix F). All of the proposed maintenance activities would be outlined in the Operations and Maintenance Plan that would be prepared according to operating regulations in USDOT 49 CFR Subpart L, Part 192 and would be completed prior to going in-service. These general maintenance activities would require only surface activities and usage of the existing right-of-way, such as insertion of the pig at one of the pig launching facilities.

Potential estuarine or stream channel disturbance would occur if an integrity issue with the pipeline was found. If this were to occur, the pipeline would need to be unearthed within the right-of-way and repair work done in-water. Within stream sites, repair work could require isolated flow from the section of pipe that is to be exposed. Typically, repairs would be made to the pipe within the right-of-way (within the trench) or, depending on the site-specific conditions and nature of the repair needed, a reroute around the affected section may be considered. Impacts would be similar to those discussed above for initial installation except on a much smaller scale, because they would only involve one crossing compared to many streams. However, should repairs be needed out of the standard stream crossing window (i.e., during periods of fish spawning or egg incubation) there would be additional adverse effects to key fish resources at the specific site. The actions would include all relevant BMPs and mitigation, dependent upon site conditions and land ownership. Any future repairs would require additional permit approval from appropriate state and federal agencies that would determine the acceptable parameters of these actions. Such pipeline integrity-based, in-water projects are very infrequent.

Vegetation maintenance would be limited adjacent to waterbodies to allow a riparian strip to permanently revegetate with native plant species across the entire right-of-way. To facilitate periodic pipeline corrosion/leak surveys, a corridor centered on the pipeline and up to 30 feet wide would be maintained in an herbaceous state, with shrubs outside of this 30-foot corridor. In addition, trees that are located within 15 feet of the pipeline may be cut and removed from the right-of-way. No vegetation or tree limitations would occur beyond the 30-foot-wide corridor in riparian areas (i.e., up to 100 feet of streams on federal lands, and 25 feet on non-federal lands).

Herbicide Application

Herbicides have the potential to cause toxic effects to different salmonid life stages and to other aquatic species, causing direct impacts, if used improperly. When herbicides are properly used according to label restrictions and BMPs to control noxious weeds, there is little to no chance of causing injury or mortality to fish or other aquatic organisms.

Pacific Connector would not use herbicides for routine vegetation maintenance. However, following construction, Pacific Connector would implement its IPM (see Appendix N to Pacific Connector's POD [appendix B to this BA]), which addresses control of noxious weeds and invasive plants across the Pipeline Project which would include the selective use of herbicides where necessary to control noxious weeds by limited application from the ground, where allowed by landowners. The plan was developed in consultation with the ODA, BLM, and Forest Service.

The BMPs would minimize the potential spread of invasive species and minimize the potential adverse effects of control treatments. Herbicides would not be applied by aerial or broadcast spraying. Noxious weeds would be removed only by manual methods in the riparian zone defined as one site potential tree height and within Riparian Reserves that are defined as being greater than 150 feet in most areas along the route. Pacific Connector would not directly spray, or otherwise apply, herbicides in waterbodies or in riparian zones. The risk of drift would be avoided by selectively applying herbicides from the ground.

Where weed control is necessary along the construction right-of-way, Pacific Connector's first priority would be to employ hand and mechanical methods (pulling, mowing, biological, disking, etc.) applicable to the species to prevent the spread of potential weed infestations, where feasible. To determine if an herbicide is to be used over other control methods, Pacific Connector would base the decision on weed characteristics and integrated weed management principles (Forest Service 2005). If herbicides are used to control noxious weed infestations, they would be used when they are the most appropriate treatment method. Spot treatments and the use of selective herbicides would be utilized to minimize impact to native or non-target species. Permits or approvals for the use of herbicides and adjuvants on federal lands would be obtained prior to use/treatment, as detailed in the IPM (see Appendix N to the POD [appendix B to this BA]). Considering the potential for limited use of herbicides along the route, and precautions that would be in place to prevent entry into waters, meaningful negative effects to Oregon Coast coho salmon from herbicides would be unlikely to occur.

Critical Habitat

The Coos Bay estuary and 25 freshwater streams known to support coho within table 3.5.4-1 are designated critical habitat for Oregon Coast coho salmon. Critical habitat is designated to include all river reaches accessible to listed coho within the range of the Oregon Coast ESU. Critical habitat consists of the water, substrate, and adjacent riparian zone of estuarine and riverine reaches in hydrologic units and counties identified in NMFS (1999b).

Similar to critical habitat designated for coho salmon in the SONCC ESU, critical habitat included stream channels laterally to the ordinary high water mark (OHWM) (or bankfull elevation or bankfull width). NMFS also defined critical habitat in estuarine and nearshore marine zones as areas contiguous with the shoreline from the extreme high water mark out to a depth no greater than 30 meters (98 feet) below the mean low water mark (NMFS 2004). The following are PCEs for designated critical habitat for the Oregon Coast coho (NMFS 2008d):

- Freshwater spawning sites with water quantity and quality conditions and substrate supporting spawning, incubation, and larval development.
- Freshwater rearing sites with water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility; water quality and forage supporting juvenile development; and natural cover such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks.
- Freshwater migration corridors free of obstruction with water quantity and quality conditions and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks a) supporting juvenile and adult mobility and survival, b) supporting juvenile use of various of habitats that allow them to avoid high flows, avoid predators, successfully compete, begin the behavioral and physiological changes needed for life in the ocean, and ability to reach the ocean, and c) essential for nonfeeding adults to successfully swim upstream, avoid predators, and reach spawning areas on limited energy stores.
- Estuarine areas free of obstruction with water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between fresh- and

saltwater; natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels; and juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation.

- Nearshore marine areas free of obstruction with water quality and quantity conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation; and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels.
- Offshore marine areas with water quality conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation.

Riparian Zone Effects. Similar analyses to those above under the Riparian Vegetation Removal and Modification subsection were conducted for effects to riparian zones associated with each waterbody supporting coho critical habitat and waterbodies that are assumed to provided coho in each watershed. Areas of forested and non-forested habitats that would be affected within the riparian zones of each waterbody during construction are provided in table 3.5.4-37a and areas affected during operation are provided in table 3.5.4-37b and summarized in table 3.5.4-37c. The tables also include riparian zone areas affected by landowner, similar to tables 3.5.4-30a and 3.5.4-30b.

TABLE 3.5.4-37a

Total Terrestrial Habitat (acres) Affected/Removed (a/) by Construction within Riparian Zones (One Site-Potential Tree Height Wide) Associated with Waterbodies Supporting Critical Habitat or Assumed Coho Habitat within Range of Oregon Coast Coho Crossed by the Pipeline

				Forest Habitat b/					Other Habitat b/						
Fifth-Field Watershed (Hydrologic Unit Code [HUC]) and Waterbody with Critical Habitat	**MP**	**CH**	**Landowner**	**Late Successional Old Growth Forest**	**Mid-Seral Forest**	**Regenerating Forest**	**Clearcut, Forest**	**Forest Total**	**Forested Wetland**	**Nonforested Wetland**	**Unaltered Nonforested Habitat**	**Agriculture**	**Altered Habitat**	**Other Total**	**Total Riparian Zone Impact (acres)**
Coos Bay Frontal Pacific Ocean (HUC 1710030403)															
			Federal					**0**						**0**	**0**
Trib to Coos Bay (NW-117/EE-6)	6.39R	No	Non-Federal					**0**		12.50		0.22	0.01	**12.73**	**12.73**
			Riparian Zone Total	**0**	**0**	**0**	**0**	**0**	**0**	**12.50**	**0**	**0.22**	**0.01**	**12.73**	**12.73**
			Federal					**0**						**0**	**0**
Willanch Slough (EE-7)	8.27R	Yes	Non-Federal		0.10			**0.10**		0.01		0.74		**0.75**	**0.85**
			Riparian Zone Total	**0**	**0.10**	**0**	**0**	**0.10**	**0**	**0.01**	**0**	**0.74**	**0**	**0.75**	**0.85**
			Federal					**0**						**0**	**0**
Johnston Creek (GDX-29 (EE-8)	8.35R	Yes	Non-Federal		0.19	0.01		**0.20**		0.37		0.61	0.02	**1.00**	**1.20**
			Riparian Zone Total	**0**	**0.19**	**0.01**	**0**	**0.20**	**0**	**0.37**	**0**	**0.61**	**0.02**	**1.00**	**1.20**
			Federal					**0**						**0**	**0**
Trib. to Cooston Channel (Echo Creek) (SS-100-002)	10.21R	No	Non-Federal			1.34		**1.34**					0.06	**0.06**	**1.40**
			Riparian Zone Total	**0**	**0**	**1.34**	**0**	**1.34**	**0**	**0**	**0**	**0**	**0.06**	**0.06**	**1.40**
			Federal					**0**						**0**	**0**
Coos River (BSP-119)	11.13R	Yes	Non-Federal					**0**		0.39		0.43	4.13	**4.95**	**4.95**
			Riparian Zone Total	**0**	**0**	**0**	**0**	**0**	**0**	**0.39**	**0**	**0.43**	**4.13**	**4.95**	**4.95**
			BLM-Coos Bay District	0.89				**0.89**						**0**	**0.89**
Vogel Creek (SS-100-005)	11.55BR	Yes	Non-Federal					**0**		4.62		2.02	0.17	**6.81**	**6.81**
			Riparian Zone Total	**0.89**	**0**	**0**	**0**	**0.89**	**0**	**4.62**	**0**	**2.02**	**0.17**	**6.81**	**7.70**
			Federal					**0**						**0**	**0**
Trib. to Stock Slough (Laxstrom Gulch) (BR-S-30)	15.18BR	Yes	Non-Federal			0.30		**0.30**		3.00		3.66	0.04	**6.70**	**7.00**
			Riparian Zone Total	**0**	**0**	**0.30**	**0**	**0.30**	**0**	**3.00**	**0**	**3.66**	**0.04**	**6.70**	**7.00**
			Federal					**0**						**0**	**0**
Stock Slough (BR-S-30)	14.82BR	Yes	Non-Federal			0.37		**0.37**		3.00		3.66	0.04	**6.70**	**7.00**
			Riparian Zone Total	**0**	**0**	**0.37**	**0**	**0.37**	**0**	**3.00**	**0**	**3.66**	**0.04**	**6.70**	**7.00**
			Federal					**0**						**0**	**0**
Stock Slough (BR-S-36)	15.32BR	Yes	Non-Federal			0.37		**0.37**		1.96				**1.96**	**2.33**
			Riparian Zone Total	**0**	**0**	**0.37**	**0**	**0.37**	**0**	**1.96**	**0**	**0**	**0**	**1.96**	**2.33**

TABLE 3.5.4-37a (continued)

Total Terrestrial Habitat (acres) Affected/Removed (a/) by Construction within Riparian Zones (One Site-Potential Tree Height Wide) Associated with Waterbodies Supporting Critical Habitat or Assumed Coho Habitat within Range of Oregon Coast Coho Crossed by the Pipeline

				Forest Habitat b/					Other Habitat b/						
Fifth-Field Watershed (Hydrologic Unit Code [HUC]) and Waterbody with Critical Habitat	**MP**	**CH**	**Landowner**	**Late Successional Old Growth Forest**	**Mid-Seral Forest**	**Regenerating Forest**	**Clearcut, Forest**	**Forest Total**	**Forested Wetland**	**Nonforested Wetland**	**Unaltered Nonforested Habitat**	**Agriculture**	**Altered Habitat**	**Other Total**	**Total Riparian Zone Impact (acres)**
North Fork Coquille River (HUC 1710030504)															
Steinnon Creek (BR-S-63)	24.32BR	Yes	BLM-Coos Bay District		1.13			**1.13**						**0**	**1.13**
			Non-Federal		1.10			**1.10**				0.20		**0.20**	**1.30**
			Riparian Zone Total	**0**	**2.23**	**0**	**0**	**2.23**	**0**	**0**	**0**	**0.20**	**0**	**0.20**	**2.43**
North Fork Coquille River (BSP-207)	23.06	Yes	Federal					**0**						**0**	**0**
			Non-Federal		0.75			**0.75**				0.76	0.08	**0.84**	**1.59**
			Riparian Zone Total	**0**	**0.75**	**0**	**0**	**0.75**	**0**	**0**	**0**	**0.76**	**0.08**	**0.84**	**1.59**
Middle Creek (BSP-133)	27.04	Yes	BLM-Coos Bay District	0.81		0.01		**0.82**				0.99	0.07	**1.06**	**1.88**
			Non-Federal					**0**				0.26		**0.26**	**0.26**
			Riparian Zone Total	**0.81**	**0**	**0.01**	**0**	**0.82**	**0**	**0**	**0**	**1.25**	**0.07**	**1.32**	**2.14**
East Fork Coquille River(HUC 1710030503)															
Trib. to E. Fork Coquille R. (BSP-77)	28.86	No	Federal					**0**						**0**	**0**
			Non-Federal		0.28	1.20		**1.48**						**0**	**1.48**
			Riparian Zone Total	**0**	**0.28**	**1.20**	**0**	**1.48**	**0**	**0**	**0**	**0**	**0**	**0**	**1.48**
Trib. to E. Fork Coquille R. (BSP-74)	29.30	No	Federal					**0**						**0**	**0**
			Non-Federal			1.45		**1.45**					0.52	**0.52**	**1.97**
			Riparian Zone Total	**0**	**0**	**1.45**	**0**	**1.45**	**0**	**0**	**0**	**0**	**0.52**	**0.52**	**1.97**
Trib. to E. Fork Coquille R. (BSP-76)	29.47	No	Federal					**0**						**0**	**0**
			Non-Federal			1.33		**1.33**						**0**	**1.33**
			Riparian Zone Total	**0**	**0**	**1.33**	**0**	**1.33**	**0**	**0**	**0**	**0**	**0**	**0**	**1.33**
East Fork Coquille River (BSP-71)	29.85	Yes	Federal					**0**						**0**	**0**
			Non-Federal		0.24			**0.24**				1.97		**1.97**	**2.21**
			Riparian Zone Total	**0**	**0.24**	**0**	**0**	**0.24**	**0**	**0**	**0**	**1.97**	**0**	**1.97**	**2.21**
Trib. to E. Fork Coquille R. (SS-003-007B)	30.29	No	Federal					**0**						**0**	**0**
			Non-Federal		0.19	1.86		**2.05**						**0**	**2.05**
			Riparian Zone Total	**0**	**0.19**	**1.86**	**0**	**2.05**	**0**	**0**	**0**	**0**	**0**	**0**	**2.05**

TABLE 3.5.4-37a (continued)

Total Terrestrial Habitat (acres) Affected/Removed (a/) by Construction within Riparian Zones (One Site-Potential Tree Height Wide) Associated with Waterbodies Supporting Critical Habitat or Assumed Coho Habitat within Range of Oregon Coast Coho Crossed by the Pipeline

				Forest Habitat b/					Other Habitat b/						
Fifth-Field Watershed (Hydrologic Unit Code [HUC]) and Waterbody with Critical Habitat	**MP**	**CH**	**Landowner**	**Late Successional Old Growth Forest**	**Mid-Seral Forest**	**Regenerating Forest**	**Clearcut, Forest**	**Forest Total**	**Forested Wetland**	**Nonforested Wetland**	**Unaltered Nonforested Habitat**	**Agriculture**	**Altered Habitat**	**Other Total**	**Total Riparian Zone Impact (acres)**
Elk Creek (BSP-57)	32.40	No	Federal					**0**						**0**	**0**
			Non-Federal		0.12	0.53		**0.65**						**0**	**0.65**
			Riparian Zone Total	**0**	**0.12**	**0.53**	**0**	**0.65**	**0**	**0**	**0**	**0**	**0**	**0**	**0.65**
Trib. to Elk Creek (BSP-55)	32.40	No	Federal					**0**						**0**	**0**
			Non-Federal		0.19	0.41		**0.60**						**0**	**0.60**
			Riparian Zone Total	**0**	**0.19**	**0.41**	**0**	**0.60**	**0**	**0**	**0**	**0**	**0**	**0**	**0.60**
South Fork Elk Creek (CSP-5)	34.46	Yes	Federal					**0**						**0**	**0**
			Non-Federal		0.76	0.49		**1.25**		0.01			0.03	**0.04**	**1.29**
			Riparian Zone Total	**0**	**0.76**	**0.49**	**0**	**1.25**	**0**	**0.01**	**0**	**0**	**0.03**	**0.04**	**1.29**
Middle Fork Coquille River (HUC 1710030501)															
Big Creek	37.41	No	BLM-Coos Bay District	1.11				**1.11**						**0**	**1.11**
			Non-Federal	0				**0**						**0**	**0**
			Riparian Zone Total	**1.11**	**0**	**0**	**0**	**1.11**	**0**	**0**	**0**	**0**	**0**	**0**	**1.11**
Olalla Creek-Lookingglass Creek (HUC 1710030212)															
Trib. to Shields Creek (BSI-202)	55.90	No	Federal					**0**						**0**	**0**
			Non-Federal	0.12	0.05			**0.17**				1.30		**1.30**	**1.47**
			Riparian Zone Total	**0.12**	**0.05**	**0**	**0**	**0.17**	**0**	**0**	**0**	**1.30**	**0**	**1.30**	**1.47**
Trib. to Olalla Creek (BSI-138)	57.31	No	Federal					**0**						**0**	**0**
			Non-Federal		0.08			**0.08**		0.18		1.79	0.03	**2.00**	**2.08**
			Riparian Zone Total	**0**	**0.08**	**0**	**0**	**0.08**	**0**	**0.18**	**0**	**1.79**	**0.03**	**2.00**	**2.08**
Olalla Creek (BSP-155)	58.78	Yes	Federal					**0**						**0**	**0**
			Non-Federal		1.20			**1.20**				2.73		**2.73**	**3.93**
			Riparian Zone Total	**0**	**1.20**	**0**	**0**	**1.20**	**0**	**0**	**0**	**2.73**	**0**	**2.73**	**3.93**
Trib. to Olalla Creek (BSI-129)	59.65	No	Federal					**0**						**0**	**0**
			Non-Federal		0.40			**0.40**			0.14	0.55	0.05	**0.74**	**1.14**
			Riparian Zone Total	**0**	**0.40**	**0**	**0**	**0.40**	**0**	**0**	**0.14**	**0.55**	**0.05**	**0.74**	**1.14**
McNabb Creek (NSP-13)	60.48	Yes	Federal					**0**						**0**	**0**
			Non-Federal	0.01	0.07			**0.08**				1.06		**1.06**	**1.14**

TABLE 3.5.4-37a (continued)

Total Terrestrial Habitat (acres) Affected/Removed (a/) by Construction within Riparian Zones (One Site-Potential Tree Height Wide) Associated with Waterbodies Supporting Critical Habitat or Assumed Coho Habitat within Range of Oregon Coast Coho Crossed by the Pipeline

				Forest Habitat b/					Other Habitat b/						
Fifth-Field Watershed (Hydrologic Unit Code [HUC]) and Waterbody with Critical Habitat	**MP**	**CH**	**Landowner**	**Late Successional Old Growth Forest**	**Mid-Seral Forest**	**Regenerating Forest**	**Clearcut, Forest**	**Forest Total**	**Forested Wetland**	**Nonforested Wetland**	**Unaltered Nonforested Habitat**	**Agriculture**	**Altered Habitat**	**Other Total**	**Total Riparian Zone Impact (acres)**
			Riparian Zone Total	**0.01**	**0.07**	**0**	**0**	**0.08**	**0**	**0**	**0**	**1.06**	**0**	**1.06**	**1.14**
Clark Branch-South Umpqua River (HUC 1710030211)															
Kent Creek (BSP-240)	63.97	Yes	Federal					**0**						**0**	**0**
			Non-Federal			0.78		**0.78**			0.17		0.02	**0.19**	**0.97**
			Riparian Zone Total	**0**	**0**	**0.78**	**0**	**0.78**	**0**	**0**	**0.17**	**0**	**0.02**	**0.19**	**0.97**
Rice Creek (S2-04; BSP-227)	65.76	Yes	Federal					**0**						**0**	**0**
			Non-Federal		0.95			**0.95**			0.05	0.17		**0.22**	**1.17**
			Riparian Zone Total	**0**	**0.95**	**0**	**0**	**0.95**	**0**	**0**	**0.05**	**0.17**	**0**	**0.22**	**1.17**
Willis Creek (BSP-168)	66.95	Yes	Federal					**0**						**0**	**0**
			Non-Federal		0.15			**0.15**			0.80	0.06		**0.86**	**1.01**
			Riparian Zone Total	**0**	**0.15**	**0**	**0**	**0.15**	**0**	**0**	**0.80**	**0.06**	**0**	**0.86**	**1.01**
South Umpqua River (BSP-26)	71.27	Yes	Federal					**0**						**0**	**0**
			Non-Federal					**0**			0.10		0.22	**0.32**	**0.32**
			Riparian Zone Total	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0.10**	**0**	**0.22**	**0.32**	**0.32**
Myrtle Creek (HUC 1710030210)															
Rock Creek (EE-SS-9032)	75.33	No	Federal					**0**						**0**	**0**
			Non-Federal		0.78			**0.78**					0.07	**0.07**	**0.85**
			Riparian Zone Total	**0**	**0.78**	**0**	**0**	**0.78**	**0**	**0**	**0**	**0**	**0.07**	**0.07**	**0.85**
Trib. to Rock Creek (EE-SS-9033)	75.34	No	Federal					**0**						**0**	**0**
			Non-Federal		0.35			**0.35**						**0**	**0.35**
			Riparian Zone Total	**0**	**0.35**	**0**	**0**	**0.35**	**0**	**0**	**0**	**0**	**0**	**0**	**0.35**
Bilger Creek (BSP-1)	76.38	Yes	Federal					**0**						**0**	**0**
			Non-Federal		0.30			**0.30**			0.12	1.58	0.06	**1.76**	**2.06**
			Riparian Zone Total	**0**	**0.30**	**0**	**0**	**0.30**	**0**	**0**	**0.12**	**1.58**	**0.06**	**1.76**	**2.06**
North Myrtle Creek (NSP-37)	79.12	Yes	Federal					0						0	0
			Non-Federal	0.10	0.54			0.64						0	0.64
			Riparian Zone Total	**0.10**	**0.54**	**0**	**0**	**0.64**	**0**	**0**	**0**	**0**	**0**	**0**	**0.64**

TABLE 3.5.4-37a (continued)

Total Terrestrial Habitat (acres) Affected/Removed (a/) by Construction within Riparian Zones (One Site-Potential Tree Height Wide) Associated with Waterbodies Supporting Critical Habitat or Assumed Coho Habitat within Range of Oregon Coast Coho Crossed by the Pipeline

				Forest Habitat b/					Other Habitat b/						
Fifth-Field Watershed (Hydrologic Unit Code [HUC]) and Waterbody with Critical Habitat	**MP**	**CH**	**Landowner**	**Late Successional Old Growth Forest**	**Mid-Seral Forest**	**Regenerating Forest**	**Clearcut, Forest**	**Forest Total**	**Forested Wetland**	**Nonforested Wetland**	**Unaltered Nonforested Habitat**	**Agriculture**	**Altered Habitat**	**Other Total**	**Total Riparian Zone Impact (acres)**
South Myrtle Creek (BSP-172)	81.19	Yes	Federal					**0**						**0**	**0**
			Non-Federal		0.24			**0.24**			0.33	0.50	0.03	**0.86**	**1.10**
			Riparian Zone Total	**0**	**0.24**	**0**	**0**	**0.24**	**0**	**0**	**0.33**	**0.50**	**0.03**	**0.86**	**1.10**
Days Creek-South Umpqua River (HUC 1710030205)															
Fate Creek (BSP-232)	88.48	Yes	Federal					**0**						**0**	**0**
			Non-Federal		0.52			**0.52**				2.34	0.03	**2.37**	**2.89**
			Riparian Zone Total	**0**	**0.52**	**0**	**0**	**0.52**	**0**	**0**	**0**	**2.34**	**0.03**	**2.37**	**2.89**
Days Creek (BSP-233)	88.60	Yes	Federal					**0**						**0**	**0**
			Non-Federal		0.23			**0.23**				2.33	0.01	**2.34**	**2.57**
			Riparian Zone Total	**0**	**0.23**	**0**	**0**	**0.23**	**0**	**0**	**0**	**2.33**	**0.01**	**2.34**	**2.57**
Saint John Creek (ASP-303)	92.62	Yes	Federal					**0**						**0**	**0**
			Non-Federal	0.54	1.76			**2.30**					0.37	**0.37**	**2.67**
			Riparian Zone Total	**0.54**	**1.76**	**0**	**0**	**2.30**	**0**	**0**	**0**	**0**	**0.37**	**0.37**	**2.67**
South Umpqua River (ASP-196)	94.73	Yes	Federal					**0**						**0**	**0**
			Non-Federal		1.06			**1.06**			0.90		0.33	**1.23**	**2.29**
			Riparian Zone Total	**0**	**1.06**	**0**	**0**	**1.06**	**0**	**0**	**0.90**	**0**	**0.33**	**1.23**	**2.29**
All Fifth-Field Watersheds and Jurisdictions															
			Federal Subtotal	**2.81**	**1.13**	**0.01**	**0**	**3.95**	**0**	**0**	**0**	**0.99**	**0.07**	**1.06**	**5.01**
			Non-Federal Subtotal	**0.77**	**12.60**	**10.44**	**0**	**23.81**	**0**	**25.12**	**2.61**	**25.33**	**6.28**	**59.34**	**83.15**
			Total	**3.58**	**13.73**	**10.45**	**0**	**27.76**	**0**	**25.12**	**2.61**	**26.32**	**6.35**	**60.40**	**88.16**

a/ Project components considered in calculation of habitat "Removed:" Pacific Connector construction right-of-way, temporary extra work areas, aboveground facilities, and permanent and temporary access roads (PAR, TAR).

b/ Habitat Types within Riparian Zones generally categorized as: Late Successional (Mature) or Old Growth Forest (coniferous, deciduous, mixed ≥80 years old); Mid-Seral Forests (coniferous, deciduous, mixed ≥40 but ≤80 years old); Regenerating Forest (coniferous, deciduous, mixed ≥5 but ≤40 years old); Clearcut Forests; Forested and Nonforested Wetland, Unaltered Nonforested Habitat (grasslands, sagebrush, shrublands), Agriculture, and Altered Habitats (urban, industrial, residential, roads, utility corridors, quarries).

TABLE 3.5.4-37b

Total Terrestrial Habitat (acres) a/ within the 30-foot Wide Corridor Maintained over the Pipeline within Riparian Zones (One Site-Potential Tree Height Wide) Associated with Waterbodies Supporting Critical Habitat or Assumed Coho Habitat within Range of Oregon Coast Coho Crossed by the Pipeline

				Forest Habitat b/					Other Habitat b/						
Fifth-Field Watershed (Hydrologic Unit Code [HUC]) and Waterbody with Critical Habitat	**MP**	**CH**	**Landowner**	**Late Successional Old Growth Forest**	**Mid-Seral Forest**	**Regenerating Forest**	**Clearcut, Forest**	**Forest Total**	**Forested Wetland**	**Nonforested Wetland**	**Unaltered Nonforested Habitat**	**Agriculture**	**Altered Habitat**	**Other Total**	**Total Riparian Zone Impact (acres)**
Coos Bay Frontal Pacific Ocean (HUC 1710030403)															
Trib to Coos Bay (NW-117/EE-6)	6.39R	No	Federal					**0**						**0**	**0**
			Non-Federal					**0**		1.63		0.05	0.03	**1.71**	**1.71**
			Riparian Zone Total	**0**	**0**	**0**	**0**	0	0	1.63	0	0.05	0.03	**1.71**	**1.71**
Willanch Slough (EE-7)	8.27R	Yes	Federal					**0**						**0**	**0**
			Non-Federal		0.01			**0.01**				0.22		**0.22**	**0.23**
			Riparian Zone Total	**0**	**0.01**	**0**	**0**	**0.01**	**0**	**0**	**0**	**0.22**	**0**	**0.22**	**0.23**
Johnston Creek (GDX-29 (EE-8)	8.35R	Yes	Federal					**0**						**0**	**0**
			Non-Federal		0.08			**0.08**		0.12		0.20	0.01	**0.33**	**0.41**
			Riparian Zone Total	**0**	**0.08**	**0**	**0**	**0.08**	**0**	**0.12**	**0**	**0.20**	**0.01**	**0.33**	**0.41**
Trib. to Cooston Channel (Echo Creek) (SS-100-002)	10.21R	No	Federal					**0**						**0**	**0**
			Non-Federal			0.36		**0.36**					0.01	**0.01**	**0.37**
			Riparian Zone Total	**0**	**0**	**0.36**	**0**	**0.36**	**0**	**0**	**0**	**0**	**0.01**	**0.01**	**0.37**
Coos River (BSP-119)	11.13R	Yes	Federal					**0**						**0**	**0**
			Non-Federal					**0**		0.10		0.13	0.27	**0.50**	**0.50**
			Riparian Zone Total	**0**	**0**	**0**	**0**	**0**	**0**	**0.10**	**0**	**0.13**	**0.27**	**0.50**	**0.50**
Vogel Creek (SS-100-005)	11.55BR	Yes	BLM-Coos Bay District	0.28				**0.28**						**0**	**0.28**
			Non-Federal					**0**		1.35		0.40	0.02	**1.77**	**1.77**
			Riparian Zone Total	**0.28**	**0**	**0**	**0**	**0.28**	**0**	**1.35**	**0**	**0.40**	**0.02**	**1.77**	**2.05**
Trib. to Stock Slough (Laxstrom Gulch) (BR-S-30)	15.18BR	Yes	Federal					**0**						**0**	**0**
			Non-Federal			0.07		**0.07**		0.75		1.00	0.01	**1.76**	**1.83**
			Riparian Zone Total	**0**	**0**	**0.07**	**0**	**0.07**	**0**	**0.75**	**0**	**1.00**	**0.01**	**1.76**	**1.83**
Stock Slough (BR-S-30)	14.82BR	Yes	Federal					**0**						**0**	**0**
			Non-Federal			0.13		**0.13**		0.47		0.01		**0.48**	**0.61**
			Riparian Zone Total	**0**	**0.00**	**0.13**	**0**	**0.13**	**0**	**0.47**	**0**	**0.01**	**0**	**0.48**	**0.61**
Stock Slough (BR-S-36)	15.32BR	Yes	Federal					**0**						**0**	**0**
			Non-Federal			0.15		**0.15**		0.48				**0.48**	**0.63**
			Riparian Zone Total	**0**	**0**	**0.15**	**0**	**0.15**	**0**	**0.48**	**0**	**0**	**0**	**0.48**	**0.63**

TABLE 3.5.4-37b (continued)

Total Terrestrial Habitat (acres) a/ within the 30-foot Wide Corridor Maintained over the Pipeline within Riparian Zones (One Site-Potential Tree Height Wide) Associated with Waterbodies Supporting Critical Habitat or Assumed Coho Habitat within Range of Oregon Coast Coho Crossed by the Pipeline

				Forest Habitat b/					Other Habitat b/						
Fifth-Field Watershed (Hydrologic Unit Code [HUC]) and Waterbody with Critical Habitat	**MP**	**CH**	**Landowner**	**Late Successional Old Growth Forest**	**Mid-Seral Forest**	**Regenerating Forest**	**Clearcut, Forest**	**Forest Total**	**Forested Wetland**	**Nonforested Wetland**	**Unaltered Nonforested Habitat**	**Agriculture**	**Altered Habitat**	**Other Total**	**Total Riparian Zone Impact (acres)**
North Fork Coquille River (HUC 1710030504)															
Steinnon Creek (BR-S-63)	24.32BR	Yes	BLM-Coos Bay District		0.29			**0.29**						**0**	**0.29**
			Non-Federal		0.29			**0.29**				0.03		**0.03**	**0.32**
			Riparian Zone Total	**0**	**0.58**	**0**	**0**	**0.58**	**0**	**0**	**0**	**0.03**	**0**	**0.03**	**0.61**
North Fork Coquille River (BSP-207)	23.06	Yes	Federal					**0**						**0**	**0**
			Non-Federal		0.20			**0.20**				0.10	0.01	**0.11**	**0.31**
			Riparian Zone Total	**0**	**0.20**	**0**	**0**	**0.20**	**0**	**0**	**0**	**0.10**	**0.01**	**0.11**	**0.31**
Middle Creek (BSP-133)	27.04	Yes	BLM-Coos Bay District	0.12				**0.12**				0.07		**0.07**	**0.19**
			Non-Federal					**0**				0.03		**0.03**	**0.03**
			Riparian Zone Total	**0.12**	**0**	**0**	**0**	**0.12**	**0**	**0**	**0**	**0.10**	**0**	**0.10**	**0.22**
East Fork Coquille River(HUC 1710030503)															
Trib. to E. Fork Coquille R. (BSP-77)	28.86	No	Federal					**0**						**0**	**0**
			Non-Federal		0.08	0.21		**0.29**						**0**	**0.29**
			Riparian Zone Total	**0**	**0.08**	**0.21**	**0**	**0.29**	**0**	**0**	**0**	**0**	**0**	**0**	**0.29**
Trib. to E. Fork Coquille R. (BSP-74)	29.30	No	Federal					**0**						**0**	**0**
			Non-Federal			0.42		**0.42**					0.12	**0.12**	**0.54**
			Riparian Zone Total	**0**	**0**	**0.42**	**0**	**0.42**	**0**	**0**	**0**	**0**	**0.12**	**0.12**	**0.54**
Trib. to E. Fork Coquille R. (BSP-76)	29.47	No	Federal					**0**						**0**	**0**
			Non-Federal			0.32		**0.32**						**0**	**0.32**
			Riparian Zone Total	**0**	**0**	**0.32**	**0**	**0.32**	**0**	**0**	**0**	**0**	**0**	**0**	**0.32**
East Fork Coquille River (BSP-71)	29.85	Yes	Federal					**0**						**0**	**0**
			Non-Federal		0.06			**0.06**				0.23		**0.23**	**0.29**
			Riparian Zone Total	**0**	**0.06**	**0**	**0**	**0.06**	**0**	**0**	**0**	**0.23**	**0**	**0.23**	**0.29**
Trib. to E. Fork Coquille R. (SS-003-007B)	30.29	No	Federal					**0**						**0**	**0**
			Non-Federal		0.08	0.58		**0.66**						**0**	**0.66**
			Riparian Zone Total	**0**	**0.08**	**0.58**	**0**	**0.66**	**0**	**0**	**0**	**0**	**0**	**0**	**0.66**

TABLE 3.5.4-37b (continued)

Total Terrestrial Habitat (acres) a/ within the 30-foot Wide Corridor Maintained over the Pipeline within Riparian Zones (One Site-Potential Tree Height Wide) Associated with Waterbodies Supporting Critical Habitat or Assumed Coho Habitat within Range of Oregon Coast Coho Crossed by the Pipeline

				Forest Habitat b/					Other Habitat b/						
Fifth-Field Watershed (Hydrologic Unit Code [HUC]) and Waterbody with Critical Habitat	**MP**	**CH**	**Landowner**	**Late Successional Old Growth Forest**	**Mid-Seral Forest**	**Regenerating Forest**	**Clearcut, Forest**	**Forest Total**	**Forested Wetland**	**Nonforested Wetland**	**Unaltered Nonforested Habitat**	**Agriculture**	**Altered Habitat**	**Other Total**	**Total Riparian Zone Impact (acres)**
Elk Creek (BSP-57)	32.40	No	Federal					**0**						**0**	**0**
			Non-Federal		0.04	0.08		**0.12**						**0**	**0.12**
			Riparian Zone Total	**0**	**0.04**	**0.08**	**0**	**0.12**	**0**	**0**	**0**	**0**	**0**	**0**	**0.12**
Trib. to Elk Creek (BSP-55)	32.40	No	Federal					**0**						**0**	**0**
			Non-Federal		0.08	0.12		**0.20**						**0**	**0.20**
			Riparian Zone Total	**0**	**0.08**	**0.12**	**0**	**0.20**	**0**	**0**	**0**	**0**	**0**	**0**	**0.20**
South Fork Elk Creek (CSP-5)	34.46	Yes	Federal					**0**						**0**	**0**
			Non-Federal		0.19	0.11		**0.30**					0.01	**0.01**	**0.31**
			Riparian Zone Total	**0**	**0.19**	**0.11**	**0**	**0.30**	**0**	**0**	**0**	**0**	**0.01**	**0.01**	**0.31**
Middle Fork Coquille River (HUC 1710030501)															
Big Creek	37.41	No	BLM-Coos Bay District	0.38				**0.38**						**0**	**0.38**
			Non-Federal	**0**				**0**				0		**0**	**0**
			Riparian Zone Total	**0.38**	**0**	**0**	**0**	**0.38**	**0**	**0**	**0**	**0**	**0**	**0**	**0.38**
Olalla Creek-Lookingglass Creek (HUC 1710030212)															
Trib. to Shields Creek (BSI-202)	55.90	No	Federal					**0**						**0**	**0**
			Non-Federal	0.01	0.02			**0.03**				0.34		**0.34**	**0.37**
			Riparian Zone Total	**0.01**	**0.02**	**0**	**0**	**0.03**	**0**	**0**	**0**	**0.34**	**0**	**0.34**	**0.37**
Trib. to Olalla Creek (BSI-138)	57.31	No	Federal					**0**						**0**	**0**
			Non-Federal		0.03			**0.03**		0.08		0.58	0.01	**0.67**	**0.70**
			Riparian Zone Total	**0**	**0.03**	**0**	**0**	**0.03**	**0**	**0.08**	**0**	**0.58**	**0.01**	**0.67**	**0.70**
Olalla Creek (BSP-155)	58.78	Yes	Federal					**0**						**0**	**0**
			Non-Federal		0.32			**0.32**				0.45		**0.40**	**0.72**
			Riparian Zone Total	**0**	**0.32**	**0**	**0**	**0.32**	**0**	**0**	**0**	**0.45**	**0**	**0.40**	**0.72**
Trib. to Olalla Creek (BSI-129)	59.65	No	Federal					**0**						**0**	**0**
			Non-Federal		0.14			**0.14**			0.03	0.14	0.01	**0.18**	**0.32**
			Riparian Zone Total	**0**	**0.14**	**0**	**0**	**0.14**	**0**	**0**	**0.03**	**0.14**	**0.01**	**0.18**	**0.32**

TABLE 3.5.4-37b (continued)

Total Terrestrial Habitat (acres) a/ within the 30-foot Wide Corridor Maintained over the Pipeline within Riparian Zones (One Site-Potential Tree Height Wide) Associated with Waterbodies Supporting Critical Habitat or Assumed Coho Habitat within Range of Oregon Coast Coho Crossed by the Pipeline

				Forest Habitat b/					Other Habitat b/						
Fifth-Field Watershed (Hydrologic Unit Code [HUC]) and Waterbody with Critical Habitat	**MP**	**CH**	**Landowner**	**Late Successional Old Growth Forest**	**Mid-Seral Forest**	**Regenerating Forest**	**Clearcut, Forest**	**Forest Total**	**Forested Wetland**	**Nonforested Wetland**	**Unaltered Nonforested Habitat**	**Agriculture**	**Altered Habitat**	**Other Total**	**Total Riparian Zone Impact (acres)**
McNabb Creek (NSP-13)	60.48	Yes	Federal					**0**						**0**	**0**
			Non-Federal		0.01			**0.01**				0.29		**0.29**	**0.30**
			Riparian Zone Total	**0**	**0.01**	**0**	**0**	**0.01**	**0**	**0**	**0**	**0.29**	**0**	**0.29**	**0.30**
Clark Branch-South Umpqua River (HUC 1710030211)															
Kent Creek (BSP-240)	63.97	Yes	Federal					**0**						**0**	**0**
			Non-Federal			0.17		**0.17**			0.03			**0.03**	**0.20**
			Riparian Zone Total	**0**	**0**	**0.17**	**0**	**0.17**	**0**	**0**	**0.03**	**0**	**0**	**0.03**	**0.20**
Rice Creek (S2-04; BSP-227)	65.76	Yes	Federal					**0**						**0**	**0**
			Non-Federal		0.22			**0.22**			0.03	0.01		**0.04**	**0.26**
			Riparian Zone Total	**0**	**0.22**	**0**	**0**	**0.22**	**0**	**0**	**0.03**	**0.01**	**0**	**0.04**	**0.26**
Willis Creek (BSP-168)	66.95	Yes	Federal					**0**						**0**	**0**
			Non-Federal		0.05			**0.05**			0.13			**0.13**	**0.18**
			Riparian Zone Total	**0**	**0.05**	**0**	**0**	**0.05**	**0**	**0**	**0.13**	**0**	**0**	**0.13**	**0.18**
South Umpqua River (BSP-26)	71.27	Yes	Federal					**0**						**0**	**0**
			Non-Federal					**0**						**0**	**0**
			Riparian Zone Total	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Myrtle Creek (HUC 1710030210)															
Rock Creek (EE-SS-9032)	75.33	No	Federal					**0**						**0**	**0**
			Non-Federal		0.17			**0.17**					0.02	**0.02**	**0.19**
			Riparian Zone Total	**0**	**0.17**	**0**	**0**	**0.17**	**0**	**0**	**0**	**0**	**0.02**	**0.02**	**0.19**
Trib. to Rock Creek (EE-SS-9033)	75.34	No	Federal					**0**						**0**	**0**
			Non-Federal		0.09			**0.09**						**0**	**0.09**
			Riparian Zone Total	**0**	**0.09**	**0**	**0**	**0.09**	**0**	**0**	**0**	**0**	**0**	**0**	**0.09**
Bilger Creek (BSP-1)	76.38	Yes	Federal					**0**						**0**	**0**
			Non-Federal		0.12			**0.12**			0.03	0.09	0.02	**0.14**	**0.26**
			Riparian Zone Total	**0**	**0.12**	**0**	**0**	**0.12**	**0**	**0**	**0.03**	**0.09**	**0.02**	**0.14**	**0.26**

TABLE 3.5.4-37b (continued)

Total Terrestrial Habitat (acres) a/ within the 30-foot Wide Corridor Maintained over the Pipeline within Riparian Zones (One Site-Potential Tree Height Wide) Associated with Waterbodies Supporting Critical Habitat or Assumed Coho Habitat within Range of Oregon Coast Coho Crossed by the Pipeline

				Forest Habitat b/					Other Habitat b/						
Fifth-Field Watershed (Hydrologic Unit Code [HUC]) and Waterbody with Critical Habitat	**MP**	**CH**	**Landowner**	**Late Successional Old Growth Forest**	**Mid-Seral Forest**	**Regenerating Forest**	**Clearcut, Forest**	**Forest Total**	**Forested Wetland**	**Nonforested Wetland**	**Unaltered Nonforested Habitat**	**Agriculture**	**Altered Habitat**	**Other Total**	**Total Riparian Zone Impact (acres)**
North Myrtle Creek (NSP-37)	79.12	Yes	Federal					**0**						**0**	**0**
			Non-Federal	0.04	0.14			**0.18**						**0**	**0.18**
			Riparian Zone Total	**0.04**	**0.14**	**0**	**0**	**0.18**	**0**	**0**	**0**	**0**	**0**	**0**	**0.18**
South Myrtle Creek (BSP-172)	81.19	Yes	Federal					**0**						**0**	**0**
			Non-Federal		0.08			**0.08**			0.07	0.12		**0.19**	**0.27**
			Riparian Zone Total	**0**	**0.08**	**0**	**0**	**0.08**	**0**	**0**	**0.07**	**0.12**	**0**	**0.19**	**0.27**
Days Creek-South Umpqua River (HUC 1710030205)															
Fate Creek (BSP-232)	88.48	Yes	Federal					**0**						**0**	**0**
			Non-Federal		0.09			**0.09**				0.39		**0.39**	**0.48**
			Riparian Zone Total	**0**	**0.09**	**0**	**0**	**0.09**	**0**	**0**	**0**	**0.39**	**0**	**0.39**	**0.48**
Days Creek (BSP-233)	88.60	Yes	Federal					**0**						**0**	**0**
			Non-Federal		0.07			**0.07**				0.42		**0.42**	**0.49**
			Riparian Zone Total	**0**	**0.07**	**0**	**0**	**0.07**	**0**	**0**	**0**	**0.42**	**0**	**0.42**	**0.49**
Saint John Creek (ASP-303)	92.62	Yes	Federal					**0**						**0**	**0**
			Non-Federal		0.22			**0.22**					0.02	**0.02**	**0.24**
			Riparian Zone Total	**0**	**0.22**	**0**	**0**	**0.22**	**0**	**0**	**0**	**0**	**0.02**	**0.02**	**0.24**
South Umpqua River (ASP-196)	94.73	Yes	Federal					**0**						**0**	**0**
			Non-Federal		0.09			**0.09**			0.11		0.01	**0.12**	**0.21**
			Riparian Zone Total	**0**	**0.09**	**0**	**0**	**0.09**	**0**	**0**	**0.11**	**0**	**0.01**	**0.12**	**0.21**
All Fifth-Field Watersheds and Jurisdictions															
			Federal Subtotal	**0.78**	**0.29**	**0**	**0**	**1.07**	**0**	**0**	**0**	**0.07**	**0**	**0.07**	**1.14**
			Non-Federal Subtotal	**0.05**	**2.97**	**2.72**	**0**	**5.74**	**0**	**4.98**	**0.43**	**5.18**	**0.58**	**11.17**	**16.91**
			Total	**0.83**	**3.26**	**2.72**	**0**	**6.81**	**0**	**4.98**	**0.43**	**5.25**	**0.58**	**11.24**	**18.05**

a/ Project components considered in calculation of habitat "Removed:" Pacific Connector construction right-of-way, temporary extra work areas, aboveground facilities, and permanent and temporary access roads (PAR, TAR).

b/ Habitat Types within Riparian Zones generally categorized as: Late Successional (Mature) or Old Growth Forest (coniferous, deciduous, mixed ≥80 years old); Mid-Seral Forests (coniferous, deciduous, mixed ≥40 but ≤80 years old); Regenerating Forest (coniferous, deciduous, mixed ≥5 but ≤40 years old); Clearcut Forests; Forested and Nonforested Wetland, Unaltered Nonforested Habitat (grasslands, sagebrush, shrublands), Agriculture, and Altered Habitats (urban, industrial, residential, roads, utility corridors, quarries).

c/ Riparian zone of Stock Slough at MP 15.11BR includes the riparian zone of Laxstrom Gulch which is adjacent to the pipeline but not crossed. Laxstrom Gulch is also designated Critical Habitat.

Effects to water temperature (shade) during construction and operation within the riparian zone of each waterbody assumed to support coho or with coho critical habitat would be minor.

Table 3.5.4-37c summarizes tables 3.5.4-37a and 3.5.4-37b. In table 3.5.4-37c, the greatest absolute impact to LW recruitment and shade within riparian zones associated with critical habitats for Oregon Coast coho would occur where the pipeline crosses Steinnon Creek, South Fork Elk Creek, Olalla Creek, Saint John Creek, and the South Fork Umpqua River where more than one acre of riparian forest would be removed at each one. Likewise, there would be high absolute impact to several streams that are known to (e.g., Tributary to Cooston Channel) or assumed (six streams) to support coho. In addition to those, relatively large amounts of riparian forest would be affected during construction at Kent Creek, Rice Creek, and North Myrtle Creek but relatively large areas of forest restoration following construction would partially offset the effects of construction. Riparian forest that would be restored would presumably attain mid-seral status (40-80 years old) at the end of the 50-year life of the Pipeline. Absolute and relative impact to forests within riparian zones (with concomitant effects to LW recruitment and shade) associated with other affected waterbodies with critical habit for Oregon Coast coho would be less severe. The longest-term effects to riparian forest, LW and shade would occur where late successional-old growth forest would be removed during construction: 0.89 acre at Vogel Creek (Coos Bay Frontal-Pacific Ocean Watershed), 0.81 acre at Middle Creek (North Fork Coquille River Watershed), 0.01 acre at McNabb Creek (Olalla Creek-Lookingglass Creek Watershed), 0.10 acre at North Myrtle Creek (Myrtle Creek Watershed), and 0.54 acre at Saint John Creek (Days Creek-South Umpqua River Watershed).

TABLE 3.5.4-37c

Summary Table for Effects to Riparian Zones (One Site Potential Tree Height Wide) Associated with Critical Habitats and Assumed Occupied Habitat for Oregon Coast Coho

Fifth-Field Watershed and Waterbody with Critical Habitat	Critical Habitat	Total Riparian Zone Affected (acres)	Riparian Forest Removed by Construction (acres) a/	Riparian Forest Not Restored During Operation (acres) b/,c/	Riparian Forest Restored After Construction (acres)	Percent Riparian Zone Originally Forested	Percent Riparian Forest Removed Permanently c/	Percent of Riparian Zone with Restored Forest
Coos Bay-Frontal Pacific Ocean (HUC 1710030403)								
Trib to Coos Bay	No	12.73	0.00	0.00	0.00	0%	0%	0.0%
Willanch Slough	Yes	0.85	0.10	0.01	0.09	12%	1%	10.6%
Johnston Creek	Yes	1.20	0.20	0.08	0.12	17%	7%	10.0%
Trib. Cooston Channel	No	1.40	1.34	0.36	0.98	96%	26%	70.0%
Coos River	Yes	4.95	0.00	0.00	0.00	0%	0%	0.0%
Vogel Creek	Yes	7.70	0.89	0.28	0.61	12%	4%	7.9%
Trib. to Stock Slough (Laxstrom Gulch)	Yes	7.00	0.30	0.07	0.23	4%	1%	3.3%
Stock Slough	Yes	2.50	0.37	0.13	0.24	15%	5%	9.6%
Stock Slough	Yes	2.33	0.37	0.15	0.22	16%	6%	9.4%
North Fork Coquille River (HUC 1710030504(								
Steinnon Creek	Yes	2.43	2.23	0.58	1.65	92%	24%	67.9%
No. Fk. Coquille River	Yes	1.59	0.75	0.20	0.55	47%	13%	34.6%
Middle Creek	Yes	2.14	0.82	0.12	0.70	38%	6%	32.7%
East Fork Coquille River (HUC 1710030503)								
Trib. to E. Fork Coquille R.	No	1.48	1.48	0.29	1.19	100%	20%	80.4%
Trib. to E. Fork Coquille R.	No	1.97	1.45	0.42	1.03	74%	21%	52.3%
Trib. to E. Fork Coquille R.	No	1.33	1.33	0.32	1.01	100%	24%	75.9%
E. Fork Coquille River	Yes	2.21	0.24	0.06	0.18	11%	3%	8.1%
Elk Creek	No	0.65	0.65	0.12	0.53	100%	18%	81.5%
Trib. to Elk Creek	No	0.60	0.60	0.20	0.40	100%	33%	66.7%
South Fork Elk Creek	Yes	1.29	1.25	0.30	0.95	97%	23%	73.6%
Middle Fork Coquille River (HUC 1710030501)								
Big Creek	No	1.11	1.11	0.38	0.73	100%	34%	65.8%
Olalla Creek-Lookingglass Creek (HUC 1710030212)								
Trib. to Shields Creek	No	1.47	0.17	0.03	0.14	12%	2%	9.5%
Trib. to Olalla Creek	No	2.08	0.08	0.03	0.05	4%	1%	2.4%
Olalla Creek	Yes	3.93	1.20	0.32	0.88	31%	8%	22.4%
Trib. to Olalla Creek	No	1.14	0.40	0.14	0.26	35%	12%	22.8%
McNabb Creek	Yes	1.14	0.08	0.01	0.07	7%	1%	6.1%
Clark Branch-South Umpqua River (HUC 1710030211)								
Kent Creek	Yes	0.97	0.78	0.17	0.61	80%	18%	62.9%
Rice Creek	Yes	1.17	0.95	0.22	0.73	81%	19%	62.4%
Willis Creek	Yes	1.01	0.15	0.05	0.10	15%	5%	9.9%
South Umpqua River	Yes	0.32	0.00	0.00	0.00	0%	0%	0.0%
Myrtle Creek (HUC 1710030210)								
Rock Creek	No	0.85	0.78	0.17	0.61	92%	20%	71.8%
Trib. to Rock Creek	No	0.35	0.35	0.09	0.26	100%	26%	74.3%
Bilger Creek	Yes	2.06	0.30	0.12	0.18	15%	6%	8.7%
North Myrtle Creek	Yes	0.64	0.64	0.18	0.46	100%	28%	71.9%
South Myrtle Creek(	Yes	1.10	0.24	0.08	0.16	22%	7%	14.5%
Days Creek-South Umpqua River (HUC 1710030205)								
Fate Creek	Yes	2.89	0.52	0.09	0.43	18%	3%	14.9%
Days Creek	Yes	2.57	0.23	0.07	0.16	9%	3%	6.2%
Saint John Creek	Yes	2.67	2.30	0.22	2.08	86%	8%	77.9%
South Umpqua River	Yes	2.29	1.06	0.09	0.97	46%	4%	42.4%

a/ Summarized from table 3.5.4-39a.

b/ Summarized from table 3.5.4-39b.

c/ Former forested area in 30-foot-wide corridor not reforested during operation.

Effects to LW during construction and operation within the riparian zone of each waterbody assumed to support coho or with coho critical habitat are assumed to be directly related to areas of riparian forest removed during construction (riparian forest within the construction right-of-way, TEWAs, TARs, and PARs) and to areas of riparian forest that would be removed within the 30-foot wide operational easement for the life of the Pipeline. Riparian forest that is not in the operational easement would be restored over time, presumably attaining mid-seral status (40-80 years old) at the end of the 50-year life of the Pipeline. The magnitude of impact to LW recruitment associated with each waterbody with critical habitat and assumed to be occupied by coho is directly related to the absolute and relative amounts of riparian forest removed during construction, amounts removed permanently by the operational easement, and amounts of riparian forest that would be restored within affected riparian zones.

Summary. The Pipeline Project would result in adverse effects to freshwater critical habitat for the Oregon Coast ESU of coho salmon. Most effects would be short-term, but some would be intermediate to long-term. Minor short-term effects would occur from sedimentation during construction actions. Minor intermediate-term effects would occur from a reduction in riparian habitat due to construction and operation. Sediment disturbance at stream crossings would affect food sources for rearing fish in the short term, and riparian plant removal would reduce LW supply affecting habitat quality and quantity in the intermediate to long-term over small stream areas (i.e., within the less than 75- to 95-foot stream length clearing area per crossing).

Designated critical habitat for the Oregon Coast coho does not include unoccupied areas. The lateral extent of critical was defined as the width of the stream channel defined as the ordinary high-water line (NMFS 2008d). Human actions on land outside of the stream channel can modify or degrade physical and biological features of the stream and associated PCE at the site and/or in downstream reaches of designated critical habitat. Each PCE defined for critical habitat could be adversely affected by the proposed action. Those effects have been quantified to the extent possible in the foregoing analyses and summarized below in table 3.5.4-38.

TABLE 3.5.4-38

Summary of Project Effects to Critical Habitat Designated for Oregon Coast Coho within Watersheds Crossed by the Pipeline Project

Subbasins and Fifth-Field Watersheds	Total Waterbodies Crossed in Watershed	Waterbodies with Coho Affected a/			Riparian Zone Width (feet) b/	Areas (acres) of Riparian Vegetation Removed c/		
		Documented	Assumed	Total with Critical Habitat /b		Forested| Habitat	Non-forested Habitat	Total
Coos Subbasin								
Coos Bay-Frontal Pacific Ocean	13	13	0	11	225	2.32	29.16	31.47
Coquille Subbasin								
North Fork Coquille River	7	3	0	3	224	2.87	1.98	4.85
East Fork Coquille River	13	2	6	2	204	1.49	2.05	3.54
Middle Fork Coquille River	16	0	1	0	189	0.00	0.00	0.00
South Umpqua Subbasin								
Olalla Creek-Lookingglass Creek	17	2	3	2	169	1.40	4.68	6.08
Clark Branch-South Umpqua River	13	4	0	4	149	2.15	2.70	4.85
Myrtle Creek	14	3	2	3	168	1.44	2.61	4.05
Days Creek-South Umpqua River d/	15	4	9	9	164	4.09	6.03	10.12
Upper Cow Creek	8	0	0	0	187	0.00	0.00	0.00
Total	**116**	**31**	**12**	**29**		**15.77**	**49.20**	**64.97**

a/ Data from ODFW GIS database (ODFW 2014c).
b/ Based on mapped designated critical habitat for Oregon Coast coho.
c/ Riparian width of 1 SPTH, one site-potential tree height.
d/ Includes the Key Watershed designated within the Days Creek-South Umpqua River fifth-field watershed.

Project effects to freshwater spawning sites would likely occur prior to coho spawning in the year of construction and there would be no effects to spawning, incubation, and larval development by suspended sediment although Project-generated sediment could increase gravel embeddedness downstream. Those effects would depend on precipitation and in-stream flow (potential freshets) following construction that would likely flush fines downstream. The project would remove small areas of riparian forest that would provide recruitment of LW. The Project would temporarily decrease water quality downstream from construction sites by entrainment of sediments and temporarily limit in-stream migration during in-stream construction. In all instances, habitat suitability (HADD, Anderson et al. 1996) would temporarily decrease though not necessarily to levels that would cause moderate habitat degradation (SEV = 7).

The Project could result in short-term adverse effects to estuarine and freshwater critical habitat for the Oregon Coast ESU of coho salmon. Short-term effects to critical habitat within the estuarine analysis area would include effects to food and rearing habitat as a result of dredging the access channel, NRIs and the slip. Dredging in proximity to the Coos Bay shipping channel would decrease water quality and affect cover (aquatic vegetation, eelgrass).

In the riverine analysis area, most effects to critical habitat would be short-term while some would be intermediate to long-term. Minor short-term effects would occur primarily from sedimentation during stream crossings. Minor intermediate-term effects would occur from a reduction in riparian habitat that would affect freshwater rearing habitat due to construction and operation. Sediment disturbance at stream crossing would affect food sources for rearing fish in the short-term, and riparian plant removal would reduce LW supply affecting habitat quality and quantity in the intermediate to long-term over small stream areas (i.e., within the less than 75- to 95-foot stream length clearing area per crossing).

3.5.4.4 Conservation Measures

Appendices N and O of this BA include a complete list of conservation measures proposed by Jordan Cove and Pacific Connector. Measures that are applicable to Oregon Coast ESU coho are summarized here.

Jordan Cove would undertake a number of measures designed to mitigate the potential construction and operation impacts on fisheries and aquatic resources as described in the above sections. As described earlier in section 3.5.1.4, Jordan Cove would do wetland restoration projects including at the Kentuck Slough where some 90 acres of wetland and estuarine habitat would be developed to offset the permanent loss of intertidal, subtidal, and salt marsh habitat from modification from dredging and Project construction of the access channel (see appendix O.1, *Compensatory Wetland Mitigation Plan*). Additionally, the Eelgrass Mitigation site would be developed, which would add about 6 acres of eelgrass habitat in the bay.

Conservation measures proposed by Jordan Cove to minimize impacts from LNG carrier transit, LNG Terminal and facility construction and operations to fisheries in the marine and estuarine analysis area are compiled in tables 1, 2A, and 2B in appendix N (see discussion in section 3.3.1). Jordan Cove has also proposed measures to rectify, repair, rehabilitate, and otherwise reduce impact to from actions noted once construction is complete; these measures are compiled in tables 3A and 3B in appendix N.

Jordan Cove's proposed conservation actions are in appendix N, and include measures related to:

- Timing of Dredging Activities – to minimize potential impacts to juvenile salmonids and other fish/invertebrate species through the avoidance of vulnerable life stages and peak migration periods;
- Berm Construction Containment – conduct most slip dredging behind soil berm to limit sedimentation in marine waters and no Coos Bay water disposal activities;
- Dredging and Disposal Activities – use of dredge equipment and techniques to minimize the potential for turbidity and contaminant releases to the water column;
- Use of Upland Disposal of Dredge Materials – includes removal of dredged spoils by barge and containment of elutriate water;
- Control of Turbidity and Contaminants – includes monitoring, corrective actions, upland and water containment, and dredging technique;
- Stormwater Management – initial run off of all storms of a two–year return period to be contained and infiltrated, the remainder would flow to the slip;
- Timing of In-water Temporary Construction Components and Terminal Construction Components – to minimize potential impacts to juvenile salmonids and other fish/invertebrate species through the avoidance of vulnerable life stages and peak migration periods;

- Control of Acoustic Disturbance – includes impact hammer work (pilings and sheet piles) behind berm outside of marine waters and monitoring plan and noise reducing measure such as bubble curtain;
- Riprap Installation – using smallest size practical;
- Lighting – direct light to shore and at lowest levels possible design; and
- Spill Prevention and Control – includes development and implementation of an SPCCP.

Conservation measures have also been proposed by Pacific Connector to minimize construction and operation impact in the riverine analysis area and estuarine analysis area crossed by the Pipeline. Those measures are compiled in tables 1 and 2C in appendix N and are summarized below. Pacific Connector has also proposed measures to rectify, repair, rehabilitate, and otherwise reduce impact to waterbodies and riparian zones once construction of the Pipeline is complete. Those measures have been compiled in table 3C in appendix N. Details of some of the major conservation measures proposed by Pacific Connector are summarized below.

The conservation measures for the freshwater stream crossings are the same as those presented for SONCC coho salmon for the following items with the details of each found in the appendix N tables noted above:

- Erosion Control
  - Temporary Slope Breakers
  - Sediment Barriers
  - Erosion Control Fabric
- Fish Salvage Plan
- OHV Barriers
- Streambank Stability
- Streambank Restoration
- In-Stream Gravel
- Stream Crossing Monitoring

The following conservation measures would also be implemented in or along streams affected by the route.

Revegetation

As required by the FERC's *Plan*, Pacific Connector has identified procedures for the preparation and planting of live stakes or sprigs and for the planting bare root tree seedlings. Those procedures are included in appendix R. Within the range of Oregon Coast coho salmon, construction of the Pipeline would remove 112.96 acres of riparian forested habitats of which 16.86 acres are late-successional (mature) old-growth, 45.82 acres are mid-seral forests, and 0.07 acre is forested wetlands (see table 3.5.4-30a).

Existing forested riparian zones in which forest would be removed during construction would be re-planted with conifers to within 15 feet of each side of the centerline. Permanent effects—persisting longer than the assumed 50-year life of the Pipeline—would occur by removing 16.86 acres of LSOG riparian forest. Even though the riparian zone would be replanted, the newly planted trees would not attain LSOG status within 50 years. Permanent effects would also last along the 30-foot wide maintenance corridor centered on the Pipeline. Those effects to former

LSOG riparian forest, mid-seral riparian forest and other existing riparian vegetation are included in table 3.5.4-30b. Due to the maintenance access route in the right-of-way that would not be allowed to grow trees for the life of the Pipeline Project, replanting conifers within each affected forested riparian zone would leave an estimated 28.27 acres of non-forested vegetation within former forested riparian zones over the long-term or permanently (see table 3.5.4-30b).

Large Wood

As discussed in the *Direct and Indirect Effects* section above in several instances, mitigation would contribute to restoring an aquatic habitat indicator's functional level, such as placement of LW within and/or adjacent to streams and placing LW on floodplains, where appropriate, to provide microsites for riparian vegetation and/or vegetation protection during flood events. Placement of LW in streams and/or on streambanks has been one focal point of recent stream rehabilitation procedures (Slaney and Martin 1997; Cederholm et al. 1997; EPA 2001) as described in Pacific Connector's *Large Woody Debris Plan* (see appendix O.3).

As indicated in table 3.5.4-10a and table 3.5.4-10b, baseline watershed conditions crossed by the Pipeline are lacking in LW due to historical disturbance and LW presence is typically below benchmark thresholds to be properly functioning. Because of the overall lack of LW in the affected watersheds, LW also provides an appropriate mitigation model for the Pipeline Project's potential waterbody crossing impacts that are temporary, short-term, and unavoidable (see appendix O.3). If approved by landowners, Pacific Connector proposes to install LW on-site during construction as an appropriate habitat enhancement feature to mitigate for potential pipeline impacts and to benefit watershed conditions. The LW would also serve to mitigate for potential long-term Pipeline Project impacts—impacts lasting for its 50-year life—such as the loss of forested riparian vegetation within the 30-foot operational corridor (see table 3.5.4-30b, above). Even though the riparian zone would be replanted, the planted trees would not attain late-successional or old-growth status within 50 years. Placement of LW would, in some measure, reduce though not eliminate the impact due to the removal of late-successional (mature) old-growth riparian forest.

For low-gradient streams, Cederholm et al. (1997) suggest using logs with diameters at least 18 inches (less in areas of low velocity) placed by vertical angling into the stream channel. Logs could be used to create a stepped-channel profile with the rootwads and encourage woody debris accumulations in pool margins. For streams with steeper gradients, Cederholm et al. (1997) suggest that logs with smaller diameters might be used if larger logs are unavailable. Near headwaters, LW is often suspended over the channel so that it can become functional during periods of maximum runoff. Smaller debris may be retained during those periods and help develop pools that would be functional during summer (see Cederholm et al. 1997).

Guidelines for LW placement, provided by ODF and ODFW (1995), suggest using the following: 1) larger diameter wood pieces because they are more effective at creating pools and complex channels which improve fish populations (see table 3.5.4-39 for minimum diameter LW per bankfull width); 2) LW that are at least twice the length of the waterbody bankfull width (1.5 times the bankfull width if the rootwad is attached) to increase the likelihood that the LW would remain in place; and 3) conifer logs, especially western red cedars if available, because they are more durable. In larger waterbodies, smaller diameter, shorter LW could be used if bundled and anchored together to provide the same benefits of the longer, larger diameter LW (ODF and ODFW 1995).

TABLE 3.5.4-39

Minimum Diameter Large Wood for Placement in Waterbody Based on Bankfull Width

Bankfull Width (feet)	Minimum Diameter Large Wood (inches)
0 to 10	10
10 to 20	16
20 to 30	18
Over 30	22

Source: ODF and ODFW 1995.

Trees classified as late successional or old growth are assumed to have attained heights equal to the site-potential tree heights that are included above in table 3.5.4-30a as Riparian Zone Widths. Site-potential tree heights range from 225 feet (for example, the Coos Bay-Frontal Pacific Ocean Watershed) to 164 feet (as in the Days Creek-South Umpqua River Watershed). If Douglas-fir trees in the Oregon Cascades grow in height at the rate of 20 inches per year and in diameter by 0.25 inch per year (Cox 2008), a 20-inch-tall seedling planted the year after construction of the Pipeline would be an estimated 85 feet tall and 12 to 13 inches in diameter (assumed dbh) after 50 years. Trees with those dimensions would provide suitable LW for streams with bankfull widths from zero to 10 feet but not larger streams (see table 3.5.4-39). Even in these streams recruitment of wood may be reduced as the young age of the forest would reduce recruitment from natural mortality as the rate would be less relative to older trees. But recruitment of wood is not solely dependent on natural tree mortally but includes important contributing factors such as bank erosions, disease, fires, slides, and windthrow (Reeves et al. 2003; Martin and Benda 2001; Gregory et al. 2003). LW contribution would occur from these areas even though natural mortality contribution would be reduced.

The Pipeline would cross 50 perennial streams within the range of Oregon Coast ESU coho salmon. Forty-five of those perennial streams have existing riparian forest ranging from clear – cut forest and regenerating forest to mid-seral stage (approximately 40 to 80 years old) to older late-successional and old-growth; 39.45 acres of existing riparian forest would be removed by construction. Five more perennial streams would also be crossed but construction would not affect riparian forest vegetation (see table 3.5.4-40). In addition, the Pipeline would cross 56 intermittent streams, 46 of which support riparian forest, and would affect riparian forest of 52 other intermittent streams, resulting in a total of 113.09 acres of riparian forest being removed. Six additional perennial streams and 25 intermittent streams with no riparian forest would be crossed as well (see table 3.5.4-40).

To offset impact from removal of riparian trees (reducing LW recruitment potential) and to provide an overall benefit by enhancing stream habitat with no potential for LW recruitment, Pacific Connector proposes to place LW at the waterbody flow types identified by watershed in table 3.5.4-40 (see the *Large Woody Debris Plan* in appendix O.3) based on the following applications:

- four pieces for each perennial stream crossed with riparian forest removed (two pieces in-stream and/or keyed into the streambank, two pieces within riparian zone on the bank);
- two pieces for each intermittent stream and unknown stream crossed with riparian forest removed (one or both LW pieces placed in-stream, keyed into the bank, or placed on the bank);

- two pieces for each perennial, intermittent, and unknown stream crossed but with no riparian forest removed (one or both LW pieces paced in-stream keyed into the bank, or placed on the bank); and
- one piece each for a perennial, intermittent, and unknown stream not crossed but adjacent to the construction right-of-way, with or without riparian forest removed (LW placed on bank).

Because the construction right-of-way at stream crossings would be 75 feet wide, Pacific Connector anticipates only enough space for two pieces of LW, preferably with rootwads attached, either placed in-stream or with stems keyed into streambanks. Unless site-specific conditions dictate otherwise, the preferable location for each in-stream LW is downstream from the pipeline to prevent scour of the pipe. LW would also be placed near or adjacent to streambanks within riparian zones to provide for and/or enhance microsites for riparian vegetation and/or vegetation protection during flood events.

The LW Plan includes placing from one to four pieces of LW per stream crossed in the stream or on the bank, depending on forest conditions, stream flow, and landowner approval. This number of pieces, if no other LW were present in the stream reach affected by clearing, would be in the range of what is considered "desirable" by ODFW (Foster et al. 2001) for forested streams. Foster et al. (2001) noted that more than 20 LW pieces/100 meters of stream length (i.e., 4.6 pieces/75 feet of right-of-way clearing) with more than 3 "key" pieces/100 meters (i.e., 0.7 "key" pieces/75 feet of right-of-way clearing) is considered "desirable" in forested streams in Oregon. The sizes of LW pieces to be installed in streams are shown in table 3.5.4-32 to meet habitat needs for specific stream sizes and number of streams crossed.

In all, Pacific Connector proposes 375 pieces of LW for placement within the nine fifth-field watersheds that coincide with Oregon Coast coho salmon ESU and designated critical habitat. Placement of LW is subject to approval by each affected landowner. If a landowner rejects the proposed placement of LW, the number of pieces that would have been applied on-site would be reserved and provided to appropriate watershed councils for their use and placement, preferably elsewhere within the affected fifth-field watershed.

TABLE 3.5.4-40

Proposed Application of Large Wood to Waterbodies and Riparian Zones Affected by Construction of the Pipeline within the Range of Oregon Coast Coho Salmon

Fifth-Field Watershed	Watershed Parameter	Waterbody Type						Total in Watershed	Pieces of LW Applied to Fifth-Field Watershed a/		
		Perennial		Intermittent		Unknown					
		Crossed	Adjacent	Crossed	Adjacent	Crossed	Adjacent		Crossed	Adjacent	Total
Coos Bay-Frontal Pacific Ocean (HUC 1710030403)	Area (acres) of Riparian Forest	0.42	1.09	3.05	21.32	0	0	25.88			
	Total Number of Waterbodies	4	4	5	33	0	0	19			
	With Riparian Forest	3	3	4	28	0	0	38	20	31	51
	No Riparian Forest	1	1	1	5	0	0	8	4	6	10
North Fork Coquille River (HUC 1710030504)	Area (acres) of Riparian Forest	4.00	0	0.24	3.11	0	0	7.34			
	Total Number of Waterbodies	4	0	1	5	0	0	10			
	With Riparian Forest	4	0	1	4	0	0	9	18	4	22
	No Riparian Forest	0	0	0	1	0	0	1	0	1	1
East Fork Coquille River (HUC 1710030503)	Area (acres) of Riparian Forest	7.84	0.00	8.03	3.16	0	0	19.03			
	Total Number of Waterbodies	9	0	6	7	0	0	22			
	With Riparian Forest	8	0	6	6	0	0	20	44	6	50
	No Riparian Forest	1	0	0	1	0	0	2	2	1	3
Middle Fork Coquille River (HUC 1710030501)	Area (acres) of Riparian Forest	6.42	0.33	8.03	2.60	0	0	17.38			
	Total Number of Waterbodies	6	1	8	4	0	0	19			
	With Riparian Forest	6	1	8	3	0	0	18	40	4	44
	No Riparian Forest	0	0	0	1	0	0	1	0	1	1
Olalla Creek-Lookingglass Creek (HUC 1710030212)	Area (acres) of Riparian Forest	2.90	0.06	2.36	0.00	0	0	5.32			
	Total Number of Waterbodies	4	0	13	1	0	0	18			
	With Riparian Forest	4	0	8	0	0	0	12	32	0	32
	No Riparian Forest	0	0	5	1	0	0	6	10	1	11
Clark Branch-South Umpqua River (HUC 1710030211)	Area (acres) of Riparian Forest	2.06	0	1.17	3.53	0	0	6.76			
	Total Number of Waterbodies	7	0	6	12	0	0	25			
	With Riparian Forest	4	0	4	7	0	0	15	24	7	31
	No Riparian Forest	3	0	2	5	0	0	10	10	5	15

TABLE 3.5.4-40 (continued)

Proposed Application of Large Wood to Waterbodies and Riparian Zones Affected by Construction of the Pipeline within the Range of Oregon Coast Coho Salmon

Fifth-Field Watershed	Watershed Parameter	Waterbody Type: Perennial Crossed	Perennial Adjacent	Intermittent Crossed	Intermittent Adjacent	Unknown Crossed	Unknown Adjacent	Total in Watershed	Pieces of LW Applied to Fifth-Field Watershed a/: Crossed	Adjacent	Total
Myrtle Creek (HUC 1710030210)	Area (acres) of Riparian Forest	5.49	0	4.30	1.54	0	0	11.33			
	Total Number of Waterbodies	7	0	7	2	0	0	16			
	With Riparian Forest	7	0	5	2	0	0	14	38	2	40
	No Riparian Forest	0	0	2	0	0	0	2	4	0	4
Days Creek-South Umpqua River (HUC 1710030205)	Area (acres) of Riparian Forest	5.47	0	6.66	0.95	0	0	13.08			
	Total Number of Waterbodies	6	0	8	1	0	0	15			
	With Riparian Forest	6	0	8	0	0	0	14	40	0	40
	No Riparian Forest	0	0	0	1	0	0	1	0	1	1
Upper Cow Creek (HUC 1710030206)	Area (acres) of Riparian Forest	2.98	0.39	2.06	1.54	0	0	6.97	6.97		
	Total Number of Waterbodies	3	1	2	2	0	0	8			
	With Riparian Forest	3	1	2	2	0	0	8	16	3	19
	No Riparian Forest	0	0	0	0	0	0	0	0	0	0
Total Fifth-Field Watersheds For Oregon Coast Coho	Area (acres) of Riparian Forest	37.59	1.87	35.89	37.75	0	0	113.09			
	Total Number of Waterbodies	50	6	56	67	0	0	152			
	With Riparian Forest	45	5	46	52	0	0	148	272	57	329
	No Riparian Forest	5	1	10	15	0	0	31	30	16	46
								Total LW	**302**	**73**	**375**

a/ Proposed schedule for applying large wood (LW) to different waterbody types, subject to landowner approval:
4 pieces for each perennial stream crossed with riparian forest removed (2 pieces in-stream, 2 pieces within riparian zone on the bank);
2 pieces for each intermittent stream and unknown stream crossed with riparian forest removed (one or both pieces placed in-stream or on bank);
2 pieces for each perennial, intermittent, and unknown stream crossed but with no riparian forest removed (one or both pieces paced in-stream or on bank).
1 piece each for perennial, intermittent, and unknown stream not crossed but adjacent to ROW with or without riparian forest removed (piece placed on bank).

Pacific Connector anticipates that during construction, in some cases, the waterbody size, landowner restrictions, or construction constraints would limit LW placement according to the proposed LW schedule provided in table 3.5.4-40. Further, the overall benefit of installation of LW at some waterbody crossings (i.e., intermittent headwater streams) may not warrant LW placement. In these situations, Pacific Connector's EI would record the uninstalled LW as a deficit during construction. After construction is completed, unutilized LW would be provided to local watershed conservation organizations or agencies for use in local enhancement projects within the affected watersheds. (Also see the discussion on the use of LW for mitigation in appendix O.3)

Mitigation

Appendix O.4 provides the draft of a suite of mitigation projects proposed by the Forest Service to address the effects of the Pipeline Project on various resources on NFS lands and to ensure that construction and operation of the pipeline would be consistent with the objectives and goals of the respective Forest Service LRMP, including protections for ESA listed Oregon Coast coho salmon ESU. These include proposed projects within watersheds in the Coquille and South Umpqua Subbasins. Additionally, mitigation to help maintain the ACS on NFS lands would have direct and indirect benefits to EFH habitat on these lands.

A summary of all Forest Service mitigation projects and their potential affects to all relevant species and habitats is provided in table 2.8-1. These include actions such as improving fish passage at existing road crossing with related riparian habitat in crossing areas to aid in aquatic biota including coho movement and increased shading; and decommissioning, closing, and stormproofing roads to reduce fine sediment to streams, mitigate soil compaction, and increase fish passage associated with culvert removal as part of road decommissioning. Water source improvements would also be undertaken that would increase fire suppression, helping to protect riparian habitat.

Currently, these projects lack the site-specific details needed for implementation; however, the Forest Service is seeking consultation at a programmatic level for these and other proposed Forest Service actions described in this BA. It is anticipated that these projects would require a secondary site-specific project-level ESA consultation prior to implementation.

3.5.4.5 Determination of Effects

Species

The Project **may affect** coho salmon in the Oregon Coast ESU because:

- several life stages and activities of coho salmon (upstream adult migration, juvenile fry rearing, and juvenile smolt out-migration) are expected to occur at various locations in the riverine analysis area during construction and operation of the proposed action; and
- several life stages and activities of coho salmon (juveniles, adults) are expected to occur within the estuarine and marine analysis areas during construction and operation of the proposed action.

The Project is **likely to adversely affect** coho salmon in the Oregon Coast ESU as listed below.

- Short-term increase in noise associated with MOF land-based pile driving and in-water pile driving at various temporary construction activities throughout the bay may cause disturbance and physical injury to Oregon Coast coho if they are in proximity to the noise during construction.

- Some juvenile coho may be subject to localized entrainment by construction and ongoing maintenance dredging associated with the access channel and marine waterway modifications.
- Short-term increases in suspended sediment in Coos Bay from in-water construction, particularly during dredging, may result in behavioral effects on rearing coho salmon juveniles with physiological consequences that may affect growth and survival.
- Short-term effects to the benthic community and potential food resources for Oregon Coast coho would result from dredging the proposed access channel and marine waterway modifications in Coos Bay.
- Removing eelgrass from donor stocks in the bay to develop the Eelgrass Mitigation site may reduce cover and food sources for rearing juvenile coho salmon in the short term.
- Even though most juvenile coho would be of sufficient size and swimming ability to avoid the LNG carrier cooling water intake, a limited number could be entrained during spring and summer while they rear in Coos Bay concurrent with carrier loading operations.
- Installation of the proposed pipeline beneath Coos Bay and the Coos River using HDD construction would avoid effects to coho unless an inadvertent return of drilling fluid occurred. An inadvertent return would temporarily increase sedimentation and turbidity and likely result in behavioral avoidance of the affected area.
- TSS could adversely affect juvenile coho salmon. Exposure of juvenile fry to TSS concentrations during dry open-cut construction (fluming or dam-and-pump) from 2 to 6 hours could potentially exceed SEV5 for an estimated 264 to 615 meters or more downstream in some watersheds. Such an effect could cause a minor physiological stress (increased coughing rate and/or increased respiration rate).
- Individual coho salmon may be directly affected by local restoration activities at the Kentuck Project due to short-term construction-related increases in turbidity, in-water work and isolation measures.
- If a failure occurs while dry open-cut construction is underway, there could be possible adverse effects to juvenile coho (SEV of 7 or 8 and limited areas up to SEV of 9). The most likely effect could include moderate habitat degradation, impaired homing by fish, and moderate to major physiological stress, but in very limited areas may include reduced growth and reduced fish density.
- Literature-based estimates of suspended sediment effects from pipeline construction on SEV effects suggest typical dry-crossing methods could result in effects to coho salmon within a few hundred feet (e.g., 150 to 500 feet) below the crossing in the range of SEV of 4 to 6, which may include factors ranging from short-term reduction in feeding to moderate physiological stress. If failure of sealing occurs, effects to coho salmon could be SEV of 8, which may include habitat degradation, major physiological stress, and long-term reduction in feeding rate or success.
- Construction requiring blasting at 22 streams (only 15 of which are known or assumed to support coho) could cause mortality to fish by rupturing swim bladders. Adult and juvenile coho salmon would be removed and/or prevented from being within 50 feet of blasting sites to the maximum extent possible.
- Fish salvage would occur within isolated construction sites, possibly when adult and juvenile coho salmon are present. Coho salmon are considered vulnerable to

electrofishing, subject to injury and mortality. Seining, electrofishing, and handling may adversely affect Oregon Coast coho salmon. A worst-case estimate of 1,055 juvenile coho could potentially be salvaged from streams crossed by dry open-cut procedures.

- Lack of LW is a limiting factor in most streams within range of Oregon Coast coho salmon. Removal of mid-seral riparian forest (40 to 80 years old) would have long-term effects to recruitment of LW and removal of LSOG forest (≥80 years old) would have permanent effects to recruitment of LW because planted conifers would not attain those age classes within the 50-year life of the Project, in addition to the ongoing loss of trees within the 30-foot-wide maintenance corridor.

Critical Habitat

The Project **may affect** designated critical habitat for coho salmon in the marine analysis area, within the estuarine analysis area, and within the riverine analysis area for the Oregon Coast ESU because:

- actions associated with construction and operation of the LNG Terminal and access channel and slip would occur within designated critical habitat; and
- the Pipeline crosses designated critical habitat within Coos Bay and riverine waterbodies of the Coos, Coquille, and South Umpqua subbasins.

The Project is **likely to adversely affect** designated critical habitat for coho salmon in the Oregon Coast ESU because:

- localized, short-term effects to the benthic community and potential food resources for Oregon Coast coho would be result from dredging the proposed access channel and marine waterway modifications in Coos Bay;
- TSS concentrations generated during dry open-cut construction and if failure of isolation structures occur, would adversely affect freshwater habitats by changing coho habitat preferences (SEV = 3) or causing moderate habitat degradations (SEV = 7 or 8);
- food resources would potentially be affected over the short-term by dry open-cut and diverted open-cut construction methods that would remove substrate and benthos at crossing sites and produce turbidity downstream in all streams likely to support Oregon Coast coho salmon;
- freshwater migration corridors would potentially be affected over the short term by dry open-cut and diverted open-cut construction methods that would create temporary barriers to in-stream movements;
- approximately 88 acres of native riparian vegetation (forest, wetlands, and nonforested habitats) and altered habitat would be removed during construction within riparian zones associated with designated critical habitat associated with waterbodies within range of Oregon Coast coho ESU. Adverse effects to riparian zones would be mid- to long-term or permanent depending on whether mid-seral riparian forests (13.7 acres) or LSOG riparian forests (3.6 acres) are removed (provided in table 3.5.4-39a); and
- SE values of 7 or higher could cause adverse effects to coho habitat from sediment releases; a failure of crossing isolation structures lasting up to 6 hours could cause an SEV score of 7 (approximate SE value; moderate habitat degradation) or higher for at least 542 meters downstream from dry open cut crossings within seven streams with critical habitat in the Coos Bay Frontal-Pacific Ocean watershed; 1,185 meters of three streams crossed by dry

open-cut with critical habitat within the North Fork Coquille River watershed; 1,999 meters of two streams crossed by dry open-cut with critical habitat within the East Fork Coquille River watershed; 1,534 meters of two streams crossed by dry open-cut with critical habitat within the Olalla Creek-Lookingglass Creek watershed; 856 meters of four streams crossed by dry open-cut with critical habitat within the Clark Branch-South Umpqua River watershed; 1,544 meters of three streams crossed by dry open-cut with critical habitat within the Myrtle Creek watershed; and 16 meters of four streams crossed by dry open-cut with critical habitat within the Days Creek-South Umpqua River watershed.

3.5.5 Lost River Sucker

3.5.5.1 Species Account and Critical Habitat

Status

The Lost River sucker was listed as a federally endangered species on July 18, 1988 (FWS 1988). The Lost River sucker was listed as endangered because of the loss of habitat and access to historical range, resulting in a declining population. A five-year review was released in August 2013 recommending no change to the current listing status as endangered.(FWS 2013l).

Threats

Lost River suckers and shortnose suckers were considered together in the final rule listing both as endangered species. Numerous factors in both species' decline were cited by FWS (1988) including historical over-fishing, dams limiting upstream movements and access to spawning habitats, introduction of non-native species that compete (fathead minnows) and prey on suckers (yellow perch, bullheads, largemouth bass, and various lepomid sunfish), and degradation of water quality due to livestock grazing, agriculture, and timber harvest. Pollution in Upper Klamath Lake has led to algal blooms with increased mortality of suckers when oxygen depletions occur due to eutrophication. Status assessments conducted in 2001 and 2002 (FWS 2002a) concluded that the Lost River sucker was threatened by the following: 1) drastically reduced adult populations and reduction in range; 2) extensive habitat loss, degradation, and fragmentation; 3) small or isolated adult populations as a result of dams; 4) poor water quality; 5) lack of sufficient recruitment; 6) entrainment into irrigation and hydropower diversions; 7) hybridization with the other native Klamath sucker species; 8) potential competition with introduced exotic fishes; and 9) lack of regulatory protection.

Many of these same issues remained as factors threatening the species' recovery in 2013 (FWS 2013l). Regulatory protection of aquatic habitats inhabited by Lost River suckers has improved with implementation of various state (Oregon and California) and federal laws that minimize effects of actions on the species and habitat during project planning and consultation. However, Lost River suckers continue to be affected by adverse water quality, habitat degradation, toxicity from blue-green algae, and entrainment into irrigation and hydropower diversions. Added to the earlier threats listed is climate change which is predicted to increase flows during winter months but decrease flows during the spawning period, from March or mid-April through May (FWS 2013l).

Two recent significant habitat improvements have been the removal of the Chiloquin Dam and restoration and reconnection of the Williamson River Delta. Additionally, about 400 habitat restoration projects have been completed or are planned for the Upper Klamath Lake Basin. The

Lost River sucker has been observed using the 6,000-acre habitat area of Williamson River Delta to Upper Klamath Lake suggesting the importance of this habitat improvement for the species. Because these efforts are so recent, population-level effects have not yet been observed. However, these actions and others are believed to be significant for the improved status of this species (FWS 2013l). Nevertheless, poor water quality in Upper Klamath Lake and the Lost River continues to threaten the viability of the species. The water quality issues are most pronounced during summers when high temperatures combined with nutrient loading from pumping diked wetlands and runoff from farms, roads, and other sources cause detrimental water quality for fish. Also, lake sediments create hypereutrophic conditions which lead to depletions of dissolved oxygen and fish die-offs (FWS 2007e and 2013l). A cyanobacterium, now present in Upper Klamath Lake, undergoes massive algal blooms; photosynthesis during daylight can supersaturate water with dissolved oxygen and respiration at night can deplete dissolved oxygen with both events deleterious to Lost River suckers (FWS 2013l). Blue-green algal or cyanobacter toxins (Microcystin) have recently been found to affect the liver, intestines, kidneys, heart, spleen, and gills of suckers (FWS 2013l).

Population levels were estimated to be 11,000 to 23,000 at the time of listing (FWS 2013l). This was considered a substantial decline from historic levels, but these and historic estimates may not be completely accurate (FWS 2007e and 2013l). The factors contributing to the decline include the following: habitat loss of approximately 77 percent of historic range, restricted access to spawning habitat, overharvest, and increased rates of mortality resulting from entrainment in water management structures and severely impaired water quality (FWS 2007e and 2013l). All known populations across the range of current distribution have chronically low recruitment, reduced survivorship of adult fish, and reduced age-class diversity (FWS 2013l). Length-frequency analysis suggests that the last substantial recruitment to the spawning population occurred during the late 1990s (FWS 2012h). Recent additional threats to both Lost River and shortnose sucker include climate change that contributes to changes in water flow, bird predation, algal toxins and various forms of parasitism (NMFS and FWS 2013b; FWS 2013l).

Species Recovery

A recovery plan for Lost River sucker and short-nose sucker was finalized on March 17, 1993 (FWS 1993b). Since then, additional information, prompted revision of the recovery plan (FWS 2012h). The recovery program goal is to stop the population decline and enhance Lost River sucker and shortnose sucker populations so that ESA protection is no longer necessary. Actions described in the recovery plan that would aid in the delisting of the Lost River sucker include improving habitat conditions through rehabilitating riparian areas and improving land management practices in the Klamath Basin watershed, developing and achieving water quality and quantity goals, and improving fish passage, spawning habitat, and other habitat conditions. Compounding effects from drought and water diversions affect lake water levels and unscreened water diversions and fish entrainment continue as threats. Substantial entrainment occurs at the river gates of the Link River Dam (FWS 2013l). Some of the suckers that pass through the gates pass downstream to the Keno Reservoir and farther along the Klamath River where they cannot return upstream. Nevertheless, there is a small population inhabiting Lake Ewauna, probably fish that survived passage through the Link River Dam and other hydroelectric canals and turbines (FWS 2013l).

Adult populations are limited by extremely low recruitment as well as by high levels of stress and mortality associated with severely impaired water quality. As a whole the species is potentially limited by the lack of habitat connectivity (FWS 2012h). However, one of the main passage barriers that reduced access to 95 percent of its river spawning habitat, the Chiloquin Dam on the Sprague River, was removed in 2008 (NMFS and FWS 2013b).

Demographic-based objectives include increasing larval production, individual survival, and recruitment to spawning populations, and ultimately increasing abundance in spawning populations. The objectives of restoring spawning and nursery habitat, expanding reproduction, reducing the negative impacts from water quality on all life stages, clarifying the effects of other species on all life stages, reducing entrainment, and establishing auxiliary populations comprise the threats-based objectives. The recovery strategy is intended to produce and document healthy, self-sustaining populations by reducing mortality, restoring habitat (including spawning, larval and juvenile habitats), and increasing connectivity between spawning and rearing habitats. It also involves ameliorating adverse effects of degraded water quality, disease, and non-native fish. The plan provides areas of emphasis and guidelines to direct recovery actions (FWS 2012h).

There are two recovery units for Lost River suckers, the Upper Klamath Lake Unit and Lost River Basin Unit (FWS 2012h). Upper Klamath Lake Unit includes all Lost River suckers within the lake, tributaries to Upper Klamath Lake, and reservoirs within the Klamath River including Keno Reservoir and populations below Keno Reservoir. The Lost River Basin Unit includes Clear Lake Reservoir and tributaries including Willow Creek and Boles Creek, Tule Lake, Gerber Reservoir and tributaries, and the Lost River mainstem (FWS 2012h) even though the Lost River is not included in designated critical habitat. The Lost River proper includes individual suckers in the mainstem downstream from the Clear Lake Dam to Anderson-Rose Diversion Dam, including the Lost River tributary Miller Creek, downstream from Gerber Dam. The population in the Lost River drainage below Clear Lake Dam is comprised mostly of adults (FWS 2012h).

Life History, Habitat Requirements, and Distribution

Lost River suckers are native to the Lost River and Upper Klamath River Basin but have adapted to lake habitats and are now a lake-dwelling fish that migrates into streams to spawn (Moyle 2002). It is a long-lived species, reaching ages over 30 years. Historically, Lost River suckers were found in the Lost River watershed, Tule Lake, Lower Klamath Lake, and Sheepy Lake. The present distribution of the Lost River sucker includes Upper Klamath Lake and its tributaries, Clear Lake Reservoir and its tributaries, Tule Lake and the Lost River up to Anderson-Rose Diversion Dam, the Klamath River downstream to Copco Reservoir, and probably Iron Gate Reservoir. In the Upper Klamath Lake watershed, the Lost River sucker spawning runs are primarily limited to Sucker Springs in Upper Klamath Lake and the Sprague and Williamson Rivers. Spawning runs also occur in the Wood River and in Crooked Creek (in the Upper Klamath Lake watershed). An additional run may occur in Sheepy Lake in the Lower Klamath Lake watershed and spawning has been documented in the Clear Lake watershed (FWS 1988 and 1993b).

Although sucker spawning habitat in the Lost River is very limited, Reclamation has documented sucker spawning below Anderson-Rose Diversion Dam, in Big Springs near Bonanza, and at the terminal end of the West Canal as it spills into the Lost River (Reclamation 2007). Suitable spawning habitats with riffle areas and rocky substrates include the spillway area below Malone Dam, immediately upstream of Keller Bridge, immediately below Big Springs in the Lost River, below Harpold Dam, and adjacent to Station 48 (Reclamation 2007). Suckers are primarily bottom dwellers, remaining within 1 foot of bottom substrates. Water depths and turbidity provide cover in lakes while pools and overhanging banks provide cover features in streams. In Tule Lake, most depths are less than 1 meter and adult suckers are confined to the few locations where depths exceed 1 meter (Reclamation 2007). During periods of deteriorating water quality, especially in Upper Klamath Lake, adult suckers may utilize shallow waters with suitable water quality even though they may be more vulnerable to predators (Reclamation 2007).

Most spawning by Lost River suckers lasts from late February to early June in the larger tributaries of inhabited lakes (FWS 2007e). River spawning habitats include riffles or runs with gravel or cobble substrate, with moderate flows, and in water 8 to 50 inches deep. Some Lost River suckers have been noted to spawn in lakes, particularly at springs occurring along the shorelines (FWS 2007e). Each Lost River sucker female may produce between 44,000 and 236,000 eggs in a single spawning season; larger, older females produce more eggs and contribute more to recruitment than younger females (Reclamation 2007).

Larval Lost River suckers are present in Upper Klamath Lake from the beginning of May through mid-July. During that period, larvae utilize protective emergent vegetation along lake shorelines, which provides cover from predators, currents, and turbulence and are areas of concentrated prey including zooplankton, macroinvertebrates, and periphyton (Reclamation 2007). Similar relationships within the Lost River watershed, including Tule Lake and Lost River, have not been studied but are assumed to be similar to those in Upper Klamath Lake (Reclamation 2007).

By mid-summer, larval suckers have become juveniles, which, in Upper Klamath Lake, tend to occupy shoreline habitats less than 4 feet deep with and without emergent vegetation and/or shoreline vegetation. Abundance of juvenile suckers in the lake declines dramatically during late summer and early autumn. Some of the decline is due to emigration of juveniles into the Link River and parallel canals at the outlet of Upper Klamath Lake (Reclamation 2007). Adult suckers (and presumably subadults) in Upper Klamath Lake tend to inhabit deeper (>1 meter) waters in the northern half of the lake (Reclamation 2007). But, when water quality deteriorates in the north end of the lake during mid-summer with lower concentrations of dissolved oxygen, adult Lost River and shortnose suckers migrate to relatively shallow waters in Pelican Bay along the west shore (Reclamation 2007). Similar seasonal movements have not been described for suckers inhabiting Tule Lake and the Lost River although reproduction has been documented in Tule Lake and is suspected to occur in the Lost River.

In the Upper Klamath subbasin (HUC 18010206), Lost River suckers are found in the Klamath River as far downstream as Copco Reservoir (RM 199) and possibly Iron Gate Reservoir (RM 191). The Pipeline would cross the Klamath River at RM 249. In the Lost River subbasin (HUC 18010204), Lost River suckers are found in the Lost River mainstem and Clear Lake Reservoir (Moyle 2002). In the Pipeline Project vicinity, Lost River suckers spawn in the Lost River and are present in John C. Boyle Reservoir at RM 225, downstream from the Pipeline crossing (NRC 2004). In addition to collections of Lost River suckers in J.C. Boyle Reservoir, ORBIC (2017c) cites records of collections in Lake Ewauna and in the Lost River Diversion Channel connecting the Klamath River (at RM 249.8) to the Lost River at the Lost River Diversion Dam, approximately 10 river miles downstream from the pipeline crossing of the Lost River at RM 9.5.

Historically, Lost River suckers migrated in the Lost River upstream from Tule Lake (in California) to spawn near Olene and Big Springs near Bonanza (in Oregon), but Anderson-Rose Diversion Dam now blocks the migration. Lost River suckers presently occur within Tule Lake, but the population in the Lost River drainage below Clear Lake Dam is composed mostly of adults and the Lost River functions as a population sink with no likely chance of being self-sustaining because of low recruitment and lack of access to spawning habitats (FWS 2012h). In the early 1990s, Lost River suckers were reported spawning over cobbles in the Lost River below Anderson-Rose Diversion Dam (RM 17.4) south of Merrill, Oregon and approximately 7.6 river miles downstream from the pipeline crossing of the Lost River (ORBIC 2017c). Suckers also spawn below Malone Dam, downstream from Clear Lake, also in California.

Population Status

The Lost River sucker population in Upper Klamath Lake was estimated between 11,000 and 23,000 at the time of the Final Rule listing the species as endangered (FWS 1988). That estimate was probably inaccurate although adults in Upper Klamath Lake and Clear Lake (in California) probably numbered in the tens of thousands (FWS 2007e). There had been several die-offs during the 1990s that affected the spawning population of older adults in Upper Klamath Lake. More recent information indicates possible increased recruitment of males and females with only slight population growth in the portion of the population normally spawning along the lakeshore of Upper Klamath Lake and low recruitment continues as a major concern (FWS 2007e). Limited information indicates declines of large adult suckers in Clear Lake (FWS 2007e). Lost River suckers are known to be present in J.C. Boyle Reservoir, Copco Reservoir, and Iron Gate Reservoir but reproduction in any of the reservoirs is unknown and they are not abundant in any of the three reservoirs (Reclamation 2007).

In the past, the Lost River was probably important spawning habitat for Lost River suckers migrating upstream from Tule Lake. Now, Lost River is highly modified, used primarily for distributing irrigation water, and impaired by surface runoff and agricultural drainage (Reclamation 2007). For several years there was no indication that Lost River or shortnose suckers continued to inhabit Tule Lake, but in 1991 both species were observed spawning below Anderson-Rose Diversion Dam, and sampling at Tule Lake in the early 1990s determined that small populations of both species were present (Reclamation 2007). Lost River sucker spring-spawning abundance in 2007 was estimated to be 56 percent and 75 percent of 2002 abundances for males and females respectively (FWS 2012h). Tagging studies conducted on Lost River suckers and shortnose suckers in Gerber Reservoir and Clear Lake Reservoir (both impoundments are connected to the Lost River below Gerber Dam and Clear Lake Dam, respectively) indicate that numbers of large adult suckers of both species have declined since 2000. Declines in large adult Lost River suckers have been particularly pronounced in Clear Lake Reservoir, possibly due to poor recruitment from younger age classes prior to 2000 (Barry et al. 2009).

Hewitt et al. (2015) estimated the annual population rate change (λ) and other population demographic properties for the adult spawning population of Lost River suckers in Upper Klamath Lake from 2001 to 2012 (figure 3.5.5-1). In the figure, the population rate of change ($\lambda = N_{t+1} / N_t$) indicates positive or negative growth. When $\lambda > 1$, the rate of change is positive and the population (N) has grown from N_t to N_{t+1} in the next time interval. Alternatively, the population is stable when $\lambda = 1$, but when $\lambda < 1$, the population has declined from N_t to N_{t+1}. The data show a declining adult spawning population but do not indicate changes in the whole population because they do not account for changes in the numbers of juveniles from year to year. With additional demographic data, Hewitt et al. (2015) concluded that the spawning population in the Upper Klamath Lake consisted "almost entirely of similarly sized individuals growing through time, with little evidence of recruitment."

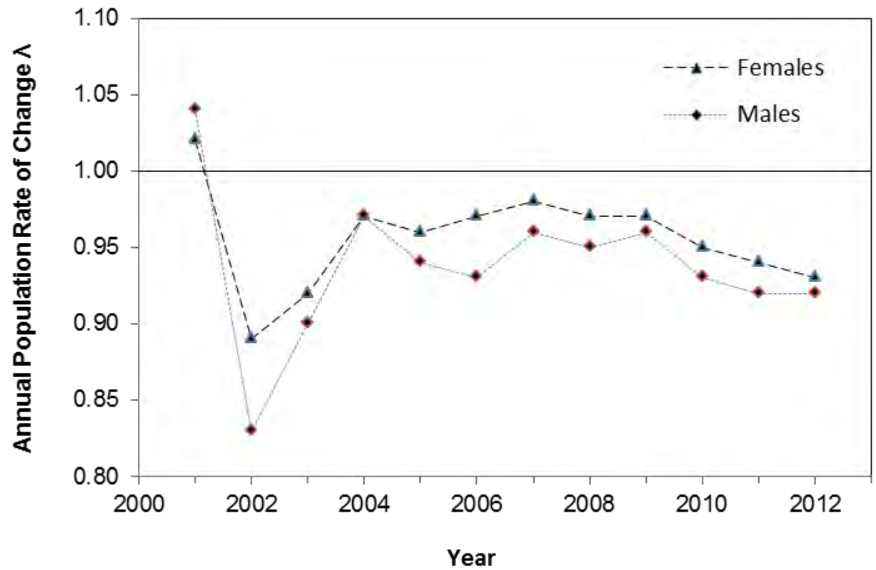


Figure 3.5.5-1. Estimates of Annual Population Rate of Change (λ) for Lost River Suckers from the Lakeshore Spawning Subpopulation, Upper Klamath Lake, Oregon. The Population is declining when λ < 1 (data from Hewitt et al. 2015).

Critical Habitat

Critical habitat for Lost River and shortnose suckers was designated in 2012 (FWS 2012i). Along the route of the Pipeline, designated critical habitat for Lost River and shortnose sucker (Unit 1 in Klamath County) includes the Link River, Lake Ewauna, and Klamath River downstream to Keno. Unit 2, in Klamath and Lake Counties, Oregon and Modoc County, California, includes Clear Lake Reservoir and tributaries and Gerber Reservoir and tributaries but does not include the Tule Lake and its tributary or the Lost River. For reasons described above (blockage by Anderson-Rose Diversion Dam), neither Tule Lake or Lost River provides spawning habitats or supports viable self-sustaining populations of Lost River suckers or shortnose suckers (FWS 2012i). The Pipeline does not coincide with critical habitat in Unit 2.

In Unit 1 (Upper Klamath Lake), there are 13 miles of critical habitat on federal land, less than 1 mile on state land, and 106 miles on lands of private/other ownership. In Unit 2 (Lost River Basin), there are 23 miles of critical habitat on federal land, less than 1 mile on state land, and 3 miles on lands of private/other ownership (FWS 2012i).

PCEs of critical habitat include (FWS 2012i):

1. **Water**. Areas with sufficient water quantity and depth within lakes, reservoirs, streams, marshes, springs, groundwater sources, and refugia habitats with minimal physical, biological, or chemical impediments to connectivity. Water must have varied depths to accommodate each life stage: Shallow water (up to 3.28 feet [1.0 meter]) for larval life stage and deeper water (up to 14.8 feet [4.5 meters]) for older life stages. The water quality characteristics should include water temperatures of less than 82.4°F (28.0°C); pH less than 9.75; DO levels greater than 4.0 mg/l; low levels of microcystin; and un-ionized ammonia (less than 0.5 mg/l). Elements also include natural flow regimes that provide flows during the appropriate time of year or, if flows are controlled, minimal flow departure from a natural hydrograph.

2. **Spawning and rearing habitat**. Streams and shoreline springs with gravel and cobble substrate at depths typically less than 4.3 feet (1.3 meters) with adequate stream velocity to allow spawning to occur. Areas containing emergent vegetation adjacent to open water provide habitat for rearing and facilitate growth and survival of suckers as well as protection from predation and protection from currents and turbulence.
3. **Food**. Areas that contain an abundant forage base, including a broad array of chironomidae, crustacea, and other aquatic macroinvertebrates.

3.5.5.2 Environmental Baseline

Analysis Area

For Lost River suckers, the riverine analysis area is limited to fresh waterbodies within the Upper Klamath River subbasin (HUC 18010206; see figure 3.5.5-2A) and Lost River subbasin (HUC 18010204; see figure 3.5.5-2B). The riverine analysis area includes two components: 1) the water column and substrate of all waterbodies crossed by the Pipeline from the point of crossing to the extent downstream where water quality is adversely affected by turbidity generated during construction and sediment generated by runoff from the construction right-of-way, and 2) waterbodies' associated riparian zones affected in the short-term during construction and in the long-term by operation. The riverine analysis area for the Lost River sucker includes two perennial flowing river crossings (Klamath River and Lost River) which would likely have Lost River suckers present at the time of constructions. In addition to the two perennial waterbodies, the Pipeline would also cross 83 intermittent streams, ditches and canals; 23 additional intermittent streams, ditches, ponds and canals would be adjacent to the Pipeline, within the construction right-of-way but not crossed. There is no information to indicate that Lost River suckers occur in any of these intermittent waterbodies but they are included in the riverine analysis area for Lost River suckers.

Species Presence

The Lost River sucker has been documented within the Klamath River from Klamath Falls to Keno Reservoir (FWS 2013l). The Pipeline would cross the Klamath River at RM 249. The Lost River sucker is also known to be present from Tule Lake Sump and Clear Lake Reservoir in northern California, which are connected by the Lost River. Tule Lake Sump is at the lower terminus of the Lost River and the population in Tule Lake is isolated from upstream spawning areas by multiple dams including blockage by the Anderson-Rose Diversion Dam.

Historically, Tule Lake supported large populations of Lost River suckers but much of the historical lake bed area has been drained and transformed to agriculture and portions were engineered to receive high runoff flows from the Klamath River via the Lost River Diversion Channel and Lost River (Hodge and Buettner 2009). Dams constructed on the Lost River, including the Lost River Diversion Dam, Anderson-Rose Diversion Dam, Malone Dam, and Harpold Dam have blocked suckers from accessing spawning areas upstream in the Lost River.

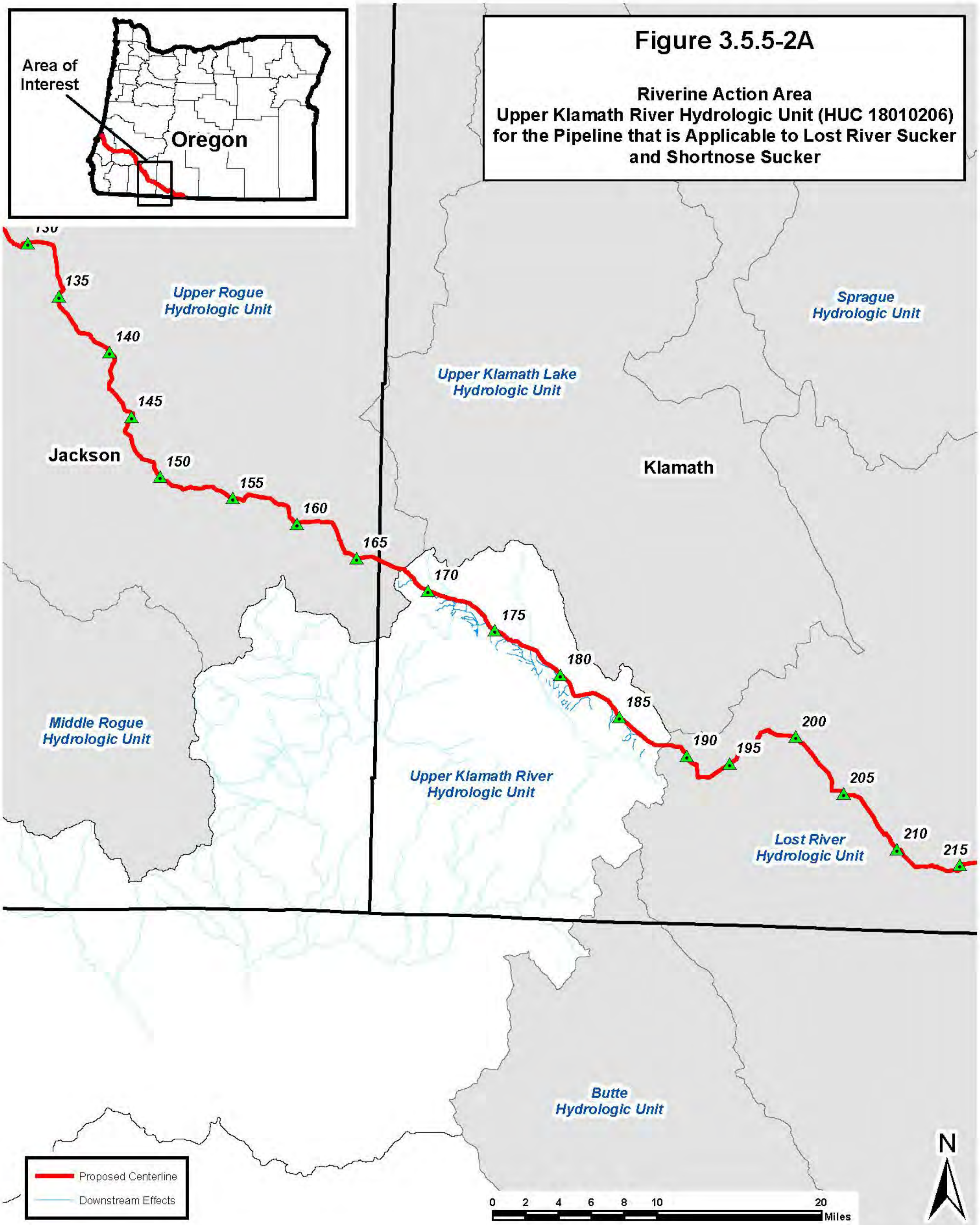


Figure 3.5.5-2A
Riverine Action Area
Upper Klamath River Hydrologic Unit (HUC 18010206)
for the Pipeline that is Applicable to Lost River Sucker
and Shortnose Sucker
Area of Interest
Oregon
135
140
145
150
155
160
165
170
175
180
185
190
195
200
205
210
215
Upper Rogue Hydrologic Unit
Jackson
Upper Klamath Lake Hydrologic Unit
Klamath
Sprague Hydrologic Unit
Middle Rogue Hydrologic Unit
Upper Klamath River Hydrologic Unit
Lost River Hydrologic Unit
Butte Hydrologic Unit
Proposed Centerline
Downstream Effects
0 2 4 6 8 10 20
Miles
N

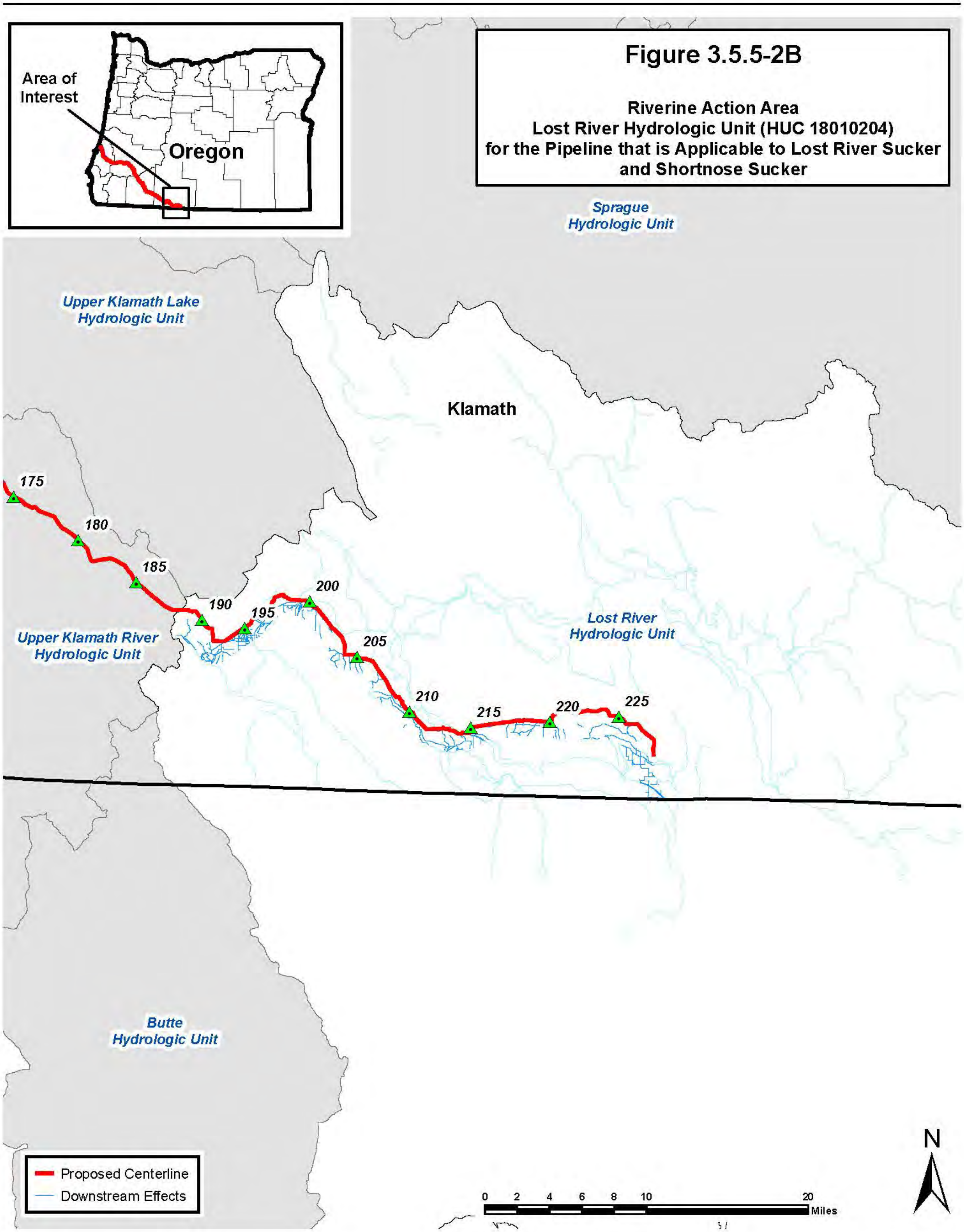


Figure 3.5.5-2B
Riverine Action Area
Lost River Hydrologic Unit (HUC 18010204)
for the Pipeline that is Applicable to Lost River Sucker
and Shortnose Sucker
Area of
Interest
Oregon
Sprague
Hydrologic Unit
Upper Klamath Lake
Hydrologic Unit
Klamath
175
180
185
190
195
200
205
210
215
220
225
Upper Klamath River
Hydrologic Unit
Lost River
Hydrologic Unit
Butte
Hydrologic Unit
Proposed Centerline
Downstream Effects
0 2 4 6 8 10 20
Miles
N

Currently, Lost River sucker spawning migrations are limited from Tule Lake to the Lost River below the Anderson-Rose Diversion Dam. Lost River suckers migrate a short distance from Tule Lake to spawn in the Lost River below Anderson-Rose Diversion Dam (RM 17.4) south of Merrill and approximately 7.6 river miles from the Pipeline crossing of the Lost River (ORBIC 2017b). As of 2006, Lost River suckers had not been detected in the Lost River from the Lost River Diversion Dam to Anderson-Rose Diversion Dam, a reach that coincides with the proposed crossing of the Lost River (FWS 2013l). Lost River suckers continue to occupy the Lost River below Anderson-Rose Diversion Dam to Tule Lake.

Very little water flows in the Lost River below the Lost River Diversion Dam except during the winter and early spring. During the irrigation season, all flows are diverted at Anderson-Rose Diversion Dam into the J-Canal for irrigation deliveries to the Tule Lake Irrigation District (Hodge and Buettner 2009). From 2006 to 2008, FWS and Reclamation placed gravels below the Anderson-Rose Diversion Dam and released flows from mid-April to early June to entice suckers to migrate from Tule Lake and spawn in the lower Lost River. Lost River suckers and shortnose suckers sporadically spawned in the graveled riffle area below the Anderson-Rose Diversion Dam and sucker larvae were documented in the Lost River during 2006 although they may have derived from Upper Klamath Lake, the Upper Lost River, and/or Clear Lake Reservoir. Reclamation salvages suckers from J-Canal, which drains into Tule Lake, suggesting that some entrained fish move into Tule Lake (Hodge and Buettner 2009).

Tagged Lost River suckers spawning in the lower Lost River peaked from late April to mid-May and from late May to early June (Hodge and Buettner 2009). Most of the suckers that migrated into the Lost River from Tule Lake moved to below the Anderson-Rose Diversion Dam and spawn there. Larval suckers were present from May 30 to July 22, 2008. The population of Lost River suckers in Tule Lake Sump is probably in the low thousands of individuals which is higher than documented in the early 1990s (Hodge and Buettner 2009). Currently, Tule Lake functions only as a sink for Lost River sucker populations (FWS 2012i).

Regular spawning occurs in the Upper Klamath Lake and in Clear Lake Reservoir. Recruitment is low for the spawning population in Upper Klamath Lake. Clear Lake Reservoir, in California, supports a sustaining population of Lost River suckers that is critical to the species' recovery (FWS 2012h; Barry et al. 2009). Growth rates for adult Lost River suckers are greater in Clear Lake Reservoir than in Upper Klamath Lake, possibly due to younger individuals present in Clear Lake (Barry et al. 2009). Suckers spawn in Willow Creek, a tributary to Clear Lake Reservoir, during February and March when water temperatures range from 4ºC to 12ºC and larva emigrate down Willow Creek into Clear Lake Reservoir from late March to mid-April (Perkins and Scoppettone 1996). There is limited evidence of a resident population of Lost River suckers in the Lost River above Malone Dam in the Langell Valley, Oregon (FWS 2012i). However, Lost River suckers are prevented from accessing historically occupied habitats in Lost River mainstem and lower Lost River from Clear Lake Reservoir by the Malone Dam.

Historically, dewatering of canals, laterals, and drains has included biological monitoring and salvage of listed species, as needed. Canals, laterals, and drains are dewatered at the end of irrigation season which includes capture and relocation (salvage) of suckers from the canal system after dewatering occurs. Nearly all canals, laterals, and drains are either dewatered after the irrigation season, before April and after October, or have the water lowered for inspection and maintenance (NMFS and FWS 2013b). Canals remain dewatered until the following spring (as early as late March) except for the input of localized precipitation-generated runoff (NMFS and

FWS 2013b). Reclamation's fish salvage efforts focus on the A Canal forebay in front of the fish screen, C4 Canal, D1 Canal, and D3 Canal within the Klamath Irrigation District, and J Canal within the Tule Lake Irrigation District (NMFS and FWS 2013b). The Pipeline would cross the C-4-E Lateral at MP 201.63, the C-4 Lateral at MP 204.12, the C-4-F Lateral at MP 204.33, and the C-4-C Lateral at MP 205.50 in the Lake Ewauna-Klamath River watershed. In addition, the Pipeline would cross the C Canal at MP 205.96 and the C-4-7 Lateral at MP 207.40 in the Mills Creek-Lost River watershed. All six canals and laterals are presumed to be associated with the C4 Canal and may be occupied by Lost River suckers prior to dewatering. The Pipeline would not cross the A Canal, D1 Canal, the D3 Canal, or the J Canal.

Past efforts have shown that salvage of suckers is practical in some locations, but numbers of salvaged suckers are highly variable among years and sites (NMFS and FWS 2013b). Occurrence of Lost River suckers in canals and ditches operated and maintained by Reclamation is possible if they are crossed before dewatering begins in October. However, based on the unpredictability of Lost River sucker occurrence at any one site at any specific time, there is no way to anticipate the species' presence during Pipeline construction. All canals, laterals, and drains operated and maintained by Reclamation would be crossed using conventional bores, thus avoiding any in-stream construction and conflicts with Lost River suckers if present. Irrigation ditches and roadside ditches on private land would be crossed by dry open-cut construction if water is present at the time. The connectivity of those ditches with canals, laterals, and drains operated and maintained by Reclamation is unknown, but because of their small size and functions as agricultural drains, Lost River suckers are not expected to occur.

A total of 26 streams/ditches in the Lake Ewauna-Klamath River watershed and 59 streams/ditches in the Mills Creek-Lost River watershed would be crossed (85 total) by the Pipeline. The right-of-way would not cross but would be adjacent to 23 additional streams/ditches in the two watersheds. Altogether, the Pipeline would potentially affect 108 waterbodies in the range of the Lost River sucker (see table 3.5.5-1). All but the Klamath River and Lost River have intermittent flow. There are 106 intermittent streams or ditches between MPs 188.9 and 228.1; 58 of them would be crossed by dry open cutting and 25 of them would be crossed using a conventional bore (with no in-stream construction). Twenty-three intermittent streams/ditches/canals would not be crossed but are present within the construction right-of-way (see table 3.5.5-1). They are expected to be dry at the time of construction.

TABLE 3.5.5-1

Waterbodies Crossed or Adjacent to the Pipeline within the Lake Ewauna- Klamath River Watershed (HUC 1801020412) and Mills Creek-Lost River Watershed (HUC 1801020409) in the Range of the Lost River Sucker and Shortnose Sucker

Waterbodies Crossed and Waterbody ID	NHD Waterbody Reach Code and/or Jurisdiction	Pipeline Milepost (MP)	Waterbody Type	Proposed Crossing Method a/ (potential for blasting) d/	Species Present b/	Fishery Construction Window c/
Lake Ewauna-Upper Klamath River (HUC 1801020412) Fifth-field Watershed, Klamath County						
Trib. To Klamath River (ASI-13/SS-100-025)	18010204003103 Private	188.90	Intermittent	Dry Open-Cut	None	Jul 1 to Jan 31
Irrigation Ditch (S2-07 (ADX-63 (MOD))	18010204003315 Private	192.67	Intermittent	Dry Open-Cut	Unknown	N/A
Ditch (192.81)	180102040033481 Private	192.81	Intermittent	Adjacent to centerline within ROW	None	N/A
Ditch (ADX-67)	18010204003314 Private	192.99	Intermittent	Dry Open-Cut	None	N/A
Ditch (ADX-72)	Private	193.07	Intermittent	Dry Open-Cut	None	N/A
Ditch (ADX-72)	Private	193.25	Intermittent	Adjacent to centerline within TEWA	None	N/A
Ditch (ADX-73)	Private	193.47	Intermittent	Adjacent to centerline within TEWA	None	N/A
Ditch (ADX-75)	Private	194.51	Intermittent	Dry Open-Cut	None	N/A
Ditch (ADX-77)	Private	194.57	Intermittent	Dry Open-Cut	None	N/A
Irrigation Ditch (NDX-77)	Private	194.57	Intermittent	Adjacent to centerline within TEWA	None	N/A
Irrigation Ditch (WW-001-010/(ADX-78)	18010204003303 Private	194.64	Intermittent	Dry Open-Cut	None	N/A
Ditch (ADX-83)	Private	195.12	Intermittent	Adjacent to centerline within ROW	None	N/A
Ditch (ADX-84)	Private	195.18	Intermittent	Adjacent to centerline within TEWA	None	N/A
Ditch (ADX-86)	Private	195.24	Intermittent	Adjacent to centerline within TEWA	None	N/A
Irrigation Ditch (NDX-82)	Private	195.28	Intermittent	Adjacent to centerline within TEWA	None	N/A
Drainage Ditch (ADX-87)	Private	195.32	Intermittent	Adjacent to centerline within TEWA	None	N/A
Ditch (ADX-19	Private	195.46	Intermittent	Dry Open-Cut	None	N/A
Ditch (ADX-22)	Private	195.46	Intermittent	Adjacent to centerline within TEWA	None	N/A
Wetland Ditch (ADX-20)	Private	195.47	Intermittent	Adjacent to centerline within ROW	None	N/A
Ditch (GDX-4)	Private	195.67	Intermittent	Dry Open-Cut	None	N/A

TABLE 3.5.5-1 (continued)

Waterbodies Crossed or Adjacent to the Pipeline within the Lake Ewauna- Klamath River Watershed (HUC 1801020412) and Mills Creek-Lost River Watershed (HUC 1801020409) in the Range of the Lost River Sucker and Shortnose Sucker

Waterbodies Crossed and Waterbody ID	NHD Waterbody Reach Code and/or Jurisdiction	Pipeline Milepost (MP)	Waterbody Type	Proposed Crossing Method a/ (potential for blasting) d/	Species Present b/	Fishery Construction Window c/
Ditch (GDX-3)	Private	195.73	Intermittent	Dry Open-Cut	None	N/A
Ditch (GDX-2)	Private	195.91	Intermittent	Dry Open-Cut	None	N/A
Irrigation Ditch (ADX-30)	Private	196.53	Intermittent	Dry Open-Cut	None	N/A
Drainage Ditch (ADX-31)	Private	196.53	Intermittent	Adjacent to centerline within ROW	None	N/A
Irrigation Canal (ADX-32)	18010204000790 Private	196.64	Intermittent	Dry Open-Cut	None	N/A
Irrigation Ditch (ADX-36)	Private	196.76	Intermittent	Dry Open-Cut	None	N/A
Irrigation Ditch (ADX-38)	18010204003183 Private	196.78	Intermittent	Dry Open-Cut	None	N/A
Weyerhaeuser Pond (AL-34)	Private	196.78	Industrial Pond	Adjacent to centerline within ROW	None	N/A
Irrigation Ditch (ADX-39)	18010204003183 Private	196.89	Intermittent	Dry Open-Cut	None	N/A
Irrigation Ditch (ADX-40)	Private	197.08	Intermittent	Dry Open-Cut	None	N/A
Irrigation Ditch (DX-GM-1)	Private	197.22	Intermittent	Adjacent to centerline within ROW	None	NA
Irrigation Ditch (DX-GM-3)	Private	197.28	Intermittent	Adjacent to centerline within ROW	None	NA
Klamath River (ASP151)	18010204002564 State	199.38	Perennial	HDD	Lost River Sucker Shortnose Sucker	Jul 1 to Jan 31
Irrigation Canal (ADX-293	Private	200.41	Intermittent	Adjacent to centerline within ROW	None	N/A
Irrigation Canal (No. 1 Drain) (ADX-294)	18010204003246 BOR	200.54	Intermittent	Bore	Unknown	N/A
Irrigation Ditch (ADX-94)	18010204003251 Private	201.49	Intermittent	Dry Open-Cut	None	N/A
Irrigation Ditch (ADX-96) (C-4-E Lateral)	1217823421646 BOR	201.63	Intermittent	Bore	Unknown	N/A
Roadside Ditch (ADX-99)	Private	203.97	Intermittent	Dry Open-Cut	None	N/A
Irrigation Canal (C-4 Lateral) (ADX-100)	18010204001225 BOR	204.12	Intermittent	Bore	Unknown	N/A
Irrigation Canal (C-4-F Lateral) (ADX-101)	18010204001222 BOR	204.33	Intermittent	Bore	Unknown	N/A
Ditch (ADX-103)	Private	204.50	Intermittent	Adjacent to centerline within TEWA	None	N/A
Ditch No. 3 Drain (ADX-105)	18010204003757 BOR	204.74	Intermittent	Bore	Unknown	N/A
Irrigation Canal (ADX-106)	Private	204.91	Intermittent	Dry Open-Cut	None	N/A
Ditch (C-4-C Lateral) (ADX-109)	18010204001218 BOR	205.50	Intermittent	Bore	Unknown	N/A

TABLE 3.5.5-1 (continued)

Waterbodies Crossed or Adjacent to the Pipeline within the Lake Ewauna- Klamath River Watershed (HUC 1801020412) and Mills Creek-Lost River Watershed (HUC 1801020409) in the Range of the Lost River Sucker and Shortnose Sucker

Waterbodies Crossed and Waterbody ID	NHD Waterbody Reach Code and/or Jurisdiction	Pipeline Milepost (MP)	Waterbody Type	Proposed Crossing Method a/ (potential for blasting) d/	Species Present b/	Fishery Construction Window c/
Mills Creek-Lost River (HUC 1801020409) Fifth-field Watershed, Klamath County						
Ditch (ADX-110)	Private	205.94	Intermittent	Bore	Unknown	N/A
Canal (C Canal) (ADX-111)	18010204004021 BOR	205.96	Intermittent	Bore	Unknown	N/A
Wetland Ditch (ADX-112)	18010204009070 Private	205.97	Intermittent	Bore	Unknown	N/A
Irrigation Ditch (D-2 Lateral) (ADX-113)	BOR	206.51	Intermittent	Bore	Unknown	N/A
Roadside Drainage Ditch (5-A Drain) (ADX-115)	18010204004039 BOR	207.26	Intermittent	Bore	Unknown	N/A
Irrigation Lateral (C-4-7 Lateral) (ADX-116)	18010204001229 BOR	207.40	Intermittent	Bore	Unknown	N/A
Irrigation Drain 5-A Drain (ADX-117)	18010204001237 BOR	207.42	Intermittent	Bore	Unknown	N/A
Irrigation Drain (5-A Drain) (ADX-118)	18010204001237 BOR	207.60	Intermittent	Bore	Unknown	N/A
Irrigation Drain (5-A Drain) (ADX-119)	18010204001237 BOR	207.99	Intermittent	Bore	Unknown	N/A
Irrigation Ditch (ADX-120)	Private	208.07	Intermittent	Dry Open-Cut	None	N/A
Irrigation Ditch (ADX-121)	Private	208.07	Intermittent	Dry Open-Cut	None	N/A
Drainage Ditch Irrigation Drain (5-A Drain) (ADX-123)	18010204001237 BOR	208.18	Intermittent	Dry Open-Cut	Unknown	N/A
Ditch (ADX-124)	Private	208.23	Intermittent	Dry Open-Cut	None	N/A
Irrigation Ditch (ADX-125)	Private	208.28	Intermittent	Dry Open-Cut	None	N/A
Irrigation Ditch (ADX-126)	Private	208.29	Intermittent	Dry Open-Cut	None	N/A
Roadside Drainage Ditch (ADX-128)	Private	208.78	Intermittent	Bored	None	N/A
Roadside Drainage Ditch (ADX-129)	Private	208.85	Intermittent	Dry Open-Cut	None	N/A
Irrigation Drain 5-K Drain (ADX-130)	18010204001229 BOR	209.02	Intermittent	Bore	Unknown	N/A
Roadside Drainage Ditch (ADX-131)	Private	209.05	Intermittent	Bored	None	N/A
Roadside Drainage Ditch (ADX-133)	Private	209.15	Intermittent	Bore	None	N/A
Irrigation C-9 Lateral (ADX-134)	BOR	209.15	Intermittent	Bore	Unknown	N/A
Irrigation Ditch (ADX-135)	Private	209.16	Intermittent	Bore	None	N/A

TABLE 3.5.5-1 (continued)

Waterbodies Crossed or Adjacent to the Pipeline within the Lake Ewauna- Klamath River Watershed (HUC 1801020412) and Mills Creek-Lost River Watershed (HUC 1801020409) in the Range of the Lost River Sucker and Shortnose Sucker

Waterbodies Crossed and Waterbody ID	NHD Waterbody Reach Code and/or Jurisdiction	Pipeline Milepost (MP)	Waterbody Type	Proposed Crossing Method a/ (potential for blasting) d/	Species Present b/	Fishery Construction Window c/
Roadside Ditch (ADX-142)	Private	210.16	Intermittent	Dry Open-Cut	None	N/A
Irrigation Ditch (No. 5 Drain) (Trib. to Lost River) (ADX-143/ SS-003-001)	18010204004367 BOR	210.26	Intermittent	Bore	Unknown	N/A
Irrigation Ditch 5-H Drain (Trib. to Lost River) (ADX-260)	18010204015577 BOR	210.85	Intermittent	Bore	Unknown	N/A
Irrigation Ditch (ADX-261)	Private	210.87	Intermittent	Dry Open-Cut	None	N/A
Ditch (NDX-29/SS-003-002)	Private	211.32	Intermittent	Dry Open-Cut	None	N/A
Ditch (NDX-92)	Private	211.52	Intermittent	Dry Open-Cut	None	N/A
Irrigation Ditch (SS-003-004 (NDX-93))	Private	211.53 211.68	Intermittent	Dry Open-Cut	None	N/A
Lost River (NSP001)	18010204004545 State	212.07	Perennial	Dry Open-Cut	Lost River Sucker Shortnose Sucker	Jul 1 to Mar 31
Irrigation Ditch (ADX-318 EDX-55/EDX-90))	18010204004940 Private	213.23	Intermittent	Dry Open-Cut	None	N/A
Irrigation Ditch (ADX 318)	18010204004940 Private	213.45	Intermittent	Adjacent to ROW	None	N/A
Irrigation Ditch (ADX-274)	BOR	213.85	Intermittent	Bore	Unknown	N/A
G Canal (G Canal) (ADX-275)	18010204001228 BOR	213.87	Intermittent	Bore	Unknown	N/A
Pond (Edge-2)	Private	214.28	Intermittent	Adjacent to centerline within ROW	None	N/A
Unnamed Creek (ASI-51)	18010204004618 Private	216.10	Intermittent	Dry Open-Cut	None	Jul 1 to Mar 31
Unnamed Creek (ASI0-2)	18010204004618 Private	216.11	Intermittent	Dry Open-Cut	None	Jul 1 to Mar 31
Unnamed Creek (ASI-50)	18010204004617 Private	216.30	Intermittent	Dry Open-Cut	None	Jul 1 to Mar 31
Unnamed Creek (ASI-49)	18010204004627 Private	216.44	Intermittent	Dry Open-Cut	None	Jul 1 to Mar 31
Trib. to D Canal (ASI-136)	18010204001993 Private	218.09	Intermittent	Dry Open-Cut	None	Jul 1 to Mar 31
Trib. to D Canal (ASI-137)	18010204004701 Private	218.46	Intermittent	Dry Open-Cut (Streambed-bedrock)	None	Jul 1 to Mar 31
Trib. to D Canal (ASI-291)	18010204004701 Private	219.69	Intermittent	Dry Open-Cut	None	Jul 1 to Mar 31
Excavated Pond (NL-116)	18010204001267 Private	219.70	Pond	Off ROW – Temp Extra Workspace	None	N/A
Trib. to V Canal (SS-502-012)	Private	220.72	Intermittent	Dry Open-Cut	None	Jul 1 to Mar 31
Trib. to V Canal SS-502-013	18010204004906 Private	221.15	Intermittent	Dry Open-Cut	None	Jul 1 to Mar 31

TABLE 3.5.5-1 (continued)

Waterbodies Crossed or Adjacent to the Pipeline within the Lake Ewauna- Klamath River Watershed (HUC 1801020412) and Mills Creek-Lost River Watershed (HUC 1801020409) in the Range of the Lost River Sucker and Shortnose Sucker

Waterbodies Crossed and Waterbody ID	NHD Waterbody Reach Code and/or Jurisdiction	Pipeline Milepost (MP)	Waterbody Type	Proposed Crossing Method a/ (potential for blasting) d/	Species Present b/	Fishery Construction Window c/
Trib. to V Canal SS-502-013b	18010204004906 Private	221.15	Intermittent	Adjacent to centerline within ROW	None	Jul 1 to Mar 31
Trib. to V Canal SS-502-014	18010204004906 Private	221.30	Intermittent	Dry Open-Cut	None	Jul 1 to Mar 31
Trib. to V Canal SS-502.016	Private	221.72	Intermittent	Dry Open-Cut	None	Jul 1 to Mar 31
Trib. to V Canal SS-502-003b	Private	222.79	Intermittent	Dry Open-Cut	None	Jul 1 to Mar 31
Trib. to V Canal SS-502-003a	Private	222.80	Intermittent	Adjacent to centerline within ROW	None	Jul 1 to Mar 31
Trib. to V Canal SS-502-004	18010204004894 Private	222.99	Intermittent	Dry Open-Cut	None	Jul 1 to Mar 31
Trib. to V Canal SS-502.005	Private	223.08	Intermittent	Dry Open-Cut	None	Jul 1 to Mar 31
Trib. to V Canal SS-502-006	Private	223.12	Intermittent	Dry Open-Cut	None	Jul 1 to Mar 31
Trib. to V Canal SS-502.023	Private	223.39	Intermittent	Dry Open-Cut	None	Jul 1 to Mar 31
Trib. to V Canal SS-502-011	Private	223.54	Intermittent	Dry Open-Cut	None	Jul 1 to Mar 31
Trib. to V Canal SS-502-009a	Private	224.03	Intermittent	Dry Open-Cut	None	Jul 1 to Mar 31
Trib. to V Canal SS-502-009	Private	224.04	Intermittent	Dry Open-Cut	None	Jul 1 to Mar 31
Trib. to V Canal SS-502-008	Private	224.17	Intermittent	Dry Open-Cut	None	Jul 1 to Mar 31
Trib. to V Canal SS-502-007	Private	224.21	Intermittent	Dry Open-Cut	None	Jul 1 to Mar 31
Trib. to V Canal SS-502-021	Private	224.44	Intermittent	Dry Open-Cut	None	Jul 1 to Mar 31
Trib. to V Canal (SS-502-025 (ASI-140))	18010204001318 Private	225.96	Intermittent	Dry Open-Cut	None	Jul 1 to Mar 31
Trib. to V Canal SS-502-024	18010204004977 Private	225.99	Intermittent	Dry Open-Cut	None	Jul 1 to Mar 31
Trib. to V Canal SS-502-020	Private	227.14	Intermittent	Dry Open-Cut	None	Jul 1 to Mar 31
Trib. to V Canal SS-502-017	Private	227.57	Intermittent	Dry Open-Cut	None	Jul 1 to Mar 31
Agricultural Pond (AL-288)	Private	228.13	Pond	Off ROW Within TEWA	None	N/A

a/ Dry open cut crossing methods include flume or dam-and-pump procedures. Dam-and-pump methods would be utilized where streambed blasting is anticipated to eliminate blasting around the flume. The dam-and-pump crossing method is the preferred crossing procedure in steep incised drainage valleys where worker safety may be compromised when placing ("threading") the pipe string under the flume pipe and where there is a risk of upsetting the flume during this operation. The dam-and-pump crossing method is also the preferred crossing method on small streams under low flow conditions during the recommended ODFW-recommended in-water work period. Pacific Connector proposes temporary/short-term fish passage restriction when completing dam-and-pump crossings within the ODFW-recommended in-water work period.

b/ ORBIC (2017b)

c/ Assumes fisheries construction windows only apply to those waterbodies flowing at the time of construction and windows do not apply to HDD crossings.

d/ Streambed bedrock based on Pacific Connector's Wetland and Waterbody delineation surveys. Streambed bedrock may require special construction techniques to ensure pipeline design depth. Special construction techniques may include rock hammering, drilling and hammering, or blasting. The need for blasting would be determined by the construction contractor and would only be initiated after ODFW blasting permits are obtained.

Habitat

The Lost River has been highly altered to meet the needs of agriculture and to reduce the threat of flooding, and therefore habitat is fragmented and disconnected by dams lacking fish passage (NMFS and FWS 2013b). Much of the water flowing through the lower Lost River channel comes from Upper Klamath Lake through the A Canal. Consequently, water in the Lost River is high in nutrients and is reused many times by different users causing nutrient concentrations to be increased. Water flowing in the Lost River eventually empties into the Tule Lake NWR as return flow from irrigation (no water is released through the Anderson-Rose Diversion Dam) and can be pumped to the Lower Klamath NWR before flowing to the Klamath River via the Klamath Straits Drain (NMFS and FWS 2013b). The extensive alterations of the Lost River watershed, along with inputs from Upper Klamath Lake and agricultural drainage, have contributed to seasonally poor water quality, and the Lost River is listed by the State of Oregon for exceedances in temperature, DO, pH, algal biomass, and ammonia toxicity (NMFS and FWS 2013b).

Dams continue to limit passage and sucker migration, impose isolation of subpopulations, and decrease available spawning habitats which raise the possibility of facilitating hybridization between several sucker species. Dams may also cause stream channel changes, alter water quality, and provide habitat for exotic fish that prey on suckers or compete with them for food and habitat. Although there are seven major dams in the Klamath Basin that may affect the migration patterns of listed suckers, only the Link River Dam has been recently equipped with a fish ladder that was designed specifically for sucker passage. Fish ladders are present at J.C. Boyle and Keno Dams and, although suckers have been observed to use the ladders, they were not designed for sucker passage and generally are inadequate for sucker passage (Reclamation 2007).

Lost River suckers continue to inhabit the Klamath River above Keno. Lost River suckers may enter the Klamath River from Upper Klamath Lake by passing through the gates at Link River Dam. Lost River suckers that survive passing through the hydroelectric facilities either die due to poor summer water quality conditions or pass downstream into the Klamath Reservoirs. At that point, fish are unlikely to return and believed to be lost from the breeding population (FWS 2007e and 2013l). The Pipeline would cross the Klamath River using HDD.

Adverse water quality is the most critical threat to the Lost River sucker (FWS 2007e). Klamath River and Klamath Lake have been designated as water quality impaired, including for nutrient loads which are enhanced by drainage of irrigation water from agricultural lands adjacent to Klamath Lake. Construction of dikes and drainage systems converted wetlands to agricultural use. Soils high in organic content were subject to mineralization processes which released nutrients into the aquatic system, especially phosphorous and nitrogen (Rykbost and Charlton 2001).

High levels of phosphorous in Klamath Lake have led to extreme eutrophication events that promote algal blooms dominated by the blue-green algae, *Aphanizomenon flos-aquae*, that reach or nearly reach theoretical biological maxima (NRC 2004). As a consequence, portions of Upper Klamath Lake develop conditions of oxygen depletion or are anoxic, and accumulate high concentrations of ammonia that has resulted in mass mortality of fish, including adult suckers (NRC 2004). Lost River suckers are likely to experience high mortality if exposed to one or more of the following: pH $\geq$ 9.8, ammonia (unionized) concentration $\geq$ 0.34 mg/l, water temperatures $\geq$29.4^{o}C ($\geq$85^{o}F), and DO concentration $\leq$ 2.3 mg/l (Bellerud and Saiki 1995). Seasonally low DO concentrations occur throughout the Lost River, and can be especially low in reservoirs where concentrations less than 2 mg/L have been reported as lasting from a day to several weeks in

Anderson-Rose, Harpold, and Wilson Reservoirs, with DO concentrations near 0 mg/l observed in some reservoirs (NMFS and FWS 2013b).

No assessments have been conducted for either of the two fifth-field watersheds that would be crossed by the Pipeline in the Lost River subbasin: Lake Ewauna-Klamath River (HUC 1801020412) and Mills Creek-Lost River (HUC 1801020409). Likewise, no stream reaches have been sampled under ODFW's Aquatic Inventories Project in either of the fifth-field watersheds. Nevertheless, modifications and degradation of aquatic habitats have been documented by FWS (1993b and 2012h), USGS (Dileanis et al. 1996), Reclamation (2007), and the NRC (2004).

Dams limit passage and fish migration, impose isolation of subpopulations, and decrease available spawning habitats (Reclamation 2007). Sediment accumulation rates in Upper Klamath Lake indicate substantial annual increases since the late 1880s due to deforestation, drainage of wetlands, agriculture, livestock production, and irrigation (Reclamation 2007).

There are no recent long-term water discharge data for waterbodies in the Lost River watershed. The A Canal connects the Link River to the Lost River via the B Canal. According to USGS Gage 11507200, there is no flow in the A Canal between November and March (see figure 3.5.5-3), corresponding to periods of water diversions from the Klamath River, discussed above.

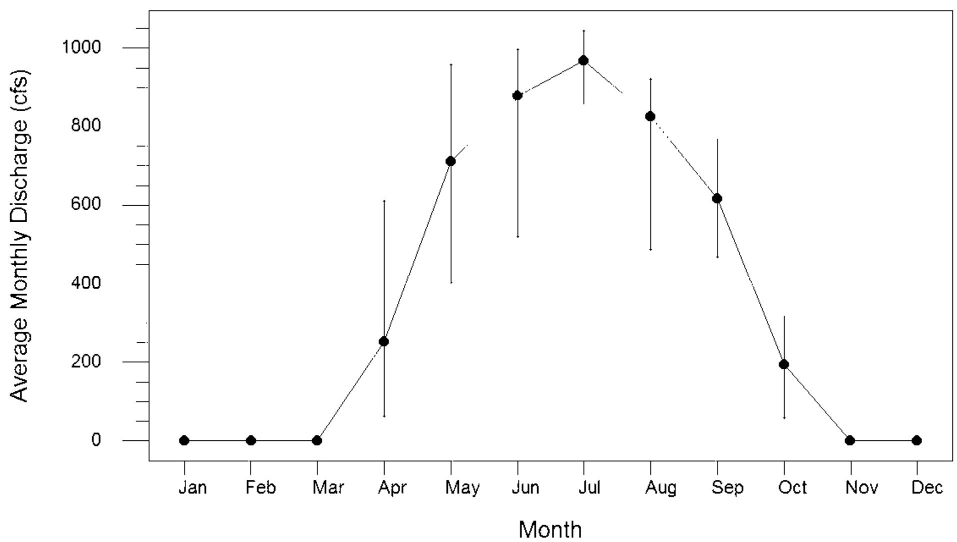


Figure 3.5.5-3 Average Monthly Discharge in the A Canal (USGS Gage 11507200) from 1960 to 1981. Vertical lines show maximum and minimum discharges for months during the periods of record.

Adequate flow and habitat conditions in the Lost River are likely during the spring and summer, with higher river flows supplemented by releases from Clear Lake and Gerber Reservoirs (NMFS and FWS 2013b). Irrigation releases typically start in April. Flows in the Upper Lost River are very low during the fall and winter because flows from Clear Lake and Gerber reservoirs are considerably reduced, but winter flows do increase downstream from tributary and spring contributions (NMFS and FWS 2013b).

Critical Habitat

Designated critical habitat for the Lost River sucker is present within the Pipeline Project area. The Pipeline would cross the Klamath River at RM 249 which is within CHU 1, Klamath County

(FWS 2012i). CHU 1 includes Upper Klamath Lake and Agency Lake, together with some wetland habitat; portions of the Williamson and Sprague Rivers; Link River; Lake Ewauna; and the Klamath River from the outlet of Lake Ewauna downstream to Keno Dam. The three PCEs are described above and include water, spawning and rearing habitat, and food(FWS 2012i).

CHU 2 includes Clear Lake Reservoir and its principal tributary, Willow Creek. CHU 2 does not coincide with the Pipeline route.

3.5.5.3 Effects of the Proposed Action

In the riverine analysis area, only the Klamath River and the Lost River are inhabited by Lost River sucker based on available information (ORBIC 2017b), although Lost River suckers enter the canal system within both subbasins and are regularly salvaged by Reclamation once canals are drained (Hodge and Buettner 2009). In the Lake Ewauna-Upper Klamath watershed, 19 intermittent streams would be crossed by dry open-cut and six others by boring. In the Mills Creek-Lost River watershed, 40 intermittent streams would be crossed by dry open-cut and 19 others by boring. There is no information documenting that Lost River suckers would be present in any of those intermittent streams, which include canals and ditches, at the time of construction (discussed above). The Lost River would be crossed using dry open-cut construction.

Direct and Indirect Effects

<u>Timing to Life History Functions</u>

The Klamath River (MP 199.38) and the Lost River (MP 212.07) are the only perennial waterbodies crossed by the Pipeline on Construction Spread 5. The ODFW (2008) allows in-stream construction in the Klamath River (above Keno) from July 1 to January 31 and in the Lost River (below Bonanza) from July 1 to March 31. Pacific Connector has requested that the HDD crossing of the Klamath River be allowed to occur outside of ODFW’s in-water construction windows to ensure that enough time is provided to successfully complete the crossings. Pacific Connector proposes to cross the Klamath River using an HDD between July and October. The Lost River would be crossed by dry open-cut crossing methods during the ODFW-recommended crossing window (July 1 to March 31). Occasionally individual Lost River suckers have been found in this stream region, so it is possible that Lost River suckers may be present in the Lost River where the Pipeline would cross during the non-spawning period.

<u>Species Presence</u>

In the vicinity of the Pipeline, Lost River suckers occur in the Lake Ewauna-Klamath River fifth-field watershed and the Mills Creek-Lost River fifth-field watershed. The Pipeline route crosses the Lake Ewauna-Klamath River fifth-field watershed for about 17.24 miles (MPs 188.41 to 205.65) and the Mills Creek-Lost River fifth-field watershed for 23.15 miles (MPs 205.66 to 228.81). The Pipeline would cross 26 waterbodies in the Lake Ewauna-Klamath River, one by HDD, six by conventional bore, and 19 by dry open-cut, and would cross 59 waterbodies in the Mills Creek-Lost River watershed, 20 by conventional bore and 39 by dry open-cut.

Potential effects to Lost River suckers inhabiting the Klamath River by HDD construction are discussed below. Because there would be no in-stream work for any of the conventional bore crossings, no effects to Lost River suckers are expected in those 26 streams, canals, drains, or ditches that are maintained by Reclamation. Potential effects to Lost River suckers and shortnose suckers are possible in waterbodies crossed by dry open-cut, including the Lost River (known to be occupied by Lost River suckers) with the exception of 26 waterbodies crossed between MP 214.38 and MP 228.81. At MP 214.38, the Pipeline route deviates from the general west to east direction and proceeds north, up a 9 percent slope (climbing from 4,100 feet to 4,360 feet elevation) to MP 215.04, and then continues to the east along a ridgeline (paralleling powerline corridors) to MP 228.81. In that segment, the route crosses 26 waterbodies that are intermittent headwater drainages with unlikely (due to steep slopes) or no pathways (no connectivity) for Lost River suckers to enter from lowland Reclamation canals, drains or ditches that might support Lost River suckers and shortnose suckers. No effects to Lost River suckers and shortnose suckers would occur by crossing those 26 waterbodies.

Potential effects to Lost River suckers are possible during dry open-cuts of 19 waterbodies crossed in the Lake Ewauna-Klamath River watershed and the remaining 13 waterbodies west of MP 214.38 crossed in the Mills Creek-Lost River watershed included in table 3.5.5-2. Except for the Lost River and one irrigation ditch at MP 194.64, none of the waterbodies have been mapped by the Klamath Project. Consequently, connectivity of those other 31 waterbodies (classified as ditches) to larger canals and laterals that may seasonally support Lost River suckers and shortnose suckers cannot be determined.

TABLE 3.5.5-2

Waterbodies Crossed by Dry Open-Cut Construction within the Lake Ewauna- Klamath River Watershed (HUC 1801020412) and Mills Creek-Lost River Watershed (HUC 1801020409) that May Be Occupied by Lost River Suckers and/or Shortnose Suckers

Waterbodies Crossed and Waterbody ID	NHD Waterbody Reach Code and/or Jurisdiction	Pipeline Milepost (MP)	Waterbody Type	Proposed Crossing Method a/	Species Present b/	Fishery Construction Window c/
Lake Ewauna-Upper Klamath River (HUC 1801020412) Fifth field Watershed, Klamath County						
Trib. To Klamath River (ASI-13/SS-100-025)	18010204003103 Private	188.90	Intermittent	Dry Open-Cut	None	Jul 1 to Jan 31
Irrigation Ditch (S2-07 (ADX-63 (MOD))	18010204003315 Private	192.67	Intermittent	Dry Open-Cut	Unknown	N/A
Ditch (ADX-67)	18010204003314 Private	192.99	Intermittent	Dry Open-Cut	None	N/A
Ditch (ADX-72)	Private	193.07	Intermittent	Dry Open-Cut	None	N/A
Ditch (ADX-75)	Private	194.51	Intermittent	Dry Open-Cut	None	N/A
Ditch (ADX-77)	Private	194.57	Intermittent	Dry Open-Cut	None	N/A
Irrigation Ditch (WW-001-010/(ADX-78)	18010204003303 Private	194.64	Intermittent	Dry Open-Cut	None	N/A
Ditch (GDX-4)	Private	195.67	Intermittent	Dry Open-Cut	None	N/A
Ditch (GDX-3)	Private	195.73	Intermittent	Dry Open-Cut	None	N/A
Ditch (GDX-2)	Private	195.91	Intermittent	Dry Open-Cut	None	N/A
Irrigation Ditch (ADX-30)	Private	196.53	Intermittent	Dry Open-Cut	None	N/A
Irrigation Canal (ADX-32)	18010204000790 Private	196.64	Intermittent	Dry Open-Cut	None	N/A
Irrigation Ditch (ADX-36)	Private	196.76	Intermittent	Dry Open-Cut	None	N/A
Irrigation Ditch (ADX-38)	18010204003183 Private	196.78	Intermittent	Dry Open-Cut	None	N/A
Irrigation Ditch (ADX-39)	18010204003183 Private	196.89	Intermittent	Dry Open-Cut	None	N/A

TABLE 3.5.5-2 (continued)

Waterbodies Crossed by Dry Open-Cut Construction within the Lake Ewauna- Klamath River Watershed (HUC 1801020412) and Mills Creek-Lost River Watershed (HUC 1801020409) that May Be Occupied by Lost River Suckers and/or Shortnose Suckers

Waterbodies Crossed and Waterbody ID	NHD Waterbody Reach Code and/or Jurisdiction	Pipeline Milepost (MP)	Waterbody Type	Proposed Crossing Method a/	Species Present b/	Fishery Construction Window c/
Irrigation Ditch (ADX-40)	Private	197.08	Intermittent	Dry Open-Cut	None	N/A
Irrigation Ditch (ADX-94)	18010204003251 Private	201.49	Intermittent	Dry Open-Cut	None	N/A
Roadside Ditch (ADX-99)	Private	203.97	Intermittent	Dry Open-Cut	None	N/A
Irrigation Canal (ADX-106)	Private	204.91	Intermittent	Dry Open-Cut	None	N/A
Mills Creek-Lost River (HUC 1801020409) Fifth field Watershed, Klamath County						
Irrigation Ditch (ADX-120)	Private	208.07	Intermittent	Dry Open-Cut	None	N/A
Irrigation Ditch (ADX-121)	Private	208.07	Intermittent	Dry Open-Cut	None	N/A
Ditch (ADX-124)	Private	208.23	Intermittent	Dry Open-Cut	None	N/A
Irrigation Ditch (ADX-125)	Private	208.28	Intermittent	Dry Open-Cut	None	N/A
Irrigation Ditch (ADX-126)	Private	208.29	Intermittent	Dry Open-Cut	None	N/A
Roadside Drainage Ditch (ADX-129)	Private	208.85	Intermittent	Dry Open-Cut	None	N/A
Roadside Ditch (ADX-142)	Private	210.16	Intermittent	Dry Open-Cut	None	N/A
Irrigation Ditch (ADX-261)	Private	210.87	Intermittent	Dry Open-Cut	None	N/A
Ditch (NDX-29/SS-003-002)	Private	211.32	Intermittent	Dry Open-Cut	None	N/A
Ditch (NDX-92)	Private	211.52	Intermittent	Dry Open-Cut	None	N/A
Irrigation Ditch (SS-003-004 (NDX-93))	Private	211.53 211.68	Intermittent	Dry Open-Cut	None	N/A
Lost River (NSP001)	18010204004545 State	212.07	Perennial	Dry Open-Cut	Lost River Sucker Shortnose Sucker	Jul 1 to Mar 31
Irrigation Ditch (ADX-318 EDX-55/EDX-90))	18010204004940 Private	213.23	Intermittent	Dry Open-Cut	None	N/A

a/ Dry open cut crossing methods include flume or dam-and-pump procedures. Dam-and-pump methods would be utilized where streambed blasting is anticipated to eliminate blasting around the flume. The dam-and-pump crossing method is the preferred crossing procedure in steep incised drainage valleys where worker safety may be compromised when placing ("threading") the pipe string under the flume pipe and where there is a risk of upsetting the flume during this operation. The dam-and-pump crossing method is also the preferred crossing method on small streams under low flow conditions during the recommended ODFW-recommended in-water work period. Pacific Connector proposes temporary/short-term fish passage restriction when completing dam-and-pump crossings within the ODFW-recommended in-water work period.

b/ ORBIC (2017a,b,c)

c/ Assumes fisheries construction windows only apply to those waterbodies flowing at the time of construction

Suspended Sediment by Pipeline Crossing Methods

Potential occurrence of Lost River suckers in waterbodies crossed by dry open-cut are included in table 3.5.5-2. Dry crossing methods would result in minimal impacts, including temporary increases in suspended sediments in restricted areas. One HDD and 25 conventional bores would be installed without in-water work and would not directly affect the aquatic environment and associated species, except in the unlikely event of an inadvertent return during an HDD crossing, which could affect stream suspended sediment levels as discussed below. The Klamath River would be crossed with an HDD.

Because all streams/ditches crossed, except for the Klamath River and Lost River, are minor or intermediate channels, any construction required would be done in the dry, reducing potential for any adverse suspended sediment conditions downstream. Additionally, road crossings where fish may be present would be constructed to meet ODFW fish passage standards so fish movement would not be blocked. While some elevated sediment may occur downstream, effects would be unsubstantial to Lost River suckers at most crossings due to the implementation of approved construction methods.

Suspended Sediment – Dry Open-Cut

As noted in section 3.5.3.3, dry open cutting (fluming, dam-and-pump, or some combination of the two) generates small amounts of turbidity compared to wet open-cut procedures. However, adult suckers appear to prefer deep, turbid water but are often forced to utilize shallow, clear water during degraded water quality conditions in the summer (NRC 2004). The amounts of turbidity generated by dry open-cut construction may cause minor short-term adverse effects to Lost River suckers if they are within several hundred feet downstream of the Lost River crossing site. However, guidance for evaluating effects of exposure and dose of suspended sediments on catostomids (including Lost River sucker) is not available, similar to documentation for salmonids (e.g., Newcombe and Jensen 1996). Crossings of the intermittent channels are planned to occur in the dry, so suspended sediment increases should be very low when flow is returned to the channels, because channel conditions would be stabilized. Should some crossings occur when flow is present, some suspended sediment levels would be more elevated. However, considering 1) the small size of these intermittent streams and ditches, 2) the short duration of construction activity at each crossing location, 3) the expectation that suckers would not be present in these streams/ditches, even when flowing (all crossings are more than two miles from flowing channels, which are irrigation channels), and 4) the apparent tolerance of this species for turbid water, any elevated suspended sediment would not cause substantial effects to Lost River suckers in these intermittent flow crossings although some potential adverse effects could occur if some fish were present near crossings.

There is a possibility that, following construction, future flows returning to the ditches listed in table 3.5.5-2 could indirectly affect suckers by mobilizing sediment replaced over the trench. Mobilized sediments could lead to downstream sediment impacts on forage species, streambank erosion and stability (geotechnical stability), and surface flow retention. However, during delineation of the ditches, field personnel reported stream gradients at ditches as less than one percent and many had mud substrates, both observations indicative of low in-stream flows and velocities in the ditches. Consequently, flows returning in the ditches after dry open-cut construction may not be sufficient to mobilize native materials replaced in the trench. Pacific Connector (in the ECRP [see appendix F]) has proposed to install erosion control matting to cover channel bottoms where revegetation of the channel bottom is required. Erosion control matting, anchored with staples to the channel sides and bottom, could be similarly used at irrigation ditches to minimize risk of sediment mobilization, downstream sediment impacts on forage species (zooplankton such as cladocerans—water fleas—and benthic insects such as chironomid midge larvae and amphipods), and streambank erosion and stability. Use of erosion control matting would allow materials replaced as bottom substrate and restored ditch banks to consolidate without eroding until the matting degrades.

Suspended Sediment – HDD

The HDD installation method is considered an effective technique for avoiding in-stream impacts by eliminating the need for in-stream excavation (Reid and Anderson 1998; Reid et al. 2004). According to GeoEngineers' (2017g) analysis for construction using HDD across the Klamath River (see appendix E), the design length of the Klamath River HDD crossing would be approximately 2,300 feet. The proposed Klamath River entry point would be in an agricultural field about 950 feet east of the river bank and the exit would be an open area about 370 feet west of the river bank. The HDD design indicates there would be between 70 and 140 feet of streambed cover in the river channel over the pipe. There is no direct in-stream disturbance so no suspended sediment increases would occur unless there is an unplanned drilling failure. There is a moderate to high risk of hydraulic fracture from the entry point to about 900 feet to the west, all within the east bank of the river. The portion of HDD beneath the river would be below bedrock with low risk of a release of drilling mud (inadvertent return). The risk of inadvertent return would be moderate to high within 425 feet from the HDD exit point on the west bank of the Klamath River due to presence of stiff silt alluvium (GeoEngineers 2017g). Though the risk of releasing drilling mud directly beneath the riverbed is low, such a release could have impacts on the aquatic environment and species.

Inadvertent Release of Drilling Muds (Inadvertent Return). There is a potential for impact as a result of the HDD process. Drilling requires use of a drilling mud for lubrication of the bit and removal of cuttings. A non-toxic, biodegradable bentonite clay mixture makes up drilling mud. Because the drilling mud is under pressure during drilling, if the bit encounters substrate fractures or channels, it is possible for bentonite to escape from the drilled hole (termed an "inadvertent return"). Bentonite can escape to the surface through fractures in the drilled substrate. Bentonite by itself is a non-toxic drilling mud (Breteler et al. 1985; Hartman and Martin 1984; Sprague and Logan 1979) although according to Reid and Anderson (1998), the toxicity of bentonite (sodium montmorillonite) in fresh water ranges from 5,000 to 19,000 ppm (mg/liter) based on 96-hour tests for LC_{50} on rainbow trout. The toxicity classifications based on LC50 values ranged from "slightly toxic" to "practically non-toxic" (Reid and Anderson 1998). In other tests, toxicities to lake whitefish and rainbow trout demonstrated threshold concentrations of 16,613 and 49,838 ppm (mg/liter), respectively (Reid and Anderson 1998). More recently, toxicity to rainbow trout (LC_{50}, 96-hour) was reported to be 19,000 mg/l (ClearTech 2015). LC_{50} concentrations > 10,000 ppm would be considered "practically non-toxic" (Reid and Anderson 1998). As with any fine particulate material, bentonite can interfere with oxygen exchange by gills and the degree of interference generally increases with water temperature.

Potential inadvertent returns are more common near the HDD drill entry and exit locations; however, impacts to waterbodies are minimized by locating the drill entry and exit points away from the waterbody. The probability of an inadvertent return may increase when the drill bit is working nearest the surface (see GeoEngineers 2017g), but is dependent on numerous factors including substrate characteristics, head pressure of the drilling mud, topography, elevation, and subsurface hydrology. Pacific Connector has proposed an HDD crossing of the Klamath River and designed this crossing such that areas of greatest risk from inadvertent return are on uplands and not adjacent to the waterbody where much greater depth would be achieved, and inadvertent return potential is reduced.

Hydraulic fracture typically occurs when the drill path passes through relatively weak cohesive soils with low shear strength or very loose granular soils. Loose and silty sands and soft to medium stiff silts and clays typically have a higher hydraulic fracture potential. Medium dense to dense sands and gravels and very stiff to hard silts and clays have a low to moderate hydraulic fracture potential. Unfractured rock, because of its high shear strength, typically has a low potential for hydraulic fracture. HDD installations with greater depth or in formations with higher shear strength may reduce the potential for hydraulic fracturing (see appendix E).

If an inadvertent return occurs into the river, drilling fluid would enter the waterway causing short-term, temporary water quality impacts downstream of the Pipeline Project area including sedimentation and turbidity. Should this occur, fish would likely avoid the immediate vicinity of any elevated suspended sediment within this larger river crossing area.

Sediments discharged into aquatic systems have the potential, depending on the concentrations, to cause hyperplasia, hypertrophy, and necrosis of fish gill tissues and impair fish vision making it difficult to feed and also making the fish more susceptible to predation. However, these effects typically occur after relatively long-term exposure to concentrated sedimentation. If drilling fluid accumulates in the substrate, it can adversely impact the quality and quantity of aquatic habitat available for aquatic species including salmonid spawning habitat and benthic macroinvertebrate rearing habitat. Drilling fluid that accumulates in the substrate may cover up food sources, and smother fish eggs and other aquatic life in the riverbed. However, significant impacts to substrate from inadvertent returns are not likely in large river systems because of the anticipated high water volumes and velocities within large rivers.

The rheologic properties of drilling fluid allow it to remain suspended within the water column for prolonged periods of time; thus the drilling fluid would likely settle out in very slow moving water downstream of the release. The distance of expected transport would likely prevent significant concentrations of the fluid from accumulating in one area of the Klamath River. If drilling fluid is inadvertently released into the river, the behavioral avoidance response of Lost River sucker is presumed to be triggered within the immediate vicinity of the release and the fish are expected to return and utilize the affected area shortly after the inadvertent release has been halted. Pacific Connector developed its *Drilling Fluid Contingency Plan for Horizontal Directional Drilling Operations* (see appendix D), which describes how the drilling operations would be conducted and monitored to minimize the potential for inadvertent drilling mud releases. The HDD Contingency Plan also includes procedures for cleanup of drilling mud releases. If significant concentrations of drilling fluid are found during monitoring as a result of a release, the following possible corrective measures would be taken:

1. Deployment of containment structures, if feasible, and removal of drilling mud from substrate and streambanks if possible.
2. Increase the drilling fluid viscosity in an attempt at sealing the point at which fluid is leaving the drilled hole. The drilling operation may be suspended for a short period (i.e., overnight) to allow the fractured zone to become sealed with the higher viscosity drilling fluid.
3. If increasing the drilling fluid viscosity is ineffective, LCMs may be introduced into the hole by incorporating them in the drilling fluid and pumping the material down-hole. The drilling operation may again be suspended for a short period (i.e., overnight) to allow the fractured zone to become sealed with the LCMs.
4. Depending on the location of the fractured zone, a steel casing may be installed that is of sufficient size to receive the largest expected down-hole tools for the crossing. This casing installation provides a temporary conduit for drilling fluids to flow while opening the

remaining section of the hole to a diameter acceptable for receiving the proposed pipe sections. To alleviate future concerns with the steel casing after the HDD installation is completed, the casing is generally extracted from the hole prior to or just after completing the HDD installation. However, there have been instances when attempts at extracting the steel casing were unsuccessful.

5. In the event drilling fluid flow is not regained through the annulus of the drilled hole and a steel casing installation is not utilized, the HDD contractor may elect to install a grout mixture into the drilled hole in an attempt to seal the fractured zone. The down-hole drilling assembly is generally extracted and existing hole is re-drilled to the point at which it had previously been drilled prior to having encountered the loss of drilling fluid.

In some instances, it may be determined that the existing hole encountered a zone of unsatisfactory soil material and the hole may have to be abandoned. If the hole is abandoned, it would be filled with cuttings and drilling fluid.

Overall, at the site of any inadvertent return, the amount of drilling mud released into a waterbody would be low. The HDD location would be under the Klamath River, with large volumes of water and moderate flows, where the drilling mud would be diluted. If an inadvertent release of drilling mud from an HDD occurred it would have minor short-term adverse effects to aquatic resources including Lost River sucker.

Waterbody crossings using the “dry” crossing methods, flume or dam-and-pump, may result in some fish being entrapped in streams. Fish inadvertently left within the dammed-off construction zone would be captured by either an ODFW biologist or qualified consultant. Waterbodies crossed by dry open-cut (the Lost River and 31 ditches) with known or potential species presence are included in table 3.5.5-2.

For typical crossings once streamflow is diverted through the flume pipe, but before trenching begins, fish trapped in any water remaining in the work area between the dams would be removed and released (salvaged) using the *Fish Salvage Plan* (see *Fish Salvage Plan* under section 3.5.5.4 or appendix T for details). Salvage methods could include seines and/or dip nets and electrofishing. Seining would be the primary method used to salvage fish but electrofishing methods may be used if all fish cannot be removed from the area potentially dewatered. The *Fish Salvage Plan* incorporates these methods to minimize adverse effects to listed fish.

Suckers as a group (family Catostomidae) appear to be susceptible to many of the same deleterious effects from electroshocking that were described above for salmonids (Snyder 2004). Although records of the effects by electroshock to Lost River suckers have not been compiled, responses by river carpsucker, longnose sucker, white sucker, and razorback sucker among others indicate that they are particularly susceptible to spinal injuries and hemorrhages by electrofishing (Snyder 2004). Reclamation has salvaged fish from canals throughout the Klamath Project each fall since 1991 following dewatering using electrofishing techniques (Reclamation 2008). Reclamation has noted that if electrofishing is found to injure juvenile suckers, they would pursue other techniques to salvage fish (Reclamation 2008). Sucker mortalities (Lost River suckers, shortnose suckers, and Klamath largescale suckers) have occurred during salvage operations, whether due to electrofishing stress or to low levels of dissolved oxygen (Peck 2000 and 2001). Reclamation has also done annual fish salvages in the forebay of a fish screen facility using backpack electrofishers and beach seines. This annual salvage procedure alleviates potential mass mortality of all fish at the fish screen as water is removed (Reclamation 2007).

All methods of capture and holding have risks of stress, injury, or mortality of fish. In conjunction to implementation of the *Fish Salvage Plan*, Pacific Connector would contract with either ODFW or a qualified consultant to capture the fish. Fish removal personnel would be approved by ODFW and NMFS for this listed species. Personnel who would handle and/or remove fish on federal lands would also be approved by the Forest Service or the BLM, or the work would be done directly by agency personnel if approved by ODFW. Overall, some listed juvenile Lost River sucker may suffer injury or mortality, but with the implementation of Pipeline Project conservation measures the numbers would be slight.

Acoustic Shock and Underwater Noise

There would be no blasting or use of mounted hydraulic impact hammer to cross the Lost River where Lost River suckers may be present during crossing or any of the 31 ditches with potential species presence included in table 3.5.5-2. Use of back-hoes for dry open-cut construction would not produce sound levels to cause harm to Lost River suckers, as discussed for SONCC coho salmon in section 3.5.3.3.

Riparian Vegetation Removal, Modification and LW Loss

Aquatic resources, including Lost River suckers and habitat components, could be affected as a result of removal of vegetation and in-stream habitat at the waterbody crossing sites as required for construction. Short-term, physical habitat disruption would occur during trenching activities. Long-term degradation of habitats could occur if the stream contours are modified in the area of the crossing; the flow patterns are changed; or erosion of the bed, banks, or adjacent upland areas introduces sediment into the waterbody. Loss of riparian vegetation along the banks would remove an important source of terrestrial food for aquatic organisms, and potentially increase mass slope failures adjacent to waterbodies.

Because HDD would be used to cross the Klamath River, only 0.04 acre (Urban or Built-up land) within the Klamath River riparian zone (extending 117 feet or one site-potential tree height from each river bank) would be affected. No forested riparian vegetation would be affected. Construction across the Lost River would disturb approximately 1.35 acres of agricultural land within the riparian zone (extending 119 feet from each river bank). Similar to the Klamath River crossing, no forest riparian vegetation would be affected or removed and all effects would be to agricultural land. Riparian zones associated with the Klamath River and Lost River crossings are on land owned by the State of Oregon. Riparian Zones for all other waterbodies crossed that are within range of the Lost River sucker are on private lands. All crossings other than the Klamath River and Lost River are on intermittent streams/ditches/canals with very limited low-growing riparian vegetation and would have unsubstantial reduction in near stream vegetation from crossing clearing. Likewise, as there are few trees in the riparian area along the route in the range of the Lost River sucker, there would be no change in LW supply to any stream system from construction of right of way clearing or maintenance.

Overall, there would be no substantial change in riparian vegetation or LW supply along the route where Lost River sucker may be present. Ecological function (e.g., supply of shade, future LW, and organic input) of the riparian conditions would be maintained and adverse effects to Lost River sucker would not occur from right-of-way clearing at stream crossings.

Water Temperature

Lost River suckers are susceptible to high water temperatures 85°F or higher (Bellerud and Saiki 1995). As discussed above, no riparian vegetation would be removed that otherwise would provide shade. Consequently, water temperature would not be affected by construction within the Lost River and Klamath River.

Aquatic Habitat

There also are potential indirect effects to aquatic habitat from increased suspended sediment from stream crossings. As discussed for SONCC coho salmon (section 3.5.3), suspended sediment released during stream crossing construction may have downstream habitat effects as well as direct fish effects such as changing substrate conditions (e.g., elevated fines) that may affect benthic food resources. Only one stream, the Lost River, is known to be crossed with stream bottom substrate-disturbing activities during flowing periods; 31 ditches with potential for species included in table 3.5.5-2 are expected to be crossed in the dry and could have suckers present in the crossing area. While the actual magnitude of sediment generated during crossing the Lost River is not known, estimates of sediment generated by dry open-cut construction along other portions of the route and implementation of BMPs would not result in short-term sediment elevations that could have substantial downstream adverse habitat effects that would indirectly affect the Lost River sucker or the species habitat.

Freshwater Stream Invertebrates

Substrates downstream from in-stream construction sites could be impacted by sediments which could affect forage species used by Lost River suckers. Mayflies, caddisflies, and stoneflies prefer large substrate particles in riffles and are adversely affected by fine sediment deposited in interparticulate spaces (Cordone and Kelley 1961; Waters 1995; Harrison et al. 2007). Suckers feed on benthic organisms including algae and invertebrates so reductions could affect their growth and survival. Fish and benthic macroinvertebrate abundance downstream of pipeline construction sites have been reported as short-term reductions (Reid and Anderson 1999). Macroinvertebrate abundance and community composition are highly related to the degree to which substrate particles are embedded by fine material (Birtwell 1999). Data below wet open-cut crossings, which generate much higher sediment levels than dry cut crossings, generally found negative changes in benthic invertebrate populations were not apparent within a year (Reid et al. 2008) and some data found rapid recolonization of substrate within 30 days (Gartman 1984). Therefore, the overall level of effect of the pipeline crossings on waterbodies crossed by dry open-cut (the Lost River and 31 ditches) with known or potential species presence included in table 3.5.5-2 (unless sealing failures at isolation structures occur) would be even less than those noted by literature and would not result in substantial reduction in growth or survival of listed Lost River individuals.

Streambank Erosion and Streambed Stability

Clearing and grading activities during construction could increase erosion along streambanks resulting in higher turbidity levels in the waterbodies crossed. Alteration of the natural drainage ways or compaction of soils by heavy equipment near streambanks during construction may accelerate erosion of the banks, runoff, and the transportation of sediments into waterbodies. Erosion, sedimentation, and higher turbidity levels related to the Pipeline Project could affect aquatic resources in waterbodies crossed by dry open-cut (the Lost River and 31 ditches) with known or potential species presence (included in table 3.5.5-2). The degree of impact on aquatic organisms due to erosion would depend on sediment loads, stream velocity, turbulence, streambank composition, and sediment particle size.

Alteration of the natural drainage ways or compaction of soils by heavy equipment near streambanks during construction may accelerate erosion of the banks, runoff, and the transportation of sediments into waterbodies. The degree of impact on aquatic organisms due to erosion would depend on sediment loads, stream velocity, turbulence, streambank composition, and sediment particle size. To minimize these impacts, Pacific Connector would use temporary equipment bridges, mats, and pads to support equipment that must cross the waterbody (perennial, intermittent, and ephemeral if water is present) or work in saturated soils adjacent to the waterbody. Pacific Connector would also install sediment barriers, such as silt fences and straw/hay bales, across the right-of-way at the edge of waterbodies throughout construction except for short periods when the removal of these sediment barriers is necessary to dig the trench, install the pipe, and restore the right-of way. Practices to minimize streambank erosion are provided in the ECRP (see appendix F).

The FWS expressed concerns that more detailed site-specific information on bank material, streambed composition, shoreline vegetation and other information is needed to adequately ensure that actions occurring at a stream crossing do not significantly increase streambank erosion and streambed instability. Pacific Connector, in response to these requests, conducted an assessment of crossing conditions of all streams suitable for analysis based on the FWS risk matrix (GeoEngineers 2017d, 2017e, 2018a). As discussed for SONCC coho salmon, Pacific Connector used this matrix to rate crossings for risk of potential stream bank and channel changes. Based on the GeoEngineers (2017d, 2017e, 2018a) Risk Matrix analysis, the Lost River crossing has a "high" level of risk based on existing stream site sensitivity based on the landscape/stream type (channel characteristics), riparian conditions (essentially none), and bed conditions (sand). If any crossing is moved into the "high" impact and "high" stream response risk matrix category, a site-specific crossing design would be developed for that site. Construction would then move forward as described in the permit documents including implementation of special additional BMPs, as described in GeoEngineers (2017d, 2017e, and 2018a), depending on individual site conditions and may include such actions as changes in bank material and bank angle modifications, specific substrate composition used, plants used on the bank, artificial stabilizing bank material, rootwad enhancement, and various other actions. These actions would reduce but not completely eliminate potential adverse effects from bank and bed stability to the listed Lost River sucker.

As a follow-up measure to help ensure crossing actions would not adversely affect stream bank and channel structure, Pacific Connector would monitor stream crossings to ensure long-term success of the restoration, maintenance of fish passage, and to identify channel erosion, scour or migration that could destabilize the site or expose the pipeline. The details of the monitoring plan for stream crossings are presented in section 3.5.3.3 (SONCC Coho Salmon ESU). Overall, these actions would reduce potential adverse effects from bank and bed stability to listed Lost River sucker to discountable levels.

<u>Hydrostatic Testing</u>

Water would be required on a one-time basis near the end of construction to hydrostatically test the pipeline. Potential impacts associated with hydrostatic testing include entrainment of fish; transfer of exotic organisms between basins; reduced downstream flows and impaired downstream uses if test water is withdrawn from surface waters; and erosion, scouring, and a release of chemical additives as a result of test water discharge. Pacific Connector would obtain its hydrostatic test water from commercial or municipal sources or surface water rights owners, the sources of which are lakes, impoundments, and streams.

Within the range of Lost River sucker, there are two potential water sources, Lost River and Klamath River. About 4.8 million gallons of water would be withdrawn from these sources for hydrostatic testing. There are four potential discharge locations, all of which are within the TEWA of the right-of-way. None of the hydrostatic test break sections are in the vicinity of a waterbody with known Lost River sucker occupancy or critical habitat. The largest withdrawal is proposed from the Klamath River. Water withdrawn from the Klamath River would be from designated critical habitat for Lost River suckers. Water withdrawals from occupied habitats risk entrainment and impingement. The screening of intake hoses would be used to prevent the entrainment of fish and other aquatic organisms, meeting NMFS screening criteria. The rate of withdrawal would also be regulated to avoid adverse impact on aquatic resources or downstream flows (NMFS 1997c).

Pacific Connector would minimize the potential effects of hydrostatic testing by adhering to the measures in its *Hydrostatic Test Plan* (see appendix U). Where test water cannot be returned to its withdrawal source, the water would be treated and discharged to an upland location (at least 150 feet from wetlands or waterbodies with no direct discharge to these features) through a dewatering device at a rate to prevent scour and erosion and to promote infiltration. Pacific Connector would obtain all necessary appropriations, withdrawal, and discharge permits through the OWRD. With the implementation of the *Hydrostatic Test Plan* and BMPs and by obtaining required permits, adequate measures would be in place to prevent direct or indirect effects of hydrostatic testing to Lost River sucker that may be in some of the stream systems.

<u>Aquatic Nuisance Species</u>

NAS are aquatic species that degrade aquatic ecosystem function and benefits, in some cases completely altering aquatic systems by displacing native species, degrading water quality, altering trophic dynamics, and restricting beneficial uses (Hanson and Sytsma 2001). Currently, there are 180 reported NAS in Oregon, of which 134 are documented within the USGS hydrologic basins crossed by the Pipeline (USGS 2017).

In the riverine environments crossed by the Pipeline, largemouth and smallmouth bass, introduced as recreational species, prey on juvenile sockeye, coho, and Chinook salmon (Tabor et al. 2007). Additionally, up to 20 exotic species (many of which can reside in streams including largemouth bass, yellow perch, and fathead minnow) are present in the range of Lost River sucker and are suspected to compete and prey on them (FWS 2013l). Management priorities in Oregon concentrate on aquatic nuisance species, which are the species whose current or potential impacts on native species and habitats and economic and recreational activity in Oregon are known to be significant (Hanson and Sytsma 2001). Some of the major potential freshwater invasive species are Chytrid fungus and mussels, including the zebra and quagga mussels (*Dreissena polymorpha*, and *Dreissena rostriformis bugenisis*).

Aquatic nuisance species could potentially be introduced into Pipeline Project area waters by interbasin transfer of hydrostatic testing water or by being carried on equipment that is moved from outside of the region or between basins. Pacific Connector has developed BMPs and guidelines to avoid the potential spread of aquatic invasive species (see *Hydrostatic Test Plan* in appendix U) in consultation with the BLM and Forest Service as well as with ODEQ and the

Center for Lakes and Reservoirs and Aquatic Bioinvasion Research and Policy Institute (Portland State University).

If it was determined to be feasible, all water used in hydrostatic testing would be returned to its withdrawal source location after use; however, cascading water from one test section to another to minimize water withdrawal requirements may make it impractical to release water within the same watershed where the water was withdrawn. If it is not possible to return the water to the same hydrologic basin from which it was withdrawn, Pacific Connector would employ an effective and practical water treatment method (chlorination, screening/filtration, or other appropriate method) to disinfect the water that would be transferred across basin boundaries. The hydrostatic test water would be treated after it is withdrawn and prior to hydrostatic testing.

As explained in the *Hydrostatic Test Plan*, Pacific Connector proposes to use a treatment of 2 ppm or 2 mg/l of free chlorine residual with a detention time of 30 minutes to treat all non-municipal surface waters that would be used as a water source for hydrostatic testing purposes. Chlorinated water would be released according to ODEQ criteria to prevent water quality impacts, potential effects to aquatic species, and minimize potential impacts to sensitive areas. These procedures would also be used for equipment used between waterbodies, and would include the inspection and cleaning of waterbody crossing equipment including flume pipes, pumps hoses, screens, or other materials and equipment that may be moved from waterbody to waterbody crossings to ensure it is free of dirt, grease, oil or other pollutants prior to installation and it would be steam-cleaned, if necessary. Forms of chemical treatment (e.g., bleach solutions) may be used as needed. The procedures are outlined in Attachment C to the *Hydrostatic Test Plan* (appendix U). Additional supplemental invasive species protective actions for cleaning of equipment used among water bodies was developed by ODFW specifically for this project and have been incorporated by Pacific Connector in their *Hydrostatic Test Plan*.

Some items in the *Hydrostatic Test Plan* that would aid in ensuring invasive aquatic species are not transported between streams, including preventing the spread of quagga and zebra mussels, New Zealand mudsnail, and aquatic plant invasion, are:

1. Clean all aquatic plants, animals, and mud from vehicles, boats, motors or trailers and discarding the debris in the trash. Rinsing, scrubbing, or pressure washing should occur away from storm drains, ditches, or waterways.
2. Drain live wells, bilge, and all internal compartments.
3. Dry equipment including boats between uses, if possible (leaving compartments open and sponging out standing water).
4. Scrub or pressure wash life jackets, waders, boats, landing nets, and other gear that comes in contact with the water.
5. Clean and sanitize as needed which may include heated power wash before moving establishing sanitizing areas away from areas where it may enter surface water including use of bleach solution and run through portable pumps for 10 minutes
6. Inspect everything for signs of aquatic invasive species before launching and before leaving.

With the implementation of these procedures and others, the potential for dispersal of aquatic nuisance organisms by other construction equipment and vehicles from one basin to another is remote. The BMPs in the noxious weed control procedures outlined in the ECRP (see appendix F) and the IPM (see Appendix N to the POD [appendix B to this BA]) would be employed to prevent the introduction and spread of invasive species from construction. With the implementation of these measures, introduction of nonnative species or movement of species between basins should not occur, resulting in no adverse effects to the listed Lost River sucker.

Fuel and Chemical Spills

Fisheries habitats could be adversely affected if petroleum products were accidentally discharged into aquatic environments including waterbodies crossed by dry open-cut (the Lost River and 31 ditches) with known or potential species presence that are included in table 3.5.5-2. Such materials are toxic to algae, invertebrates, and fish. Of the products likely to be present during construction, data compiled from a wide range of sources indicate that diesel fuels and lubricating oils are considerably more toxic to aquatic organisms than other, more volatile products (gasoline) or heavier crude oil (Markarian et al. 1994). For example, one study reported that release of diesel fuel in freshwater habitats significantly reduced aquatic invertebrate densities and species richness at least three miles downstream but invertebrate densities recovered within a year (Lytle and Peckarsky 2001). Impacts to aquatic habitats that primarily affect aquatic substrates—hence spawning, incubating and rearing habitats—can remain for much longer periods (Markarian et al. 1994).

Equipment used for construction across waterbodies could potentially release hydraulic fluid comprised of a variety of compounds, the most common of which are mineral oil-based, organophosphate esters, and polyalphaolefins (HHS 1997). Release from machinery can occur through faulty seals, hoses, sumps, and reservoirs, or general system failure.

Inadvertent spills of fluids used during construction, such as fuels and lubricants, could contaminate wetland soils and vegetation if not sufficiently contained. To minimize the potential for spills and any impacts from such spills, Pacific Connector's SPCCP (see appendix L) would be implemented. In general, hazardous materials, chemicals, fuels, lubricating oils, and concrete-coating activities would not be stored, nor would refueling operations be conducted, within 100 feet (150 feet on BLM and NFS lands) of a wetland or waterbody in accordance with FERC's *Procedures* (see appendix C) and the SPCCP (see appendix L) except where no reasonable location is possible and additional containment steps have been taken. The SPCCP would be updated with site-specific information prior to construction. Adherence to these plans and procedures would prevent substantial adverse effects to the listed Lost River sucker from Project-related oil product uses.

Runoff from Facility Surfaces

There are nine contractor and pipe storage yards, one rock source and disposal site, two new TARs, two new PARs, and three aboveground facilities, including the Klamath Compressor Station, within the range of Lost River suckers.

Two of the yards, K-Falls Memorial Dr 1 Yard and K-Falls Memorial Dr 2 / Bair Yard, border the Klamath River, and the K-Falls - Industrial Oil Yard is about 235 feet from the Klamath River which is designated critical habitat for Lost River suckers. The Klamath Compressor Station is about 700 feet from the T Canal for which there are no records of Lost River sucker being present (construction and operation of the compressor station would not affect suckers even if present).

Stored materials at the yards may include construction mats, fencing materials, fuel and lubricants, stormwater control materials (straw bales, erosion control fabric, silt fence materials, etc.), and other construction materials. The yards would also be used for contractor office trailers and employee parking facilities. Although the yards are previously disturbed industrial sites, stored materials and surface runoff could enter Lost River sucker critical habitat. Runoff from any of these sites would be avoided and minimized through measures provided in Pacific Connector's ECRP (see appendix F).

Operation and Maintenance Activities

Once installed, maintenance of the pipeline would include activities such as aerial inspections, gas flow monitoring, visual inspection of surrounding vegetation for signs of leaks, and integrity management, which includes smart pigging to investigate the interior surface of the pipe for any signs of stress cracking, pitting, and other anomalies (see the ECRP, appendix F). All of the proposed maintenance activities would be outlined in the Operations and Maintenance Plan that would be prepared according to operating regulations in USDOT 49 CFR Subpart L, Part 192 and would be completed prior to the Pipeline going in-service. These general maintenance activities would require only surface activities and usage of the existing right-of-way, such as insertion of the pig at one of the pig launching facilities.

The potential stream channel disturbance would occur if an integrity issue with the pipeline were found at a crossing location. If this were to occur, the pipeline would need to be unearthed within the right-of-way and repair work done in-water. Within stream sites, repair work could require isolated flow from the section of pipe that is to be exposed. Typically, repairs would be made to the pipe within the right-of-way (within the trench) or, depending on the site-specific conditions and nature of the repair needed, a reroute around the affected section may be considered.

Impacts would be similar to those discussed above for initial installation except on a much smaller scale, because they would only involve one crossing compared to many crossings. However should repairs be needed out of the standard stream crossing window (i.e., during periods of fish spawning or egg incubation) there would be additional adverse effects to key fish resources at the specific site. The actions would include all relevant BMPs and mitigation, dependent upon site conditions and land ownership. Any future repairs would require additional permit approval from appropriate state and federal agencies which would determine the acceptable parameters of these actions. Such pipeline integrity-based in-water projects are very infrequent.

Vegetation maintenance would be limited adjacent to waterbodies to allow a riparian strip to permanently revegetate with native plant species across the entire right-of-way. To facilitate periodic pipeline corrosion/leak surveys, a corridor centered on the pipeline and up to 10 feet wide would be maintained in an herbaceous state, with scrubs outside of this 10-foot corridor. In addition, trees that are located within 15 feet of the pipeline may be cut and removed from the right-of-way. No vegetation or tree limitations would occur beyond the 30 foot wide corridor in riparian areas (i.e., up to 100 feet of streams on federal lands, and up to 25 feet of streams on non-federal lands). Because most native riparian vegetation along the Pipeline route has been altered by agriculture, the effects of maintaining the 30-foot-wide corridor on Lost River sucker in-stream habitat would be minimal.

<u>Herbicide Application</u>

Herbicides have the potential to cause toxic effects to different sucker life stages and to other aquatic species, causing direct impacts, if used improperly. When herbicides are properly used according to label restrictions and BMPs to control noxious weeds, there is little to no chance of causing injury or mortality to fish or other aquatic organisms.

Pacific Connector would not use herbicides for routine vegetation maintenance. However, following construction, Pacific Connector would implement an IPM (Appendix N to Pacific Connector's POD [appendix B to this BA]) that addresses control of noxious weeds and invasive plants across the Pipeline Project which would include the selective use of herbicides where necessary to control noxious weeds by limited application from the ground, where allowed by landowners. The IPM was developed in consultation with the ODA, BLM, and Forest Service. The BMPs would minimize the potential spread of invasive species and minimize the potential adverse effects of control treatments. Herbicides would not be applied by aerial or broadcast spraying. Noxious weeds would be removed only by manual methods in the riparian zone adjacent to streams, ditches and canals within the range of Lost River suckers. Pacific Connector would not directly spray, or otherwise apply, herbicides in waterbodies or in riparian zones. The risk of drift would be avoided by selectively applying herbicides from the ground.

Where weed control is necessary along the construction right-of-way, Pacific Connector's first priority would be to employ hand and mechanical methods (pulling, mowing, biological, disking, etc.) applicable to the species to prevent the spread of potential weed infestations, where feasible. To determine if an herbicide is to be used over other control methods, Pacific Connector would base the decision on weed characteristics and integrated weed management principles (Forest Service 2005). If herbicides are used to control noxious weed infestations, they would be used when they are the most appropriate treatment method. Spot treatments and the use of selective herbicides would be utilized to minimize impact to native or non-target species. Permits or approvals for the use of herbicides and adjuvants on federal lands would be obtained prior to use/treatment, as detailed in the IPM (see Appendix N to the POD [appendix B to this BA]). Considering the potential for limited use of herbicides along the route and precautions that would be in place to prevent entry into waters, meaningful negative effects to the Lost River sucker from herbicides would be unlikely to occur.

Critical Habitat

Designated critical habitat for the Lost River sucker within the Pipeline Project area is present only at the Klamath River crossing. The Pipeline would cross the Klamath River at RM 249, which is within CHU 1, Klamath County (FWS 2012i). CHU 1 includes Upper Klamath Lake and Agency Lake, together with some wetland habitat; portions of the Williamson and Sprague Rivers; Link River; Lake Ewauna; and the Klamath River from the outlet of Lake Ewauna downstream to Keno Dam. Some or all of the three PCEs noted above (water, spawning and rearing habitat, and food) could be affected during the HDD across the Klamath River if an inadvertent return occurred with release of bentonite into the water column; the same effects to critical habitat that were described as Direct and Indirect Effects, above, would occur.

Only 0.04 acre within the Klamath River riparian zone (extending 117 feet or one site-potential tree height from each river bank) would be affected by construction, and all of that area is in an existing industrial facility.

3.5.5.4 Conservation Measures

Conservation measures have been proposed by Pacific Connector to minimize construction and operation impact to waterbodies and riparian zones. Those measures have been compiled in table 2C in appendix N and apply to Lost River suckers.

Pacific Connector has also proposed measures to rectify, repair, and rehabilitate and otherwise reduce impact to waterbodies and riparian zones once construction of the Pipeline is complete. Those measures have been compiled in table 3C in appendix N.

Details of some of the major conservation measures to be implemented by Pacific Connector are summarized below.

Erosion Control

Many of the conservation measures in table 3C in appendix N focus on erosion control to prevent sediment from entering surface waters. Temporary erosion controls would be installed immediately after vegetation clearing and grading and would be properly maintained throughout construction and reinstalled as necessary until replaced by permanent erosion controls or restoration is complete. At a minimum, the following temporary erosion control structures would be installed: temporary slope breakers, sediment barriers, mulch, and erosion control fabric. Pacific Connector would install permanent slope breakers consistent with the requirements of FERC's *Plan*. Part of long-term erosion control would include a final cleanup including final grading and installation of permanent erosion control structures. Final cleanup of an area would generally occur within 10 days after backfilling the trench and not be delayed beyond the end of the next recommended seeding season. During final cleanup, Pacific Connector would remove all construction debris and grade disturbed areas to preconstruction grades to the extent practicable. An adequate seedbed would be prepared at the conclusion of cleanup.

<u>Temporary Slope Breakers</u>

Pacific Connector would install temporary slope breakers over the backfilled, recontoured construction right-of-way as specified in FERC's *Plan*. The outfall of each temporary slope breaker would be to a stable, well-vegetated area or to an energy-dissipating device at the end of the slope breaker off the construction right-of-way. Slope breakers reduce runoff velocity, thereby intercepting sediment and allowing it to drop out of suspension. They also can effectively divert runoff away from a disturbed site to a stable outlet (Goldman et al. 1986).

<u>Sediment Barriers</u>

Pacific Connector would primarily rely upon silt fence and staked hay or straw bales to confine sediment to the construction right-of-way. These structures would be used adjacent to wetland and waterbody crossings consistent with the requirements of FERC's *Procedures*. Straw bales and filter fabric (silt fence) can be used together to create a highly effective sediment barrier, a combination that compensates for the limitations of each used in isolation; straw bales provide extra support and the fabric provides greater filtering capability (Goldman et al. 1986).

All straw or hay bales used for sediment barriers would be certified as weed-free. Temporary sediment barriers would be maintained in place until permanent revegetation measures are successful or until the upland areas adjacent to wetlands, waterbodies or roads are stabilized. The structures would be removed once vegetation in the area has been successfully restored.

<u>Erosion Control Fabric</u>

Pacific Connector would install erosion control fabric (such as jute or excelsior) on waterbody banks at the time of recontouring. The fabric would be anchored using staples or other appropriate devices. Although there are no measures specific to pipeline construction, data related to cut-and-fill slopes treated during construction of forest roads indicate varying effectiveness of different types of stabilization measures designed to control surface erosion (EPA 2001). On fill slopes, combining straw mulch and netting decreased erosion by 99 percent. Excelsior mulch alone decreased erosion by 92 percent on fill slopes. On cut slopes, straw mulch by itself decreased erosion in a range from 32 to 97 percent (EPA 2001). Applications of mulches and/or fabric are effective measures promoting slope stabilization until vegetation can successfully be reestablished. These measures also promote plant growth (EPA 2001).

Fish Salvage Plan

Lost River suckers could potentially occur within the construction right-of-way on the Lost River at the time of construction. Since the Lost River would be crossed using dry open-cut technology, fish salvage procedures (see section 3.5.3.4) may occur while fish, including Lost River suckers, are within isolated construction sites. Because suckers in general appear to be vulnerable to electroshocking, Pacific Connector's implementation of its *Fish Salvage Plan* in the Lost River may have to avoid use of electroshock, relying instead on seining and dip netting as described in section 3.5.3.4.

A *Fish Salvage Plan* has been provided in appendix T. The plan has been developed to minimize adverse effects to listed salmonids (SONCC coho, Oregon Coast coho), non-listed salmonids (Chinook salmon, steelhead, and cutthroat trout) and listed catostomids (Lost River sucker, shortnose sucker). The portions of the plan relevant to salvaging salmonids were adapted from the protocol developed by WSDOT (2011). The protocol specifies procedures for 1) isolating the work area, 2) removing fish and dewatering the work area, 3) handling, holding, and releasing fish, 4) documenting fish that have been captured, handled, held, and released, and 5) notifying NMFS and FWS. The same protocol would generally be followed during salvage of Klamath Basin suckers. However, salvage operations within the crossing where these suckers may be present would include the latest *Handling Guidelines for Klamath Basin Suckers* (Reclamation 2008). These guidelines may be updated frequently. Some of the main factors in handling are the requirement of having a 0.5 percent saline solution of un-chlorinated well water to place any captured listed sucker in should it be collected during fish salvage operations. Aeration would also be supplied and the container a sucker is placed into would have been coated with a commercially available slime coat. Fish would be retained in this solution until released upstream of the capture site unless otherwise indicated through agreement with FWS.

OHV Barriers

Limiting OHV access would reduce potential increased sedimentation to streams and human access to sensitive fish areas. In accordance with FERC's *Plan*, the applicant must offer to install and maintain measures to control unauthorized vehicle access to the right-of-way to each landowner or manager of forested lands. Such measures may include signs; fences with locking gates; slash and timber barriers, pipe barriers, or a line of boulders across the right of way; and conifers or other appropriate trees or shrubs across the right-of-way. If allowed by the landowner, and if available, slash, stumps, and/or logs would be placed on the right-of-way within the riparian zones to discourage OHV crossings of streams and to provide carbon and nutrients. If not allowed, Pacific Connector would discuss with the landowner the use of other methods, as noted above. At a minimum, the area would be revegetated and re-seeded.

Streambank Stability

The root network of trees adjacent to streambanks is essential to maintaining streambank stability (WDNR 1997). Because root strength decreases significantly at distances beyond one-half the tree crown diameter, trees promoting streambank stability lie within half a tree crown diameter from the streambank. Trees within 25 feet of the streambank are assumed to promote streambank stability (WDNR 1997). Generally, trees that must be removed during construction would be cut at ground level with the roots left in place, except where located within the trenchline. Although roots would decay overtime, streambank stability would be retained by their presence until revegetation is successful.

Streambank Restoration

Pacific Connector's ECRP (see appendix F) describes the measures that would be used to stabilize streambanks crossed by the Pipeline. Pacific Connector would not use riprap to stabilize streambanks. The alignment has been designed at waterbody crossings to be as perpendicular to the axis of the waterbody channel as engineering and routing constraints allow, minimizing streambank disturbance and avoiding parallel stream alignments or multiple stream crossings. Immediately after installation of a waterbody crossing, the contours of the streambed, shoreline, and streambanks would be restored to preconstruction configurations (i.e., contour/elevations) to restore the physical integrity/condition of these features and to minimize the loss of stream complexity.

Pacific Connector has completed a scour analysis for the Pipeline Project that would be used to ensure that appropriate pipeline burial depths and cover design parameters beneath channel streambeds and within adjacent floodplains are utilized, so that the effects on natural stream processes would be avoided or minimized. The Pipeline's scour analysis, which was completed by GeoEngineers, was included in Pacific Connector's September 2017 FERC certificate application.

Pacific Connector would install erosion control fabric (such as jute or excelsior) on streambanks at the time of recontouring. The fabric would be anchored using staples or other appropriate devices. The erosion control fabric to be used on streambanks would be designed for the proposed use and would be approved by Pacific Connector's EIs.

Consistent with the FERC's *Procedures* (section V.C.3.), during streambank restoration/recontouring, the streambanks would be returned to their preconstruction contours or to a stable configuration. The Lost River is included in the application of the conservation measure. Streambank revegetation measures, including supplemental riparian planting procedures are also outlined in the ECRP. The shrubs and trees planted at each site would be determined at the time of planting based on the moisture regimes and site-specific conditions at each planting location and landowner requirements.

In-stream Gravel

Pipeline trenches across the Lost River and other perennial waterbodies within the Upper Klamath River subbasin and Lost River subbasin would be backfilled with material removed from the trench with the upper one foot of the trench backfilled with clean gravel or native cobbles of a size appropriate for resident fish, including suckers. The bottom and banks would be returned to preconstruction contours, banks would be stabilized, and temporary sediment barriers would be installed before returning flow to the waterbody channel.

Stream Crossing Risk Matrix

The FWS expressed concerns that more detailed site-specific information on bank material, streambed composition, shoreline vegetation, and other information is needed to adequately ensure that actions occurring at a stream crossing do not significantly increase streambank erosion and streambed instability. Follow-up surveys, site designs, and additional site actions resulting from these surveys as described below would reduce risk of stream bank and bed instability in Lost River sucker habitat to unsubstantial adverse effects levels.

Pacific Connector, in response to these requests, has conducted an assessment of crossing conditions of all streams suitable for analysis based on the FWS risk matrix (GeoEngineers 2017d, 2017e, and 2018a). GeoEngineers, using a combination of field and GIS data, rated proposed stream crossings based on the matrix along the entire route including 19 stream, ditch, and canal crossings in the range of Lost River sucker. The matrix has two axes rating the crossing based on the impact potential at the crossing and the relative stream response potential at the crossing. Each crossing was rated as low, medium, or high for each of the two axes (all stream crossings were placed into one of nine categories, such as Low–Low, Low–Medium, and Medium–High).

No crossing within the range of Lost River sucker was rated as having both high risk of Pipeline Project impact potential (i.e., high risk of impacts and high risk of site response potential) and high risk of stream and site response potential. For any crossing in this category, Pacific Connector would develop a site-specific crossing plan, similar to that required by FERC for stream crossings over 100 feet wide. All crossings that would have an open cut within the range of the Lost River sucker had moderate or low ratings for the two categories. The Lost River crossing was rated moderate project impact potential and high for the relative stream response potential.

Those stream crossings that were rated to have a low or moderate project impact potential would be crossed using project-typical BMPs. The remaining stream crossings would have a variety of site-specific BMP actions taken to reduce the probability of stream bank and bed erosion or instability from project actions (see pre-construction surveys below). Stream crossings that are unstable can ultimately adversely affect aquatic resources from such factors as loss of local habitat, impacts to downstream habitat from addition of high unstable sediment, and increased recovery time of the specific site to stable conditions.

A pre-construction survey would be conducted by a technically qualified team on all stream crossings to confirm and clarify conditions developed in the aforementioned matrix analysis. This team would be composed of professionals qualified to assess terrestrial and aquatic habitat and the geotechnical and geomorphic conditions relative to pipeline construction across stream channels and ditches. Following these surveys, if significant changes were to occur to parameters of the risk matrix for a crossing, changes would be made to risk level and appropriate final methods of crossing and BMPs made at each stream crossing. If any crossing is moved into the "high" project impact and "high" stream response risk matrix category, a site-specific crossing design would be developed for that site. Construction would then move forward as described in permit documents including implementation of special additional BMPs, as described in GeoEngineers (2017d, 2017e, and 2018a), depending on individual site conditions. Special additional BMPs may include such actions as changes in bank material and bank angle, specific substrate composition used, plants used on the bank, artificial stabilizing bank material, rootwad enhancement, and various other actions.

As a follow-up measure to help ensure crossing actions would not adversely affect stream bank and channel structure, Pacific Connector would monitor stream crossings to ensure long-term success of the restoration, maintenance of fish passage, and to identify channel erosion, scour or migration that could destabilize the site or expose the pipeline. As requested by FERC, Pacific Connector developed a monitoring plan (GeoEngineers 2017e, 2018a) following consultation with a representative from FWS and NMFS (Castro 2015). The monitoring plan would be customized, where necessary, to address risks of stream crossings identified in the Risk Analysis and those identified in subsequent preconstruction surveys.

Monitoring would consist of:

- Annual visits to all stream crossings, regardless of risk level, as part of Pacific Connector's monitoring of pipeline integrity. These visits would be completed by Pacific Connector staff and would note any obvious signs of channel erosion, pipeline exposure, or major shifts in restoration elements. Potential problem areas would be subsequently visited by Pacific Connector and a geoprofessional.
- Aerial reconnaissance would be completed annually for the life of the Pipeline and stream crossings would be reviewed for major landscape changes such as channel migration and excessive erosion. Potential problem areas would be subsequently visited by Pacific Connector and a geoprofessional.
- Quarterly site visits to all sites in the Orange management category (see GeoEngineers 2018a) for two years after construction to monitor revegetation success, structural stability of the restoration elements, any changes to fish passage potential resulting from the Pipeline, evidence of channel migration, erosion, head-cutting, or other stream channel movement that could influence stream or pipeline stability. Field measurements would be taken to monitor adjustments to the channel profile and cross sectional area.
- Annual site visits to 15 percent of all sites in the Blue management category and 100 percent of all sites in the Yellow management category (see GeoEngineers 2018a) for two years after construction to monitor revegetation success, structural stability of the restoration elements, any changes to fish passage potential resulting from the Pipeline, evidence of channel migration, erosion, head-cutting, or other stream channel movement that could influence stream or pipeline stability. Field measurements would be taken to monitor adjustments to the channel profile and cross-sectional area.
- Annual site visits to 50 percent of the sites in the Yellow and 100 percent of sites in the Orange management category (see GeoEngineers 2018a) by a geo-professional in Years 3, 5, 7, and 10 to monitor revegetation success, structural stability of the restoration elements, any changes to fish passage potential resulting from the Pipeline Project, evidence of channel migration, erosion, head-cutting, or other stream channel movement that could influence stream or pipeline stability. Field measurements would be taken to monitor adjustments to the channel profile and cross-sectional area.
- Observations would be made during all site visits on the effects of cattle/elk browsing on restoration success, and of impacts associated with recreational use.
- Revegetation planning along the right-of-way is detailed in the ECRP. The ECRP describes monitoring and performance standards for revegetation.
- Records would be maintained annually to document any significant hydrologic events (flow or rainfall) that occur in between site visits. This shall be done to better understand the site response to moderate or large flood events. As gauging stations are extremely limited over the majority of the crossings along the Pipeline route, rainfall records would

be used to identify the potential flooding that may occur in between scheduled monitoring events. These climatic events would be considered during annual monitoring when evaluating site response.

- Unscheduled site visits may be completed at stream crossings on BLM and Forest Service jurisdiction following localized rainfall events exceeding a 25-year rainfall intensity to monitor revegetation success, structural stability of the restoration elements, any changes to fish passage potential resulting from the Pipeline, evidence of channel migration, erosion, head-cutting, or other stream channel movement that could influence stream or pipeline stability. Field measurements would be taken to monitor adjustments to the channel profile and cross-sectional area.
- Annual reporting in Years 1, 2, 3, 5, 7, and 10 following construction would be provided to outline observations of stream crossings and any remedial action taken to restore site conditions.
- Monitoring frequency and locations may be modified in response to demonstrating site restoration success in the Annual Monitoring reports.

Overall, these actions would reduce but not completely eliminate potential adverse effects from bank and bed stability to the listed Lost River sucker.

3.5.5.5 Determination of Effects

Species

The Project **may affect** Lost River suckers because:

- Lost River suckers occur within the Upper Klamath and Lost River subbasins, which would be affected during construction of the proposed action.

The Project is **likely to adversely affect** Lost River suckers because:

- Lost River suckers could occur in 19 waterbodies crossed by dry open-cut construction in the Lake Ewauna-Klamath River watershed and in 13 waterbodies west of MP 214.38 (including the Lost River) crossed in the Mills Creek-Lost River watershed and be indirectly affected by elevated suspended sediment levels, streambank erosion and stability, and aquatic nuisance species introductions; and
- adults and juveniles subject to fish salvage within the isolated construction sites at 31 ditches crossed by dry-open cuts and the Lost River could be affected if electroshocking is used and stressed if seining is used.

Critical Habitat

The Project **may affect** designated critical habitat for the Lost River sucker because:

- there may be a low risk of hydraulic fracture resulting in inadvertent release of drilling mud during the HDD into the Klamath River.

However, the Project is **not likely to adversely affect** designated critical habitat for the Lost River sucker because:

- HDD would avoid critical habitat in the Klamath River.

- the potential for hydraulic fracture during HDD drilling is so unlikely as to be discountable; and
- in the event of released bentonite, corrective actions would contain and temporally limit drill mud volumes.

3.5.6 Shortnose Sucker

3.5.6.1 Species Account and Critical Habitat

Status

The shortnose sucker was listed as a federally endangered species on July 18, 1988 (FWS 1988). The shortnose sucker was listed as endangered because of the loss of habitat and access to historical range, resulting in a declining population. A five-year review was released in August 2013 recommending no change to the current listing status as endangered (FWS 2013m).

Threats

Lost River suckers and shortnose suckers were considered together in the final rule listing both as endangered species. Numerous factors in both species' decline were cited by FWS (1988) including historical over-fishing, dams limiting upstream movements and access to spawning habitats, introduction of non-native species that compete (fathead minnows) and prey on suckers (yellow perch, bullheads, largemouth bass, and various lepomid sunfish), and degradation of water quality due to livestock grazing, agriculture, and timber harvest. Pollution in Upper Klamath Lake has led to algal blooms with increased mortality of suckers when oxygen depletions occur due to eutrophication. Status assessments conducted in 2001 and 2002 (FWS 2002a) concluded that the shortnose sucker was threatened by the following: 1) drastically reduced adult populations and reduced range; 2) extensive habitat loss, degradation, and fragmentation; 3) small or isolated adult populations as a result of dams; 4) poor water quality; 5) lack of sufficient recruitment; 6) entrainment into irrigation and hydropower diversions; 7) hybridization with the other native Klamath sucker species; 8) potential competition with introduced exotic fishes; and 9) lack of regulatory protection.

Many of these same issues remained as factors threatening the species' recovery in 2013 (FWS 2013m). Regulatory protection of aquatic habitats inhabited by shortnose suckers has improved with implementation of various state (Oregon and California) and federal laws that minimize effects of actions on the species and habitat during project planning and consultation. However, shortnose suckers continue to be affected by adverse water quality, habitat degradation, toxicity from blue-green algae, and entrainment into irrigation and hydropower diversions. Added to the earlier threats listed is climate change, which is predicted to increase flows during winter months but decrease flows during the spawning period, from March or mid-April through May (FWS 2013m).

Approximately 400 habitat restoration projects have been completed or are planned for the Upper Klamath Lake Basin to help offset historical habitat loss. Shortnose suckers have been observed using the 6,000-acre habitat area of Williamson River Delta to Upper Klamath Lake where restoration has occurred. Additionally, the Chiloquin Dam on the Sprague River in 2008 was removed, which unblocked 75 miles of stream believed to be migration and spawning habitat. Because these efforts are so recent, population-level effects have not yet been observed. However, these actions and others are believed to be significant toward the improved status of this species (FWS 2013m). Nevertheless, poor water quality in Upper Klamath Lake and the Lost River continues to threaten the viability of the species. The water quality issues are most pronounced during summers when high temperatures combined with nutrient loading from pumping diked wetlands and runoff from farms, roads, and other sources cause detrimental water quality for fish species. Also, lake sediments create hypereutrophic conditions which lead to depletions of dissolved oxygen and fish die-offs (FWS 2007f, 2013m). A cyanobacterium, now present in Upper Klamath Lake, undergoes massive algal blooms; photosynthesis during daylight can supersaturate water with dissolved oxygen and respiration at night can deplete dissolved oxygen with both events deleterious to shortnose suckers (FWS 2013m). Blue-green algal or cyanobacter toxins (Microcystin) have recently been found to affect liver, intestines, kidneys, heart, spleen, and gills of suckers (FWS 2013m).

Population levels were estimated to be about 2,700 individuals in 1984 prior to listing. Although this estimate is likely inaccurate, it was substantially lower than historic population levels (FWS 2013m). This decrease in abundance was due to the following factors: habitat loss of approximately 77 percent of historic range, restricted access to spawning habitat, overharvest, and increased rates of mortality resulting from entrainment in water management structures and severely impaired water quality (FWS 2007f, 2013m). Population levels in Upper Klamath Basin are not well known, but production is affected by lack of suitable spawning habitat and spawning success. The Tule Lake population has better survival conditions than that of the Upper Klamath Lake system primarily due to better water quality. Length-frequency analysis suggests that the last substantial recruitment to the spawning population occurred during the late 1990s (FWS 2012h).

Species Recovery

Actions described in the recovery plan that would aid in the delisting of the shortnose sucker include improving habitat conditions through rehabilitating riparian areas and improving land management practices in the Klamath Basin watershed, developing and achieving water quality and quantity goals, and improving fish passage, spawning habitat, and other habitat conditions.

A recovery plan for Lost River sucker and shortnose sucker was finalized on March 17, 1993 (FWS 1993b). Since then additional information prompted revision of the recovery plan (FWS 2012h). The recovery program goal is to stop the population decline and enhance Lost River sucker and shortnose sucker populations so that ESA protection is no longer necessary.

At the time of listing, population declines were related to loss or degradation of spawning, rearing, and adult habitats. Only about 25 percent of the original habitat remains. Reductions in habitat quality compound the effects of reduced habitat quantity and availability on Lost River sucker and shortnose sucker abundance. In addition to habitat, factors currently limiting species recovery include high mortality of larvae and juveniles due to reduced rearing habitat, entrainment in water management structures, poor water quality, and adverse effects (predation, competition) from non-native, introduced fish species. Compounding effects from drought and water diversions affect lake water levels and unscreened water diversions and fish entrainment continue as threats. Substantial entrainment occurs at the river gates of the Link River Dam (FWS 2013m). Some of the shortnose suckers that pass through the gates pass downstream to the Keno Reservoir and farther along the Klamath River where they cannot return upstream. Nevertheless, there is a small population inhabiting Lake Ewauna, probably fish that survived passage through the Link River Dam and other hydroelectric canals and turbines (FWS 2013m).

Adult populations are limited by extremely low recruitment as well as by high levels of stress and mortality associated with severely impaired water quality. As a whole the species is potentially limited by the lack of habitat connectivity (FWS 2012h). However, one of the main passage barriers that reduced access to 95 percent of its river spawning habitat, the Chiloquin Dam on the Sprague River, was removed in 2008 (NMFS and FWS 2013b).

Demographic-based objectives include increasing larval production, individual survival, and recruitment to spawning populations, and ultimately increasing abundance in spawning populations. The objectives of restoring spawning and nursery habitat, expanding reproduction, reducing the negative impacts from water quality on all life stages, clarifying the effects of other species on all life stages, reducing entrainment, and establishing auxiliary populations comprise the threats-based objectives. The recovery strategy is intended to produce and document healthy, self-sustaining populations by reducing mortality, restoring habitat (including spawning, larval, and juvenile habitats), and increasing connectivity between spawning and rearing habitats. It also involves ameliorating adverse effects of degraded water quality, disease, and non-native fish. The plan provides areas of emphasis and guidelines to direct recovery actions (FWS 2012h).

There are two recovery units for shortnose suckers, the Upper Klamath Lake Unit and Lost River Basin Unit (FWS 2012h). Upper Klamath Lake Unit includes all shortnose suckers within the lake, tributaries to Upper Klamath Lake, and reservoirs within the Klamath River including Keno Reservoir and populations below Keno Reservoir. The Lost River Basin Unit includes Clear Lake Reservoir and tributaries including Willow Creek, Boles Creek, Tule Lake, Gerber Reservoir and tributaries, and the Lost River mainstem (FWS 2012h) even though the Lost River is not included in designated critical habitat. The Lost River proper includes individual suckers in the mainstem downstream from the Clear Lake Dam to Anderson-Rose Diversion Dam, including the Lost River tributary Miller Creek, downstream from Gerber Dam. The population in the Lost River drainage below Clear Lake Dam is comprised mostly of adults (FWS 2012h).

Life History, Habitat Requirements, and Distribution

Shortnose suckers are native to the Upper Klamath River Basin and Lost River Basin but have adapted to lake habitats and spawn in larger tributary rivers associated with lakes (Moyle 2002), generally from February through early May. Larval stages persist from May through July (Reclamation 2007). Although Lost River suckers may live to 43 years old, shortnose suckers are shorter-lived, surviving to 25 years old; females attain sexual maturity at 4 years old while Lost River sucker females are sexually mature at 6 to 9 years old (Reclamation 2007). Shortnose sucker females may produce 72,000 eggs per spawning season, generally fewer than Lost River suckers.

River spawning habitats include riffles or runs with gravel or cobble substrate, with moderate flows, and in water 4 to 51 inches deep. Shortnose suckers have historically spawned in lakes, particularly at springs occurring along the shorelines (FWS 2007f). Currently, shortnose suckers are found in Upper Klamath Lake and its tributaries, Klamath River downstream to Iron Gate Reservoir, Clear Lake Reservoir and its tributaries, Gerber Reservoir and its tributaries, the Lost River, and Tule Lake. In the Upper Klamath Lake watershed, shortnose sucker spawning runs are primarily limited to the Sprague and Williamson Rivers, although spawning runs may also be present in the Wood River and in Crooked Creek. Shortnose sucker spawning has also been recorded in the Clear Lake watershed (FWS 1988) and Gerber Reservoir watershed (FWS 1994a). Adult and juvenile shortnose suckers prefer turbid, highly productive but shallow lakes that are cool in the summer with adequate dissolved oxygen and water that is moderately alkaline (FWS 2007f).

As discussed for Lost River suckers, a small population of several hundred adult shortnose suckers exists in Tule Lake but, the population in the Lost River drainage below Clear Lake Dam is comprised mostly of adults, and the Lost River functions as a population sink with no likely chance of being self-sustaining because of low recruitment and lack of access to spawning habitats (FWS 2012h). Shortnose suckers have resident populations in both lake and some riverine habitats, including Lost River, Willow Creek, and other tributaries of Clear Lake and Gerber Reservoir (Reclamation 2007). Shortnose suckers have been documented spawning below Anderson-Rose Dam, in Big Springs near Bonanza, and at the terminal end of the West Canal as it spills into the Lost River. Suitable spawning habitats with riffle areas and rocky substrates include the spillway area below Malone Dam, immediately upstream of Keller Bridge, immediately below Big Springs in the Lost River, below Harpold Dam, and adjacent to Station 48 (Reclamation 2007). Seasonal movements of shortnose suckers are similar to those described for Lost River suckers.

Population Status

At the time of the Final Rule, estimates of the shortnose sucker population could not be made. Nevertheless, there was very little recruitment to the population and that, plus mortality from fish die-offs and fishing, indicated a declining trend (FWS 2007f). Continued efforts to estimate shortnose sucker populations have been based on several approaches which indicate a declining population with nearly no measurable recruitment in Upper Klamath Lake and limited survival of adults past the age of sexual maturity. Shortnose suckers attain sexual maturity when 4 to 6 years old and survival after entering the spawning population was estimated at only 3.6 years indicating insufficient time for reproduction to sustain the population (FWS 2007f).

For several years there was no indication that shortnose suckers continued to inhabit Tule Lake, but in 1991 both sucker species were observed spawning below Anderson-Rose Dam, and sampling at Tule Lake in the early 1990s determined that small populations of the two species were present (Reclamation 2007). Estimates of shortnose sucker annual survival rates in Upper Klamath Lake between 1995 and 2004 indicate that the population is likely to be decreasing, although the survival estimates appear to be imprecise (Reclamation 2007).

Shortnose sucker spring-spawning abundance in 2007 was estimated to be 42 percent and 48 percent of 2001 abundancies for males and females, respectively (FWS 2012h). Tagging studies conducted on Lost River suckers and shortnose suckers in Gerber Reservoir and Clear Lake (both impoundments are connected to the Lost River below Gerber Dam and Clear Lake Dam, respectively) indicated that numbers of large adult suckers of both species had declined since 2000. Declines in large adult shortnose suckers have been particularly pronounced in Clear Lake Reservoir, possibly due to poor recruitment from younger age classes prior to 2000 (Barry et al. 2009).

Hewitt et al. (2015) estimated λ and other population demographic properties for the adult spawning population of shortnose suckers in Upper Klamath Lake from 2001 to 2012 (figure 3.5.6-1). In the figure, the population rate of change ($\lambda = N_{t+1} / N_t$) indicates positive or negative growth. When $\lambda > 1$, the rate of change is positive and the population (N) has grown from N_t to N_{t+1} in the next time interval. Alternatively, the population is stable when $\lambda = 1$, but when $\lambda < 1$, the population has declined from N_t to N_{t+1}. The data show a declining adult spawning population but does not indicate changes in the whole population because it does not account for changes in the numbers of juveniles from year to year. With additional demographic data, Hewitt et al. (2015) concluded that current spawning population is a subset of the individuals that were present in the late 1990s. Both male and female shortnose suckers appear to have reached senescence. Low estimates of survival from 2010 to 2012 may indicate increased mortality is occurring as a result of older age classes.

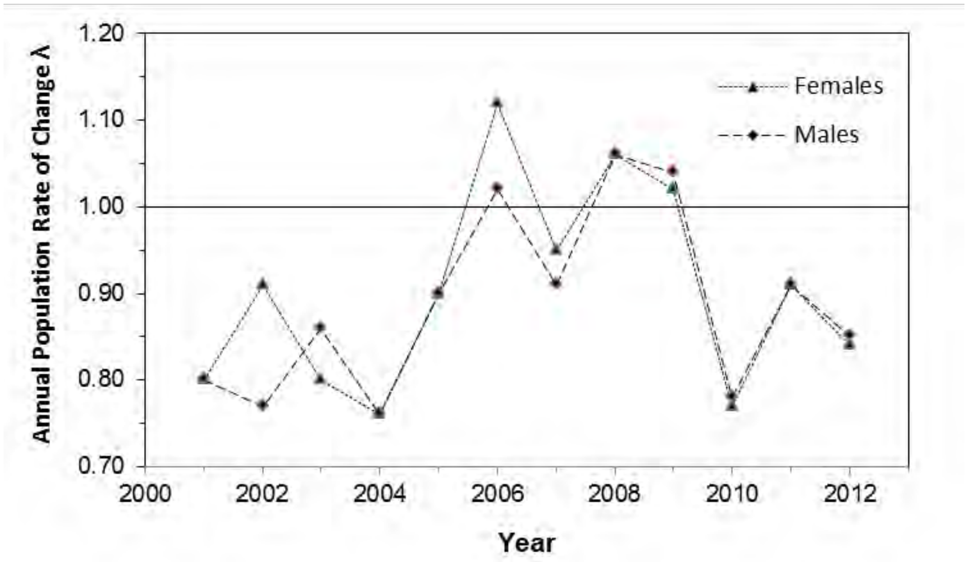


Figure 3.5.6-1. Estimates of Annual Population Rate of Change (λ) for Shortnose Suckers from the Spawning Population in Upper Klamath Lake, Oregon. The population is declining when λ < 1 (data from Hewitt et al. 2015).

Critical Habitat

Critical habitat for the Lost River sucker and shortnose sucker was proposed by FWS in 1994 (FWS 1994a). Critical habitat for Lost River and shortnose suckers was re-proposed in 2011 and designated in 2012 (FWS 2012i). Along the route of the Pipeline, designated critical habitat for Lost River and shortnose sucker (CHU 1 in Klamath County) includes the Link River, Lake Ewauna, and the Klamath River downstream to Keno. CHU 2 in Klamath and Lake Counties, Oregon and Modoc County, California includes Clear Lake Reservoir and tributaries and Gerber Reservoir and tributaries, but does not include Tule Lake and its tributary or the Lost River. For reasons described above (blockage by Anderson-Rose Diversion Dam), neither Tule Lake or Lost River provides spawning habitats or supports viable self-sustaining populations of Lost River or shortnose suckers (FWS 2012i). The Pipeline does not coincide with critical habitat in CHU 2.

In CHU 1 (Upper Klamath Lake), there are 13 miles of critical habitat on federal land, less than 1 mile on state land, and 106 miles on lands of private/other ownership. In CHU 2 (Lost River Basin), there are 23 miles of critical habitat on federal land, less than 1 mile on state land, and 3 miles on lands of private/other ownership (FWS 2012i).

PCEs of critical habitat include (FWS 2012i):

1. Water. Areas with sufficient water quantity and depth within lakes, reservoirs, streams, marshes, springs, groundwater sources, and refugia habitats with minimal physical, biological, or chemical impediments to connectivity. Water must have varied depths to accommodate each life stage: shallow water (up to 3.28 feet [1.0 meters]) for larval life stage and deeper water (up to 14.8 feet [4.5 meters]) for older life stages. The water quality

characteristics should include water temperatures of less than 82.4°F (28.0°C); pH less than 9.75; DO levels greater than 4.0 mg/l; low levels of microcystin; and un-ionized ammonia (less than 0.5 mg/l). Elements also include natural flow regimes that provide flows during the appropriate time of year or, if flows are controlled, minimal flow departure from a natural hydrograph.

2. Spawning and rearing habitat. Streams and shoreline springs with gravel and cobble substrate at depths typically less than 4.3 feet (1.3 meters) with adequate stream velocity to allow spawning to occur. Areas containing emergent vegetation adjacent to open water provide habitat for rearing and facilitate growth and survival of suckers as well as protection from predation and protection from currents and turbulence.
3. Food. Areas that contain an abundant forage base, including a broad array of chironomidae, crustacea, and other aquatic macroinvertebrates.

3.5.6.2 Environmental Baseline

Analysis Area

For shortnose suckers, the riverine analysis area is limited to fresh waterbodies within the Upper Klamath River subbasin (HUC 18010206; see Lost River sucker figure 3.5.5-2A) and Lost River subbasin (HUC 18010204; see figure 3.5.5-2B). The riverine analysis area includes two components: 1) the water column and substrate of all waterbodies crossed by the Pipeline from the point of crossing to the extent downstream where water quality is adversely affected by turbidity generated during construction and sediment generated by runoff from the construction right-of-way; and 2) waterbodies' associated riparian zones affected in the short-term during construction and in the long-term by operation. The riverine analysis area for the shortnose sucker includes two perennial flowing river crossings (Klamath and Lost Rivers) and 106 intermittent streams, ditches, and canals that would either be crossed or are in the right-of-way. The two perennial flowing rivers likely have shortnose suckers present. In addition to the two perennial waterbodies, the Pipeline would also cross 83 intermittent streams, ditches and canals; 23 additional intermittent streams, ditches, ponds and canals would be adjacent to the Pipeline, within the construction right-of-way, but not crossed. There is no information to indicate that shortnose suckers occur in any of these intermittent waterbodies but they are included in the riverine analysis area for shortnose suckers.

Species Presence

Shortnose suckers are found in Upper Klamath Lake and its tributaries, Klamath River downstream to Iron Gate Reservoir, in Clear Lake Reservoir and its tributaries, Gerber Reservoir and its tributaries, the Lost River, and Tule Lake (FWS 2013m). Shortnose sucker spawning has also been recorded in the Clear Lake watershed (FWS 1988) and Gerber Reservoir watershed (FWS 1994a). In the Upper Klamath River subbasin (HUC 18010206) shortnose sucker are found in the Klamath River as far downstream as Copco Reservoir and possibly Iron Gate Reservoir. In the Lost River Subbasin, they are found in the Lost River mainstem below Anderson-Rose Diversion Dam, above Malone Dam, and in Clear Lake Reservoir (Moyle 2002).

Shortnose suckers spawn in the Lost River and are present in John C. Boyle Reservoir, downstream from the pipeline crossing at RM 225 (NRC 2004). In addition to collections of shortnose suckers in John C. Boyle Reservoir, ORBIC (2012) cites records of spawning in the Link River. Shortnose suckers have been documented from Lake Ewauna and in the Lost River Diversion Canal. Currently, shortnose suckers migrate a short distance from Tule Lake to spawn in the Lost River below Anderson-Rose Diversion Dam (RM 17.4) south of Merrill and approximately 7.6 river miles from the pipeline crossing of the Lost River (ORBIC 2017b). Suckers also spawn in the Lost River below Malone Dam, downstream from Clear Lake Reservoir. A population inhabits the Tule Lake sumps at the terminus of the Lost River (FWS 2007f). That population is isolated from upstream spawning habitats in the Lost River by the Anderson-Rose Diversion Dam and the population is not self-sustaining (FWS 2007f). As of 2006, shortnose suckers had been documented in the Lost River from the confluence with Miller Creek to Tule Lake, a reach that coincides with the proposed Pipeline crossing of the Lost River (FWS 2013m). Shortnose suckers continue to occupy the Lost River below Anderson-Rose Diversion Dam to Tule Lake (Hodge and Buettner 2009).

Within the Pipeline Project area, the shortnose sucker has been documented within the Klamath River from Klamath Falls to Keno Reservoir. The Pipeline would cross the Klamath River at RM 249. The shortnose sucker is also known to be present from Tule Lake Sump and Clear Lake Reservoir in northern California, which are connected by the Lost River. Tule Lake Sump is at the lower terminus of the Lost River and the population in Tule Lake is isolated from upstream spawning areas by multiple dams including blockage by the Anderson-Rose Diversion Dam.

Historically, dewatering of canals, laterals, and drains has included biological monitoring and salvage of listed species, as needed. Canals, laterals, and drains are dewatered at the end of irrigation season which includes capture and relocation (salvage) of suckers from the canal system after dewatering occurs. Nearly all canals, laterals, and drains are either dewatered after the irrigation season, before April and after October, or have the water lowered for inspection and maintenance (NMFS and FWS 2013b). Canals remain dewatered until the following spring (as early as late March) except for the input of localized precipitation-generated runoff (NMFS and FWS 2013b). Reclamation’s fish salvage efforts focus on the A Canal forebay in front of the fish screen, C4 Canal, D1 Canal, and D3 Canal within the Klamath Irrigation District, and J Canal within the Tule Lake Irrigation District (NMFS and FWS 2013b). The Pipeline would cross the C-4-E Lateral at MP 201.63, the C-4 Lateral at MP 204.12, the C-4-F Lateral at MP 204.33, and the C-4-C Lateral at MP 205.50 in the Lake Ewauna-Klamath River watershed. In addition, the Pipeline would cross the C Canal at MP 205.96 and the C-4-7 Lateral at MP 207.40 in the Mills Creek-Lost River watershed. All six canals and laterals are presumed to be associated with the C4 Canal and may be occupied by shortnose suckers prior to dewatering. The Pipeline would not cross the A Canal, D1 Canal, the D3 Canal, or the J Canal.

Past efforts have shown that salvage of suckers is practicable in some locations, but numbers of salvaged suckers are highly variable among years and sites (NMFS and FWS 2013b). Occurrence of shortnose suckers in canals and ditches operated and maintained by Reclamation is possible if they are crossed before dewatering begins in October. However, based on the unpredictability of shortnose sucker occurrence at any one site at any specific time, there is no way to anticipate the species’ presence during construction.

All canals, laterals, and drains operated and maintained by Reclamation would be crossed using conventional bores, thus avoiding any in-stream construction and conflicts with shortnose suckers if present. Irrigation ditches and roadside ditches on private land would be crossed by dry open-cut construction if water is present at the time. The connectivity of those ditches with canals, laterals, and drains operated and maintained by Reclamation is unknown. Because of their small size and function as agricultural drains, shortnose suckers are not expected to occur. A total of 26 streams/ditches in the Lake Ewauna-Klamath River watershed and 59 streams/ditches in the Mills

Creek-Lost River watershed would be crossed (85 total) by the Pipeline. The right-of-way would not cross but would be adjacent to 23 additional streams/ditches in the two watersheds. Altogether, the Pipeline would potentially affect 108 waterbodies in the range of the shortnose sucker included in table 3.5.5-1 (in Lost River sucker section 3.5.5). All but the Klamath River and Lost River have intermittent flow. There are 106 intermittent streams or ditches between MPs 188.9 and 228.1; 58 would be crossed by dry open cutting and 25 of them would be crossed using a conventional bore (with no in-stream construction). Twenty-three intermittent streams/ditches/canals would not be crossed but are present within the construction right-of-way (see table 3.5.5-1). They are also expected to be dry at the time of construction.

Habitat

The Lost River has been highly altered to meet the needs of agriculture and reduce the threat of flooding, and therefore habitat is fragmented and disconnected by dams lacking fish passage (NMFS and FWS 2013b). Much of the water flowing through the lower Lost River channel comes from Upper Klamath Lake through the A Canal. Consequently, water in the Lost River is high in nutrients and is reused many times by different users causing nutrient concentrations to be increased. Water flowing in the Lost River eventually empties into the Tule Lake NWR as return flow from irrigation (no water is released through the Anderson-Rose Diversion Dam) and can be pumped to the Lower Klamath NWR before flowing to the Klamath River via the Klamath Straits Drain (NMFS and FWS 2013b). The extensive alterations of the Lost River watershed, along with inputs from Upper Klamath Lake and agricultural drainage, have contributed to seasonally poor water quality and the Lost River is listed by the State of Oregon for exceedances in temperature, DO, pH, algal biomass, and ammonia toxicity (NMFS and FWS 2013b).

Dams continue to limit passage and sucker migration, impose isolation of subpopulations, and decrease available spawning habitats which raise the possibility of facilitating hybridization between several sucker species (Reclamation 2007). Dams may also cause stream channel changes, alter water quality, and provide habitat for exotic fish that prey on suckers or compete with them for food and habitat (Reclamation 2007). Although there are seven major dams in the Klamath Basin that may affect the migration patterns of listed suckers, only the Link River Dam has been recently equipped with a fish ladder that was designed specifically for sucker passage (Reclamation 2007). Fish ladders are present at John C. Boyle and Keno Dams and, although suckers have been observed to use the ladders, they were not designed for sucker passage and generally are inadequate for sucker passage (Reclamation 2007).

The Link River Dam regulates water flows downstream to Lake Euwana, Keno Reservoir, and the Klamath River. The river gates on the dam do not protect fish from becoming entrained and numerous juvenile suckers are drawn through the dam gates. Shortnose suckers that survive passing through the hydroelectric facilities either die due to poor summer water quality conditions or pass downstream into the Klamath Reservoir. At that point, fish cannot return and are believed to be lost from the breeding population (FWS 2007f).

Adverse water quality is the most critical threat to the shortnose sucker (FWS 2007f). Klamath River and Klamath Lake have been designated as water quality impaired, including for nutrient loads which are enhanced by drainage of irrigation water from agricultural lands adjacent to Klamath Lake. Construction of dikes and drainage systems converted wetlands to agricultural use. Soils high in organic content were subject to mineralization processes which released nutrients into the aquatic system, especially phosphorous and nitrogen (Rykbost and Charlton 2001).

High levels of phosphorous in Klamath Lake have led to extreme eutrophication events that promote algal blooms dominated by the blue-green algae *Aphanizomenon flos-aquae* that reach or nearly reach theoretical biological maxima (NRC 2004). As a consequence, portions of Upper Klamath Lake develop conditions of oxygen depletion or are anoxic, and accumulate high concentrations of ammonia, which has resulted in mass mortality of fish, including adult suckers (NRC 2004). Shortnose suckers are likely to experience high mortality if exposed to one or more of the following: pH 9.8 or higher, ammonia (unionized) concentration 0.34 mg/l or higher, water temperatures 29.4°C (≥85°F) or higher, and DO concentrations 2.3 mg/l or less (Bellerud and Saiki 1995). Seasonally low DO concentrations occur throughout the Lost River and can be especially low in reservoirs where concentrations less than 2 mg/l have been reported as lasting from a day to several weeks in Anderson-Rose, Harpold, and Wilson Reservoirs, with DO concentrations near 0 mg/L observed in some reservoirs (NMFS and FWS 2013b).

No assessments have been conducted for either of the two fifth-field watersheds that would be crossed by the Pipeline in the Lost River subbasin: Lake Ewauna-Klamath River (HUC 1801020412) and Mills Creek-Lost River (HUC 1801020409). Likewise, no stream reaches have been sampled under ODFW's Aquatic Inventories Project in either of the fifth-field watersheds. Nevertheless, modifications and degradation of aquatic habitats have been documented by FWS (1993b and 2012h), USGS (Dileanis et al. 1996), Reclamation (2007), and the NRC (2004), among others.

There are no recent long-term water discharge data for waterbodies in the Lost River watershed. The A Canal connects the Link River to the Lost River via the B Canal. According to USGS Gage 11507200, there is no flow in the A Canal between November and March (see figure 3.5.5-4, in section 3.5.5, Lost River sucker), consistent with periods of water diversions from the Klamath River, discussed above. Adequate flow and habitat conditions in the Lost River are likely during the spring and summer with higher river flows supplemented by releases from Clear Lake and Gerber reservoirs (NMFS and FWS 2013b). Irrigation releases typically start in April. Flows in the Upper Lost River are very low during the fall and winter because flows from Clear Lake and Gerber reservoirs are considerably reduced, but winter flows do increase downstream from tributary and spring contributions (NMFS and FWS 2013b).

Critical Habitat

Designated critical habitat for the shortnose sucker is present within the Pipeline Project area. The Pipeline would cross the Klamath River at RM 249, which is within CHU 1, Klamath County (FWS 2012i). Unit 1 includes Upper Klamath Lake and Agency Lake, together with some wetland habitat; portions of the Williamson and Sprague Rivers; Link River; Lake Ewauna; and the Klamath River from the outlet of Lake Ewauna downstream to Keno Dam. PCEs are described above and include water, spawning and rearing habitat, and food (FWS 2012i).

CHU 2 includes Clear Lake Reservoir and its principal tributary, Willow Creek. CHU 2 does not coincide with the Pipeline Project area.

3.5.6.3 Effects of the Proposed Action

In the riverine analysis area, only the Klamath River and the Lost River are inhabited by shortnose suckers based on available information (ORBIC 2017b) although shortnose suckers enter the canal system within both sub-basins and are regularly salvaged by Reclamation once canals are drained after the irrigation season (Hodge and Buettner 2009). In the Lake Ewauna-Upper Klamath watershed, 19 intermittent streams would be crossed by dry open-cut and six others by boring. In the Mills Creek-Lost River watershed, 40 intermittent streams would be crossed by dry open-cut and 19 others by boring. There is no information documenting that shortnose suckers would be present in any of those intermittent streams, which include canals and ditches, at the time of construction (discussed above). The Lost River would be crossed using dry open-cut construction.

Direct and Indirect Effects

Timing

The Klamath River (MP 199.38) and the Lost River (MP 212.07) are the only perennial waterbodies crossed by the Pipeline on Construction Spread 5. The ODFW (2008) allows in-stream construction in the Klamath River (above Keno) from July 1 to January 31 and in the Lost River (below Bonanza) from July 1 to March 31. Pacific Connector has requested that HDD crossing the Klamath River be allowed to occur outside of ODFW's in-water construction windows to ensure that enough time is provided to successfully complete the crossings. Pacific Connector proposes cross the Klamath River using HDD crossing methods between July and October. The Lost River would be crossed by dry-open crossing methods during the ODFW-recommended crossing window (July 1 to March 31). Spawning occurs within limited areas of the Lost River (Reclamation 2007), and occasional individual shortnose suckers have been found in this stream region, so it is possible that shortnose suckers be present in the Lost River where the Pipeline would cross during the non-spawning period.

Species Presence

In the vicinity of the Pipeline, shortnose suckers occur in the Lake Ewauna-Klamath River fifth-field watershed and the Mills Creek-Lost River fifth-field watershed. The pipeline route crosses the Lake Ewauna-Klamath River fifth-field watershed for about 17.24 miles (MPs 188.41 to 205.65) and the Mills Creek-Lost River fifth-field watershed for 23.15 miles (MPs 205.66 to 228.81). The Pipeline would cross 26 waterbodies in the Lake Ewauna-Klamath River, one by HDD, six by conventional bore, and 19 by dry open-cut, and would cross 59 waterbodies in the Mills Creek-Lost River watershed, 20 by conventional bore and 39 by dry open-cut.

Potential effects to shortnose suckers inhabiting Klamath River by HDD construction are discussed below. Since there would be no in-stream work for any of the conventional bore crossings, no effects to shortnose suckers are expected in those 26 streams, canals, drains or ditches that are maintained by Reclamation. Potential effects to shortnose suckers are possible in waterbodies crossed by dry open-cut, including the Lost River (known to be occupied by shortnose suckers) with the exception of 26 waterbodies crossed between MP 214.38 and MP 228.81. At MP 214.38, the pipeline route deviates from the general west to east direction and proceeds north, up a 9 percent slope (climbing from 4,100 feet to 4,360 feet elevation) to MP 215.04, and then continues to the east along a ridgeline (paralleling powerline corridors) to MP 228.81. In that segment, the route crosses 26 waterbodies that are intermittent headwater drainages with unlikely (due to steep slopes) or no pathways (no connectivity) for shortnose suckers to enter from lowland Reclamation canals, drains, or ditches that might support Lost River suckers and shortnose suckers. No effects to shortnose suckers would occur by crossing those 26 waterbodies.

Potential effects to shortnose suckers are possible during dry open-cuts of 19 waterbodies crossed in the Lake Ewauna-Klamath River watershed and the remaining 13 waterbodies west of MP 214.38 crossed in the Mills Creek-Lost River watershed included in table 3.5.5-2 (in Lost River sucker section 3.5.5). Except for the Lost River and one irrigation ditch at MP 194.64, none of the waterbodies have been mapped by the Klamath Project. Consequently, connectivity of those other 31 waterbodies (classified as ditches) to larger canals and laterals that may seasonally support shortnose suckers cannot be determined.

Suspended Sediment by Pipeline Crossing Methods

Potential occurrence of shortnose suckers in waterbodies crossed by dry open-cut are included in table 3.5.5-2. Dry crossing methods would result in minimal impacts, including temporary increases in suspended sediments in restricted areas. One HDD and 25 conventional bores would be installed without in-water work and would not directly affect the aquatic environment and associated species (except in the case of an inadvertent return during an HDD crossing, which could affect stream suspended sediment levels as discussed below). The Klamath River would be crossed with an HDD.

Because all streams/ditches crossed, except for the Klamath River and Lost River, are minor or intermediate channels, any construction required would be done in the dry, reducing potential for any adverse suspended sediment conditions downstream. Additionally, road crossings where fish may be present would be constructed to meet ODFW fish passage standards so fish movement would not be blocked. While some elevated sediment may occur downstream, effects would be unsubstantial at most crossings to shortnose sucker due to the implementation of approved construction methods.

Suspended Sediment – Dry Open Cut

As noted in section 3.5.3.3, dry open-cutting (fluming, dam-and-pump, or some combination of the two) generates small amounts of turbidity compared to wet open-cut procedures. However, adult suckers appear to prefer deep, turbid water but are often forced to utilize shallow, clear water during degraded water quality conditions in the summer (NRC 2004). The amounts of turbidity generated by dry open-cut construction may cause minor short-term adverse effects to shortnose suckers if they are within several hundred feet downstream of the Lost River crossing site. However, guidance for evaluating effects of exposure and dose of suspended sediments on catostomids (including shortnose sucker) is not available, similar to documentation for salmonids (e.g., Newcombe and Jensen 1996). Crossing of the intermittent channels is planned to occur in the dry so suspended sediment increases should be very low when flow is returned to the channels, as channel conditions would be stabilized. Should a crossing occur when flow is present, some suspended sediment levels would be more elevated. However, considering 1) the small size of these intermediate streams/ditches, 2) the short duration of construction activity at each crossing location, 3) the expectation that suckers would not be present in these streams/ditches, even when they are flowing, and 4) the apparent tolerance of this species for turbid water, these elevated suspended sediment levels would not cause substantial effects to shortnose suckers in these intermittent flow crossings but some potential adverse effects could occur if some fish were present near crossings.

There is a possibility that following construction, future flows returning to the ditches listed in table 3.5.5-2 could potentially indirectly affect suckers by mobilizing sediment replaced over the trench. Mobilized sediments could lead to downstream sediment impacts on forage species, streambank erosion and stability (geotechnical stability), and surface flow retention. However, during delineation of the ditches, field personnel reported stream gradients at ditches as less than one percent and many had mud substrates, both observations indicative of low in-stream flows and velocities in the ditches. Consequently, flows returning in the ditches after dry open-cut construction may not be sufficient to mobilize native materials replaced in the trench. Pacific Connector (in the ECRP [appendix F]) has proposed to install erosion control matting to cover channel bottoms where revegetation of the channel bottom is required. Erosion control matting, anchored with staples to the channel sides and bottom, could be similarly used at irrigation ditches to minimize risk of sediment mobilization, downstream sediment impacts on forage species (zooplankton such as cladocerans – water fleas – and benthic insects such as chironomid midge larvae and amphipods), and streambank erosion and stability. Use of erosion control matting would allow materials replaced as bottom substrate and restored ditch banks to consolidate without eroding until the matting degrades.

Suspended Sediment – HDD

The HDD installation method is considered an effective technique for avoiding in-stream impacts by eliminating the need for in-stream excavation (Reid and Anderson 1998; Reid et al. 2004). According to GeoEngineers' (2017g) analysis for construction using HDD across the Klamath River (see appendix E), the design length of the Klamath River HDD crossing would be approximately 2,300 feet. The proposed Klamath River entry point would be in an agricultural field about 950 feet east of the river bank and the exit would be an open area about 370 feet west of the river bank. The HDD design indicates there would be between 70 and 140 feet of streambed cover in the river channel over the pipe. There is no direct in-stream disturbance so no suspended sediment increases would occur unless there is an unplanned drilling failure. There would be a moderate to high risk of hydraulic fracture from the entry point to about 900 feet to the west, all within the east bank of the river. The portion of HDD beneath the river would be below bedrock with a low risk of a release of drilling mud ("inadvertent return"). The risk of inadvertent return would be high within 425 feet from the HDD exit point on the west bank of the Klamath River due to presence of stiff silt alluvium (GeoEngineers 2017g). Though the risk of releasing drilling mud directly beneath the riverbed is low, such a release could have impacts on the aquatic environment and species.

Inadvertent Release of Drilling Muds (Inadvertent Return). There is a potential for impact as a result of the HDD process. Drilling requires use of a drilling mud for lubrication of the bit and removal of cuttings. A non-toxic, biodegradable bentonite clay mixture makes up drilling mud. Because the drilling mud is under pressure during drilling, if the bit encounters substrate fractures or channels, it is possible for bentonite to escape from the drilled hole (termed an "inadvertent return"). Bentonite can escape to the surface through fractures in the drilled substrate. Bentonite by itself is a non-toxic drilling mud (Breteler et al. 1985; Hartman and Martin 1984; Sprague and Logan 1979) although according to Reid and Anderson (1998), the toxicity of bentonite (sodium montmorillonite) in fresh water ranges from 5,000 to 19,000 ppm (mg/liter) based on 96-hour tests for LC_{50} on rainbow trout. The toxicity classifications based on LC_{50} values ranged from "slightly toxic" to "practically non-toxic" (Reid and Anderson 1998). In other tests, toxicities to lake whitefish and rainbow trout demonstrated threshold concentrations of 16,613 and 49,838 ppm (mg/liter), respectively (Reid and Anderson 1998). LC_{50} concentrations > 10,000 ppm would be considered "practically non-toxic" (Reid and Anderson 1998). As with any fine particulate material, bentonite can interfere with oxygen exchange by gills and the degree of interference generally increases with water temperature.

Potential inadvertent returns are more common near the HDD drill entry and exit locations; however, impacts to waterbodies are minimized by locating the drill entry and exit points away from the waterbody.

If an inadvertent return occurs into the river, drilling fluid would enter the waterway causing short-term, temporary water quality impacts downstream of the Pipeline Project area including sedimentation and turbidity. Should this occur, fish would likely avoid the immediate vicinity of any elevated suspended sediment within this larger river crossing area.

If drilling fluid accumulates in the substrate, it can adversely impact the quality and quantity of aquatic habitat available for aquatic species including catostomid (sucker) spawning habitat and benthic macroinvertebrate rearing habitat. Drilling fluid that accumulates in the substrate may cover up food sources and smother fish eggs and other aquatic life in the riverbed. However, significant impacts to substrate from inadvertent returns are not likely in large river systems because of the anticipated high water volumes and velocities within large rivers. Pacific Connector developed its *Drilling Fluid Contingency Plan for Horizontal Directional Drilling Operations* (see appendix D), which describes how the drilling operations would be conducted and monitored to minimize the potential for inadvertent drilling mud releases. The HDD Contingency Plan also includes procedures for cleanup of drilling mud releases. As discussed above for Lost River suckers, if drilling fluid is inadvertently released into the Klamath River and significant concentrations are found during monitoring as a result of a release, the following possible corrective measures would be taken:

1. Deployment of containment structures, if feasible, and removal of drilling mud from substrate and streambanks if possible.
2. Increase the drilling fluid viscosity in an attempt at sealing the point at which fluid is leaving the drilled hole. The drilling operation may be suspended for a short period (i.e., overnight) to allow the fractured zone to become sealed with the higher viscosity drilling fluid.
3. If increasing the drilling fluid viscosity is ineffective, LCMs may be introduced into the hole by incorporating them in the drilling fluid and pumping the material down-hole. The drilling operation may again be suspended for a short period (i.e., overnight) to allow the fractured zone to become sealed with the LCMs.
4. Depending on the location of the fractured zone, a steel casing may be installed that is of sufficient size to receive the largest expected down-hole tools for the crossing. This casing installation provides a temporary conduit for drilling fluids to flow while opening the remaining section of the hole to a diameter acceptable for receiving the proposed pipe sections. To alleviate future concerns with the steel casing after the HDD installation is completed, the casing is generally extracted from the hole prior to or just after completing the HDD installation. However, there have been instances when attempts at extracting the steel casing were unsuccessful.
5. In the event drilling fluid flow is not regained through the annulus of the drilled hole and a steel casing installation is not utilized, the HDD contractor may elect to install a grout mixture into the drilled hole in an attempt to seal the fractured zone. The down-hole drilling assembly is generally extracted and existing hole is re-drilled to the point at which it had previously been drilled prior to having encountered the loss of drilling fluid.

In some instances, it may be determined that the existing hole encountered a zone of unsatisfactory soil material and the hole may have to be abandoned. If the hole is abandoned, it would be filled with cuttings and drilling fluid.

Overall, at the site of any inadvertent return, the amount of drilling mud released into a waterbody would be low. The HDD location would be under the Klamath River with large volumes of water and swift flows where the drilling mud would be diluted. If an inadvertent release of drilling mud from an HDD occurred it would have minor short-term adverse effects to aquatic resources including shortnose sucker.

Movement Blockage

Dry open-cut construction is expected to temporarily preclude short-term movements of shortnose sucker, possibly in the Lost River, but likely not in other crossings as shortnose sucker would unlikely be present in these areas. Restrictions on movement would be at most short-term. The fluming process is expected to require about 36 to 96 hours of in-stream work while dam-and-pump construction is expected to require between 20 and 56 hours of in-stream work (Reid et al. 2004). During this time, fish may be exposed to suspended sediment levels that they may avoid. Flumes would maintain streamflow and fish might move upstream or downstream through the flume, but fish would be unable to move past a dam-and-pump crossing until it was removed. Flumes and dams would be removed as soon as possible following backfilling of the trench. Normal migration of adult shortnose suckers to spawning areas would likely be in the mid-winter to spring as spawning occurs from late February to early June, so short-term blockages could affect spawning migration due to the in-stream work extending to the end of March. Overall, the levels of suspended sediment and physical structure blockages would not cause substantial delays to shortnose sucker movement, resulting in unsubstantial effects to shortnose sucker individuals.

Entrainment and Entrapment

Waterbody crossings using the "dry" crossing methods, flume or dam-and-pump, may result in some fish being entrapped in streams. Fish inadvertently left within the dammed-off construction zone would be captured by either an ODFW biologist or qualified consultant.. Waterbodies crossed by dry open-cut (the Lost River and 31 ditches) with known or potential species presence are included in table 3.5.5-2.

For typical crossings once streamflow is diverted through the flume pipe, but before trenching begins, fish trapped in any water remaining in the work area between the dams would be removed and released (salvaged) using the *Fish Salvage Plan* (see *Fish Salvage Plan* under section 3.5.6.4 or appendix T for details). Salvage methods could include seines and/or dip nets and electrofishing. Seining would be the primary method used to salvage fish but electrofishing methods may be used if all fish cannot be removed from the area potentially dewatered. The *Fish Salvage Plan* incorporates these methods to minimize adverse effects to listed fish.

Suckers as a group (family Catostomidae) appear to be susceptible to many of the same deleterious effects from electroshocking that were described above for salmonids (Snyder 2004). Although records of the effects by electroshock to shortnose suckers have not been compiled, responses by river carpsucker, longnose sucker, white sucker, and razorback sucker among others indicate that they are particularly susceptible to spinal injuries and hemorrhages by electrofishing (Snyder 2004). Reclamation has salvaged fish from canals throughout the Klamath Project each fall since 1991 following dewatering using electrofishing techniques (Reclamation 2008). Reclamation has noted that if electrofishing is found to injure juvenile suckers, they would pursue other techniques to salvage fish (Reclamation 2008). Sucker mortalities (Lost River suckers, shortnose suckers, and Klamath largescale suckers) have occurred during salvage operations, whether due to electrofishing stress or to low levels of DO (Peck 2000 and 2001). Reclamation has also done annual fish salvages in the forebay of a fish screen facility using backpack electrofishers and beach seines. This annual salvage procedure alleviates potential mass mortality of all fish at the fish screen as water is removed (Reclamation 2007).

All methods of capture and holding have risks of stress, injury, or mortality of fish. In conjunction to implementation of the *Fish Salvage Plan,* Pacific Connector would contract with either ODFW or a qualified consultant to capture the fish. Fish removal personnel would be approved by ODFW and NMFS for this listed species. Personnel who would handle and/or remove fish on federal lands would also be approved by the Forest Service or the BLM, or the work would be done directly by agency personnel if approved by ODFW. Overall, some listed juvenile shortnose sucker may suffer injury or mortality, but with the implementation of conservation measures the numbers would be slight.

Acoustic Shock and Underwater Noise

There would be no blasting or use of mounted hydraulic impact hammer to cross the Lost River where shortnose suckers may be present or any of the 31 ditches with potential species presence included in table 3.5.5-2. Use of back-hoes for dry open-cut construction would not produce sound levels to cause harm to shortnose suckers, as discussed for SONCC coho salmon in section 3.5.3.3.

Riparian Vegetation Removal, Modification, and LW Loss

Aquatic resources, including shortnose suckers and their habitat components, could be affected as a result of removal of vegetation and in-stream habitat at the waterbody crossing sites as required for construction. Short-term physical habitat disruption would occur during trenching activities. Long-term degradation of habitats could occur if the stream contours are modified in the area of the crossing, the flow patterns are changed, or erosion of the bed, banks, or adjacent upland areas introduces sediment into the waterbody. Loss of riparian vegetation along the banks would remove an important source of terrestrial food for aquatic organisms; and potentially increase mass slope failures adjacent to waterbodies.

Because HDD would be used to cross the Klamath River, only 0.04 acre (Urban or Built-up land) within the Klamath River riparian zone (extending 117 feet or one site-potential tree height from each river bank) would be affected. No forested riparian vegetation would be affected. Construction across the Lost River would disturb approximately 1.35 acres of agricultural land within the riparian zone (extending 119 feet from each river bank). Similar to the Klamath River crossing, no forested riparian vegetation would be affected or removed and all effects would be to agricultural land. Riparian zones associated with the Klamath River and Lost River crossings are on land owned by the State of Oregon. Riparian Zones for all other waterbodies crossed that are within range of the shortnose sucker are on private lands. All crossings other than the Klamath River and Lost River are on intermittent streams/ditches/canals with very limited low-growing riparian vegetation and would have unsubstantial reduction in near-stream vegetation from crossing clearing. Likewise, as there are few trees in the riparian area along the route in the range of the shortnose sucker, there would be no change in LW supply to any stream system from construction of right-of-way clearing or maintenance.

Overall, there would be no substantial change in riparian vegetation or LW supply along the route where shortnose sucker may be present. As a result, ecological function (e.g., supply of shade, future LW, and organic input) of the riparian conditions would be maintained and adverse effects to the shortnose sucker would not occur from right-of-way clearing at stream crossings.

Water Temperature

Shortnose suckers are susceptible to water temperatures 85°F or higher (Bellerud and Saiki 1995) but prefer water temperatures between 60 and 77°F (FWS 2007f). As discussed above, no riparian vegetation would be removed that otherwise would provide shade. Consequently, water temperature would not be affected by construction in the Lost River and Klamath River.

Aquatic Habitat

There also are potential indirect effects to aquatic habitat from increased suspended sediment from stream crossings. As discussed for SONCC coho salmon, suspended sediment released during stream crossing construction may have downstream habitat effects as well as direct fish effects such as changing substrate conditions (e.g., elevated fines) that may affect benthic food resources. Only one stream, the Lost River, is known to be crossed with stream bottom substrate-disturbing activities during flowing periods; 31 ditches with potential for species included in table 3.5.5-2 are expected to be crossed in the dry and could have suckers present in the crossing area. Estimates of sediment generated by dry open-cut construction along other portions of the Pipeline route and implementation of BMPs would not result in short-term sediment elevations that could have substantial downstream adverse habitat effects that would indirectly affect the shortnose sucker or the species habitat.

Freshwater Stream Invertebrates

Substrates downstream from in-stream construction sites could be impacted by sediments which could affect forage species used by shortnose suckers. Mayflies, caddisflies, and stoneflies prefer large substrate particles in riffles and are adversely affected by fine sediment deposited in interparticulate spaces (Cordone and Kelley 1961; Waters 1995; Harrison et al. 2007). Suckers feed on benthic organisms including algae and invertebrates so reductions could affect their growth and survival. Fish and benthic macroinvertebrate abundance downstream of pipeline construction sites have been reported as short-term reductions (Reid and Anderson 1999). Macroinvertebrate abundance and community composition are highly related to the degree to which substrate particles are embedded by fine material (Birtwell 1999). Data below wet open-cut crossings, which generate much higher sediment levels than dry-cut crossings, generally showed negative changes in benthic invertebrate populations were not apparent within a year (Reid et al. 2008) and some data indicated rapid recolonization of substrate within 30 days (Gartman 1984). Therefore, the overall level of effect of the pipeline crossings on waterbodies crossed by dry open-cut (the Lost River and 31 ditches) with known or potential species presence included in table 3.5.5-2 (unless crossing sealing failures at isolation structures occur), would be even less than those noted by literature and would not result in substantial reduction in growth or survival of listed shortnose sucker individuals.

Streambank Erosion and Streambed Stability

Clearing and grading activities during construction could increase erosion along streambanks resulting in higher turbidity levels in the waterbodies crossed. Alteration of the natural drainage ways or compaction of soils by heavy equipment near streambanks during construction may accelerate erosion of the banks, runoff, and the transportation of sediments into waterbodies. Erosion, sedimentation, and higher turbidity levels related to the Pipeline Project could affect aquatic resources in waterbodies crossed by dry open-cut (the Lost River and 31 ditches) with known or potential species presence (included in table 3.5.5-2). The degree of impact on aquatic organisms due to erosion would depend on sediment loads, stream velocity, turbulence, streambank composition, and sediment particle size.

Alteration of the natural drainage ways or compaction of soils by heavy equipment near streambanks during construction may accelerate erosion of the banks, runoff, and the transportation of sediments into waterbodies. The degree of impact on aquatic organisms due to erosion would depend on sediment loads, stream velocity, turbulence, streambank composition, and sediment particle size. To minimize these impacts, Pacific Connector would use temporary equipment bridges, mats, and pads to support equipment that must cross the waterbody (perennial, intermittent, and ephemeral if water is present) or work in saturated soils adjacent to the waterbody. Pacific Connector would also install sediment barriers, such as silt fence and straw/hay bales, across the right-of-way at the edge of waterbodies throughout construction except for short periods when the removal of these sediment barriers is necessary to dig the trench, install the pipe, and restore the right-of way. Practices to minimize streambank erosion are provided in the ECRP (see appendix F).

The FWS expressed concerns that more detailed site-specific information on bank material, streambed composition, shoreline vegetation, and other information is needed to adequately ensure that actions occurring at a stream crossing do not significantly increase streambank erosion and streambed instability. Pacific Connector, in response to these requests, conducted an assessment of crossing conditions of all streams suitable for analysis based on the FWS risk matrix (GeoEngineers 2017d and 2017e). As discussed for SONCC coho salmon, Pacific Connector used this matrix to rate crossings for risk of potential stream bank and channel changes. Based on the GeoEngineers (2017d and 2017e) Risk Matrix analysis, the Lost River crossing has a “high” level of risk based on existing stream site sensitivity based on the landscape/stream type (channel characteristics), riparian conditions (essentially none), and bed conditions (sand). If any crossing is moved into the “high” impact and “high” stream response risk matrix category, a site-specific crossing design would be developed for that site. Construction would then move forward as described in the permit documents including implementation of special additional BMPs, as described in GeoEngineers (2017d and 2017e), depending on individual site conditions and may include such actions as changes in bank material and bank angle modifications, specific substrate composition used, plants used on the bank, artificial stabilizing bank material, rootwad enhancement, and various other actions. These actions would reduce but not completely eliminate potential adverse effects from bank and bed stability to the listed shortnose sucker.

As a follow-up measure to help ensure crossing actions would not adversely affect stream bank and channel structure, Pacific Connector would monitor stream crossings to ensure long-term success of the restoration, maintenance of fish passage, and to identify channel erosion, scour or migration that could destabilize the site or expose the pipeline. The details of the monitoring plan for stream crossings is presented in section 3.5.3.3 (SONCC Coho Salmon ESU). Overall, these actions would reduce potential adverse effects from bank and bed stability to listed Shortnose to discountable levels.

<u>Hydrostatic Testing</u>

Water would be required on a one-time basis near the end of construction to hydrostatically test the pipeline. Potential impacts associated with hydrostatic testing include entrainment of fish; transfer of exotic organisms between basins; reduced downstream flows and impaired downstream uses if test water is withdrawn from surface waters; and erosion, scouring, and release of chemical additives as a result of test water discharge. Pacific Connector would obtain its hydrostatic test water from commercial or municipal sources or surface water rights owners, the sources of which are lakes, impoundments, and streams.

Within the range of the shortnose sucker, there are two potential water sources, Klamath River and Lost River. About 4.8 million gallons of water would be withdrawn from these sources for hydrostatic testing. There are four potential discharge locations, all of which are within the TEWA of the right-of-way. None of the hydrostatic test break sections are in the vicinity of a waterbody with known shortnose sucker occupancy or critical habitat. The largest withdrawal is proposed from the Klamath River. Water withdrawn from the Klamath River would be from designated critical habitat for shortnose suckers. As with Lost River suckers, water withdrawals from occupied habitats risk entrainment and impingement. The screening of intake hoses would be used to prevent the entrainment of fish and other aquatic organisms, meeting NMFS screening criteria. The rate of withdrawal would also be regulated to avoid adverse impact on aquatic resources or downstream flows (NMFS 1997c).

Pacific Connector would minimize the potential effects of hydrostatic testing by adhering to the measures in its *Hydrostatic Test Plan* (see appendix U). Where test water cannot be returned to its withdrawal source, the water would be treated and discharged to an upland location (at least 150 feet from wetlands or waterbodies with no direct discharge to these features) through a dewatering device at a rate to prevent scour and erosion and to promote infiltration. Pacific Connector would obtain all necessary appropriations, withdrawal, and discharge permits through the OWRD.

With the implementation of the *Hydrostatic Test Plan* and BMPs and by obtaining required permits, adequate measures would be in place to prevent direct or indirect effects of hydrostatic testing to shortnose sucker that may be in some of the stream systems.

Aquatic Nuisance Species

NAS are aquatic species that degrade aquatic ecosystem function and benefits, in some cases completely altering aquatic systems by displacing native species, degrading water quality, altering trophic dynamics, and restricting beneficial uses (Hanson and Sytsma 2001). Currently, there are 180 reported NAS in Oregon, of which 134 are documented within the USGS hydrologic basins crossed by the Pipeline (USGS 2017).

In the riverine environments crossed by the Pipeline, largemouth and smallmouth bass, introduced as recreational species, prey on juvenile sockeye, coho, and Chinook salmon (Tabor et al. 2007). Additionally, up to 20 exotic species (many of which can reside in streams including largemouth bass, yellow perch, and fathead minnow) are present in the range of shortnose sucker and are suspected to compete and prey on them (FWS 2013m). Management priorities in Oregon concentrate on aquatic nuisance species, which are the species whose current or potential impacts on native species and habitats and economic and recreational activity in Oregon are known to be significant (Hanson and Sytsma 2001). Some of the major potential freshwater invasive species are Chytrid fungus and mussels, including the zebra and quagga mussels (*Dreissena polymorpha*, and *Dreissena rostriformis bugenisis*).

Aquatic nuisance species could potentially be introduced into Pipeline Project area waters by interbasin transfer of hydrostatic testing water or by being carried on equipment that is moved from outside of the region or between basins. Pacific Connector has developed BMPs and guidelines to avoid the potential spread of aquatic invasive species (see *Hydrostatic Test Plan* in appendix U*)* in consultation with the BLM and Forest Service as well as with ODEQ and the Center for Lakes and Reservoirs and Aquatic Bioinvasion Research and Policy Institute (Portland State University).

If determined to be feasible, all water used in hydrostatic testing would be returned to its withdrawal source location after use; however, cascading water from one test section to another to minimize water withdrawal requirements may make it impractical to release water within the same watershed where the water was withdrawn. If it is not possible to return the water to the same basin from which it was withdrawn, Pacific Connector would employ an effective and practical water treatment method (chlorination, screening/filtration, or other appropriate method) to disinfect the water that would be transferred across basin boundaries. The hydrostatic test water would be treated after it is withdrawn and prior to hydrostatic testing.

As explained in the *Hydrostatic Test Plan*, Pacific Connector proposes to use a treatment of 2 ppm or 2 mg/l of free chlorine residual with a detention time of 30 minutes to treat all non-municipal surface waters that would be used as a water source for hydrostatic testing purposes. Chlorinated water would be released according to ODEQ criteria to prevent water quality impacts, potential effects to aquatic species, and minimize potential impacts to sensitive areas. These procedures would also be used for equipment used between water bodies, and would include the inspection and cleaning of waterbody crossing equipment (including flume pipes, pumps hoses, screens, or other materials) and equipment that may be moved from waterbody to waterbody crossings to ensure it is free of dirt, grease, oil, or other pollutants prior to installation; equipment would be steam cleaned, if necessary. Forms of chemical treatment (e.g., bleach solutions) may be used as needed. The procedures are outlined in Attachment C to the *Hydrostatic Test Plan* (appendix U). Additional supplemental invasive species protective actions for cleaning of equipment used among waterbodies was developed by ODFW specifically for this Project and have been incorporated by Pacific Connector in their *Hydrostatic Test Plan*.

Some items in the *Hydrostatic Test Plan* that would aid in ensuring invasive aquatic species are not transported between streams, including preventing the spread of quagga and zebra mussels, New Zealand mudsnail, and aquatic plant invasion, are:

1. Clean all aquatic plants, animals, and mud from vehicles, boats, motors or trailers and discarding the debris in the trash. Rinsing, scrubbing, or pressure washing should occur away from storm drains, ditches, or waterways.
2. Drain live wells, bilge, and all internal compartments.
3. Dry equipment including boats between uses, if possible (leaving compartments open and sponging out standing water).
4. Scrub or pressure wash life jackets, waders, boats, landing nets, and other gear that comes in contact with the water.
5. Clean and sanitize as needed which may include heated power wash before moving establishing sanitizing areas away from areas where it may enter surface water including use of bleach solution and run through portable pumps for 10 minutes.
6. Inspect everything for signs of aquatic invasive species before launching and before leaving.

With the implementation of these procedures and others, the potential for dispersal of aquatic nuisance organisms by other construction equipment and vehicles from one basin to another is remote. The BMPs in the noxious weed control procedures outlined in the ECRP (see appendix F) and the IPM (see Appendix N to the POD [appendix B to this BA]) would be employed to prevent the introduction and spread of invasive species from construction. With the implementation of these measures, introduction of nonnative species or movement of species between basins should not occur, resulting in no adverse effects to the listed shortnose sucker.

Fuel and Chemical Spills

Fisheries habitats could be adversely affected if petroleum products were accidentally discharged into aquatic environments including waterbodies crossed by dry open-cut (the Lost River and 31 ditches) with known or potential species presence that are included in table 3.5.5-2. Such materials are toxic to algae, invertebrates, and fish. Of the products likely to be present during construction, data compiled from a wide range of sources indicate that diesel fuels and lubricating oils are considerably more toxic to aquatic organisms than other, more volatile products (gasoline) or heavier crude oil (Markarian et al. 1994). For example, one study reported that release of diesel fuel in freshwater habitats significantly reduced aquatic invertebrate densities and species richness at least three miles downstream but invertebrate densities recovered within a year (Lytle and Peckarsky 2001). Impacts to aquatic habitats that primarily affect aquatic substrates—hence spawning, incubating, and rearing habitats—can remain for much longer periods (Markarian et al. 1994).

Equipment used for construction across waterbodies could potentially release hydraulic fluid comprised of a variety of compounds, the most common of which are mineral oil-based, organophosphate esters, and polyalphaolefins (HHS 1997). Release from machinery can occur through faulty seals, hoses, sumps and reservoirs, or general system failure.

Inadvertent spills of fluids used during construction, such as fuels and lubricants, could contaminate wetland soils and vegetation if not sufficiently contained. To minimize the potential for spills and any impacts from such spills, Pacific Connector's SPCCP (see appendix L) would be implemented. In general, hazardous materials, chemicals, fuels, lubricating oils, and concrete-coating activities would not be stored, nor would refueling operations be conducted, within 100 feet (150 feet on BLM and NFS lands) of a wetland or waterbody in accordance with FERC's *Procedures* (see appendix C) and the SPCCP (see appendix L) except where no reasonable location is possible and additional containment steps have been taken. The SPCCP would be updated with site-specific information prior to construction. Adherence to these plans and procedures would prevent substantial adverse effects to the listed shortnose sucker from Project-related oil product uses.

Runoff from Facility Surfaces

There are nine contractor and pipe storage yards, one rock source and disposal site, two new temporary access roads, two new permanent access roads, and three aboveground facilities including the Klamath Compressor Station within the range of shortnose suckers.

Two of the yards, K-Falls Memorial Dr 1 Yard and K-Falls Memorial Dr 2 / Bair Yard, border the Klamath River, and the K-Falls - Industrial Oil Yard is about 235 feet from the Klamath River which is designated critical habitat for shortnose suckers. The Klamath Compressor Station is about 700 feet from the T Canal, for which there are no records of shortnose sucker being present (construction and operation of the compressor station would not affect suckers even if present).

Stored materials at the yards may include: construction mats, fencing materials, fuel and lubricants, stormwater control materials (straw bales, erosion control fabric, silt fence materials, etc.), and other construction materials. The yards would also be used for contractor office trailers and employee parking facilities. Although the yards are previously disturbed industrial sites, there is some unknown level of risk that stored materials and surface runoff could enter shortnose sucker critical habitat. Runoff from any of these sites would be mitigated through measures provided in Pacific Connector's ECRP (see appendix F).

Operation and Maintenance Activities

Once installed, maintenance of the pipeline would include activities such as aerial inspections, gas flow monitoring, visual inspection of surrounding vegetation for signs of leaks, and integrity management, which includes smart pigging to investigate the interior surface of the pipe for any signs of stress cracking, pitting, and other anomalies (see the ECRP, appendix F). All of the proposed maintenance activities would be outlined in the Operations and Maintenance Plan that would be prepared according to operating regulations in USDOT 49 CFR Subpart L, Part 192 and would be completed prior to the Pipeline going in-service. These general maintenance activities would require only surface activities and usage of the existing right-of-way, such as insertion of the pig at one of the pig launching facilities.

The potential stream channel disturbance would occur if an integrity issue with the pipeline were found at a crossing location. If this were to occur, the pipeline would need to be unearthed within the right-of-way and repair work done in-water. Within stream sites, repair work could require isolated flow from the section of pipe that is to be exposed. Typically, repairs would be made to the pipe within the right-of-way (within the trench) or, depending on the site-specific conditions and nature of the repair needed, a reroute around the affected section may be considered.

Impacts would be similar to those discussed above for initial installation except on a much smaller scale because they would only involve one crossing compared to many crossings. However, should repairs be needed out of the standard stream crossing window (i.e., during periods of fish spawning or egg incubation) there would be additional adverse effects to key fish resources at the specific site. The actions would include all relevant BMPs and mitigation, dependent upon site conditions and land ownership. Any future repairs would require additional permit approval from appropriate state and federal agencies which would determine the acceptable parameters of these actions. Such pipeline integrity-based in-water projects are very infrequent.

Vegetation maintenance would be limited adjacent to waterbodies to allow a riparian strip to permanently revegetate with native plant species across the entire right-of-way. To facilitate periodic pipeline corrosion/leak surveys, a corridor centered on the pipeline and up to 10 feet wide would be maintained in an herbaceous state, with scrubs outside of this 10 foot corridor. In addition, trees that are located within 15 feet of the pipeline may be cut and removed from the right-of-way. No vegetation or tree limitations would occur beyond the 30 foot wide corridor in riparian areas (i.e., up to 100 feet of streams on federal lands and up to 25 feet of streams on non-federal lands). Since most native riparian vegetation along the Pipeline route has been altered by agriculture, the effects of maintaining the 30-foot-wide corridor on Lost River sucker in-stream habitat would be minimal.

Herbicide Application

Herbicides have the potential to cause toxic effects to different sucker life stages and to other aquatic species, causing direct impacts, if used improperly. When herbicides are properly used according to label restrictions and BMPs to control noxious weeds, there is little to no chance of causing injury or mortality to fish or other aquatic organisms.

Pacific Connector would not use herbicides for routine vegetation maintenance. However, following construction, Pacific Connector would implement its IPM (Appendix N to Pacific Connector's POD [appendix B to this BA]) that addresses control of noxious weeds and invasive plants across the Pipeline Project which would include the selective use of herbicides where necessary to control noxious weeds by limited application from the ground, where allowed by landowners. The IPM was developed in consultation with the ODA, BLM, and Forest Service. The BMPs would minimize the potential spread of invasive species and minimize the potential adverse effects of control treatments. Herbicides would not be applied by aerial or broadcast spraying. Noxious weeds would be removed only by manual methods in the riparian zone adjacent to streams, ditches and canals within the range of shortnose suckers. Pacific Connector would not directly spray, or otherwise apply, herbicides in waterbodies or in riparian zones. The risk of drift would be avoided by selectively applying herbicides from the ground.

Where weed control is necessary along the construction right-of-way, Pacific Connector's first priority would be to employ hand and mechanical methods (pulling, mowing, biological, disking, etc.) applicable to the species to prevent the spread of potential weed infestations, where feasible. To determine if an herbicide is to be used over other control methods, Pacific Connector would base the decision on weed characteristics and integrated weed management principles (Forest Service 2005). If herbicides are used to control noxious weed infestations, they would be used when they are the most appropriate treatment method. Spot treatments and the use of selective herbicides would be utilized to minimize impact to native or non-target species. Permits or approvals for the use of herbicides and adjuvants on federal lands would be obtained prior to use/treatment, as detailed in the IPM (see Appendix N to the POD [appendix B to this BA]). Considering the potential for limited use of herbicides along the route and precautions that would be in place to prevent entry into waters, meaningful negative effects to the shortnose sucker from herbicides would be unlikely to occur.

Critical Habitat

Designated critical habitat for the shortnose sucker is present within the Pipeline Project area. The Pipeline would cross the Klamath River at RM 249, which is within CHU 1, Klamath County (FWS 2012i). CHU 1 includes Upper Klamath Lake and Agency Lake, together with some wetland habitat; portions of the Williamson and Sprague Rivers; Link River; Lake Ewauna; and the Klamath River from the outlet of Lake Ewauna downstream to Keno Dam. Some or all of the three PCEs noted above (water, spawning and rearing habitat, and food) could be affected during the HDD across the Klamath River if an inadvertent return occurred with release of drilling mud into the water column; the same effects to critical habitat that were described under *Direct and Indirect Effects*, above, would occur.

Only 0.04 acre within the Klamath River riparian zone (extending 117 feet or one site-potential tree height from each river bank) would be affected by construction, and all of that area is in an existing industrial facility.

3.5.6.4 Conservation Measures

Conservation measures have been proposed by Pacific Connector to minimize construction and operation impact to waterbodies and riparian zones within the riverine analysis area. Those measures have been compiled in table 2C in appendix N and apply to shortnose suckers.

Pacific Connector has also proposed measures to rectify, repair, and rehabilitate and otherwise reduce impact to waterbodies and riparian zones once construction of the Pipeline is complete. Those measures have been compiled in table 3C in appendix N.

Details of some of the major conservation measures to be implemented by Pacific Connector are the same as those provided in section 3.5.5.4 for the Lost River sucker.

Overall, these actions would reduce but not completely eliminate potential adverse effects from bank and bed stability to the listed shortnose sucker.

3.5.6.5 Determination of Effects

Species

The Project **may affect** shortnose suckers because:

- shortnose suckers occur within the Upper Klamath River and Lost River subbasins, which would be affected during construction of the proposed action.

The Project is **likely to adversely affect** shortnose suckers because:

- there is a possibility that shortnose suckers could occur within the Lost River when it would be crossed by the Pipeline and be affected by elevated suspended sediment levels;
- shortnose suckers could occur in 19 waterbodies crossed by dry open-cut construction in the Lake Ewauna-Klamath River watershed and in 13 waterbodies west of MP 214.38 (including the Lost River) crossed in the Mills Creek-Lost River watershed and be indirectly affected by elevated suspended sediment levels, streambank erosion and stability, and aquatic nuisance species introductions; and
- adults and juveniles subject to fish salvage within the isolated construction site at 31 ditches crossed by dry-open cuts and the Lost River could be affected if electroshocking is used and stressed if seining is used.

Critical Habitat

The Project **may affect** designated critical habitat for the shortnose sucker because:

- there may be a low risk of hydraulic fracture resulting in inadvertent release of drilling mud during the HDD into the Klamath River.

However, the Project is **not likely to adversely affect** designated critical habitat for the shortnose sucker because:

- HDD would avoid critical habitat in the Klamath River.
- the potential for hydraulic fracture during HDD drilling is so unlikely as to be discountable; and

- in the event of released bentonite, corrective actions would contain and temporally limit drill mud volumes.

3.6 INVERTEBRATES

3.6.1 Vernal Pool Fairy Shrimp

Vernal pool fairy shrimp (*Branchinecta lynchi*) are small crustaceans, usually less than 2.4 cm (1 inch) long that live for only one season while there is water in a vernal pool. They can be found from Tulare County, California, north into Jackson County, Oregon.

3.6.1.1 Species Account and Critical Habitat

Status

On September 19, 1994, the final rule to list the vernal pool fairy shrimp as threatened was published in the Federal Register (FWS 1994b). In 2003, the FWS designated 839,460 acres of critical habitat for this species (FWS 2003b). In 2005, FWS (2005f) reevaluated the economic exclusions made in the 2003 final rule and excluded approximately 241,640 acres of land from the final 2003 designation for economic reasons. In 2006, the FWS produced species-specific unit descriptions and maps for the 597,821 acres of critical habitat designated for the vernal pool fairy shrimp, which included 7,574 acres of critical habitat in Jackson County, Oregon (FWS 2006e).

Threats

The FWS identified significant threats to vernal pool fairy shrimp by urbanization, conversion of wetlands to agriculture, indirect impacts from timber operations, grazing, mining, OHV use, road construction, right-of-way designation, hazard mitigation and post-disaster repairs, and other man-made changes in hydrologic patterns. Other factors noted as threats to vernal pool fairy shrimp include stochastic events, which can have disproportionate effects on small, isolated populations and may result in local extirpations. Pools and pool complexes supporting vernal pool fairy shrimp are usually small, and unforeseen natural and human-caused catastrophic events threaten some sites (FWS 1994b).

In many cases, vernal pool complexes inhabited by the shrimp occurred on private land in areas of proposed or ongoing road, utility, residential, and commercial developments; the FWS was concerned that landowners could knowingly destroy vernal pool habitats (FWS 1994b, 2005e, and 2012j). Vernal pool contamination from runoff of surrounding areas may also injure or kill vernal pool fairy shrimp (FWS 2006e).

Species Recovery

In November 2012, the FWS finalized a recovery plan for vernal pool species within the Rogue River and Illinois Valleys (FWS 2012j). The recovery plan (FWS 2012j) takes an ecosystem-based approach for recovery of three federally listed species, including the vernal pool fairy shrimp, and seven other rare species, and includes more Oregon-specific direction for recovery of the vernal pool fairy shrimp than previously provided in *The Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon* (FWS 2005e).

The recovery goal specific to the vernal pool fairy shrimp is (FWS 2012j):

- Recover the vernal pool fairy shrimp within its Klamath Mountains Recovery Zone (Agate Desert, Table Rocks, and White City area).

The recovery objectives included in the recovery plan are (FWS 2012j):

- Stabilize and protect populations of the vernal pool fairy shrimp within its Klamath Mountains Vernal Pool Region so further decline in species status and range are prevented.
- Minimize or eliminate the threats that caused the species to be listed and any newly identified threats.
- Conduct research necessary to refine downlisting and recovery criteria.
- Promote natural ecosystem processes and functions by protecting and conserving intact vernal pool-mounded prairie complexes and seasonally wet meadows within the recovery planning area.

The recovery plan includes the following delisting criteria for vernal pool fairy shrimp in the Klamath Mountain Region (FWS 2012j):

- At least 80 percent (9 of 11) of the occurrences within the Klamath Mountain Vernal Pool Region have been protected.
- At least 85 percent of suitable vernal pool habitat within the Klamath Mountain Vernal Pool Region has been protected.
- Develop and implement habitat management and monitoring plans that facilitate maintenance of vernal pool ecosystem function, especially hydrology function that contributes to population viability for all protected habitat.
- Cyst banking actions have been completed for the vernal pool fairy shrimp from at least one population in each of the three major core area groups (Agate Desert, Table Rocks, and White City).
- Status surveys, five-year status reviews, and population monitoring show vernal pool fairy shrimp populations within the Klamath Mountain Vernal Pool Region are viable (self-sustaining) and have been maintained (stable, increasing, or showing only minor declines from high population levels) for a 10-year monitoring period.

The recommended recovery and long-term conservation actions are (FWS 2012j):

- Protect vernal pool, wet meadow, and sloped mixed-conifer forest habitats.
- Manage, restore, and monitor vernal pool and wet meadow habitat.
- Conduct rangewide population status surveys.
- Conduct research essential to the conservation and recovery of the species.
- Enhance public awareness and participation in the recovery of the species.
- Develop a post-delisting monitoring plan.

Life History, Habitat Requirements, and Distribution

This freshwater crustacean is endemic to California and the Agate Desert of southern Oregon. The vernal pool fairy shrimp has an ephemeral life cycle and only inhabits vernal pools, or seasonal wetlands that fill with water during fall and winter rains. They are known to occupy a variety of vernal pool habitats, from small, clear, sandstone rock pools to large, turbid, alkaline, grassland valley floor pools. Vernal pools in which the shrimp has been collected have water temperatures ranging from 40 to 73°F, with low to moderate amounts of salinity or total dissolved solids (FWS 2005e). Individuals hatch from cysts during winter storms and require water temperatures of 50°F or lower to hatch. The time to maturity and reproduction is dependent on temperature, ranging between 18 and 147 days, with a mean of 39.7 days. The shrimp can die when water temperatures rise to about 75°F. Flooding and wildlife movement within and between vernal pool complexes allow the shrimp to disperse between individual pools, indicating that vernal pool fairy shrimp populations are defined by entire pool complexes, rather than individual pools (FWS 2007g).

Vernal pool fairy shrimp are found in 28 counties across the Central Valley and Coast ranges of California, and the inland valleys of southern California and southern Oregon (FWS 2005e). The shrimp was discovered in Jackson County, Oregon in 1998 at two distinct vernal pool habitats: on alluvial fan terraces associated with Agate-Winlo soil complexes in the Agate Desert, and in the Table Rocks area on Randcore-Shoat soil complexes underlain by lava bedrock (FWS 2005e). In Oregon, the vernal pool fairy shrimp is associated with the same vernal pool habitats as the large-flowered woolly meadowfoam and Cook's lomatium plant species (discussed below). The Agate Desert comprises the northern extent of the vernal pool fairy shrimp's range (FWS 2005e), where vernal pool fairy shrimp are located on non-federal lands in three small Nature Conservancy Preserves totaling 297 acres, and within the 720-acre ODFW's Denman Wildlife Management Area (FWS 2007g). The vernal pool fairy shrimp was identified relatively recently (in 1990) and was not discovered in Jackson County, Oregon until 1998 (FWS 2005e). As a result, it is possible that additional locations for the species will be found in Oregon in the future (FWS 2005e).

Population Status

Actual numbers of fairy shrimp are not available, given their short lifespan and the nature of their reproduction (FWS 2012j); therefore, population (or species distribution) can only be inferred from the loss of vernal pool habitat. The historical distribution of vernal pool fairy shrimp is not known, especially in the Agate Desert in Oregon where it was recently discovered in 1998. However, it is estimated that vernal pool habitat in the Agate Desert has likely declined by 75 percent from historical extent (FWS 2007g). Additionally, over 40 percent of the vernal pool habitats remaining in Oregon have been degraded. Vernal pool fairy shrimp have been documented in 50 percent of the pools sampled in the Agate Desert Preserve, which is the highest percentage compared with other locales where the species is found (i.e., California) (FWS 2005e).

Critical Habitat

Within the Rogue Valley, 7,574 acres have been designated as critical habitat for the vernal pool fairy shrimp within the following quadrangles in Jackson County: Shady Cove, Eagle Point, Boswell Mountain, Brownsboro, and Sams Valley (FWS 2006e). The FWS (2003b) determined that two essential PCEs would apply to all critical habitat designated for vernal pool fairy shrimp:

1. vernal pools, swales, and other ephemeral wetland features of needed size and depth that become inundated during winter rains and hold water for the time necessary for life cycle completion, including but not limited to, Northern Hardpan, Northern Claypan, Northern Volcanic Mud Flow, and Northern Basalt Flow vernal pools; and
2. the geographic, topographic, and edaphic features that support systems of hydrologically interconnected pools, swales, and other ephemeral wetlands and depressions within a matrix of surrounding uplands that together form what are known as vernal pool complexes.

3.6.1.2 Environmental Baseline

Analysis Area

The analysis area extends 250 feet from the perimeter of four proposed pipe storage yards that are located within the Vernal Pool Complex – Agate Desert, Jackson County, Oregon where this species is known to occur (as shown in figure 3.6.1-1). This is a distance (250 feet) in which indirect effects from the proposed action could occur to vernal pools supporting this species (FWS 2011f). Additionally, similar to the botanical analysis area that is described below for vernal pool plant species (see large-flowered woolly meadowfoam, section 3.7.3.2), the analysis area for the vernal pool fairy shrimp extends 250 feet each side of the Pipeline Project (construction right-of-way, TEWAs) on lands that have potential habitat (Agate-Winlo soil complex) for the vernal pool fairy shrimp (figure 3.6.1-2).

Species Presence

Three proposed pipe storage yards (Burrill Lumber, Avenue F & 11th Street, and WC Short) are within proximity to federally-designated CHUs VERFS 3A and 3B in Denman Wildlife Management Area (WMA) and Agate Desert Preserve, and occur within the Agate-Winlo soil complex. A fourth proposed pipe storage yard (Rogue Aggregates) is 1 to 2 miles southwest/west of CHUs VERFS 4B and 3C (see figure 3.6.1-1) but does not occur within the Agate-Winlo soil complex. Surveys within CHUs in the vicinity of proposed pipe storage yards have documented vernal pool fairy shrimp. The most recent observations were in 2004 and 2005 where 15 to 25 percent of the vernal pools sampled were occupied by fairy shrimp (ORBIC 2017b):

- VERFS 3A (Denman WMA):
  - 2004: eight pools occupied out of 53 sampled.
  - 2005: one pool occupied out of 31 sampled.
- VERFS 3B (Agate Desert Preserve, Denman WMA):
  - 2001: 11 occupied out of 43 sampled.
  - 2002: 11 occupied out of 62 sampled.
  - 2003: 35 pools occupied out of 99 sampled (complete habitat survey).
  - 2004: 12 pools occupied out of 25 sampled.
  - 2005: 2 occupied out of 8 sampled.
- VERFS 3C (Whetstone Savanna Preserve):
  - 2001: 1 pool occupied out of 3 sampled.
  - 2002: 75 occupied out of 271 sampled.
  - 2003: 28 occupied out of 80 sampled.
  - 2004: no survey.
  - 2005: 0 occupied out of 7 sampled.
- VERFS 4B (Lower Table Rock ACEC, Medford BLM): 3 individuals observed in 2004.

In 2015, a survey protocol for Branchiopods, including vernal pool fairy shrimp, was published by the FWS (2015c). A complete survey consists of one wet season survey and one dry season survey conducted and completed within a 3-year period. Although potential vernal pool habitat that could be occupied by vernal pool fairy shrimp has been identified either through on-site surveys and/or off-site observations (table 3.6.1-1), no protocol vernal pool fairy shrimp surveys have been conducted for the Pipeline Project because of landowner access denial. Figure 3.6.1-3 identifies areas in the vicinity of the proposed pipe storage yards that have been evaluated for vernal pools on-site, areas that have been evaluated for habitat from off-site observations, and areas where vernal pool habitat was observed, and, where permitted, surveyed for large-flowered woolly meadowfoam or Cook's lomatium. At the time of ESA plant surveys, no surveys for vernal pool fairy shrimp were conducted; since ESA plant surveys, access to survey for vernal pool fairy shrimp and other species has been denied.

In 2007, SBS identified vernal pool habitat in and near possible pipe storage yards in Jackson County that could provide habitat for two federally listed plants (large-flowered woolly meadowfoam and Cook's lomatium, discussed in sections 3.7.3 and 3.7.4, respectively), as well as vernal pool fairy shrimp. Surveys for the federally listed plants occurred in the proposed Burrill Lumber pipe yard and Rogue Aggregates pipe yard in 2007; no vernal pools were identified in the two proposed pipe storage yards, although approximately 4.4 acres of high-quality suitable vernal pool habitat was observed 850 to 1,165 feet east of Burrill Lumber pipe storage yard where large-flowered woolly meadowfoam was documented (see figure 3.7.3-1 for large-flowered woolly meadowfoam; SBS 2008b).

No surveys within the Avenue F & 11th Street and WC Short pipe storage yards have been permitted by the landowner. Based on aerial photography and off-site observation in April 2018, Avenue F & 11th Street and WC Short pipe yard do not appear to contain vernal pools: Avenue F & 11th Street pipe yard is highly disturbed and graded, with railroad and docking facilities located on the southern edge of the yard, and WC Short pipe yard is an existing train yard that would assist moving and offloading pipe.

In addition to potentially suitable vernal pool habitat near proposed pipe yards in Jackson County, nine vernal pools (approximately 0.2 acre) within and adjacent to the proposed right-of-way (MPs 145.34 to 145.40) were identified on private lands during botanical surveys conducted in 2007 and 2008. The vernal pools were surveyed for Cook's lomatium and large-flowered woolly meadowfoam in 2007 and 2008, and no plants were observed (SBS 2008b). Although this area is outside of the known range for vernal pool fairy shrimp, and the closest known occupied habitat is located approximately 8.2 miles west in CHU VERFS 2B, the vernal pools may provide suitable habitat for the vernal pool fairy shrimp because the pools occur within the appropriate soils type (Agate-Winlo) for vernal pool fairy shrimp (see figure 3.6.1-2). However, since botanical surveys in 2007 and 2008, no additional surveys have been permitted; therefore, no wetland delineations according to appropriate protocols have been completed to confirm vernal pool (wetland) presence within and adjacent to the construction right-of-way between MPs 145.34 and 145.40, and no protocol surveys for vernal pool fairy shrimp have occurred in these potentially suitable vernal pools. Once survey access is permitted, Pacific Connector would conduct wetland delineations. If vernal pool habitat is confirmed during wetland delineations, Pacific Connector would conduct surveys for vernal pool fairy shrimp following the 2015 FWS survey protocol by a certified surveyor – one wet season survey and one dry season survey conducted and completed within a three-year period (FWS 2015c). Surveys would not commence until a permit to survey is acquired from the FWS. Pacific Connector will assume presence of vernal pool fairy shrimp until further surveys either determine no vernal pools present and/or protocol surveys for the fairy shrimp determine absence.

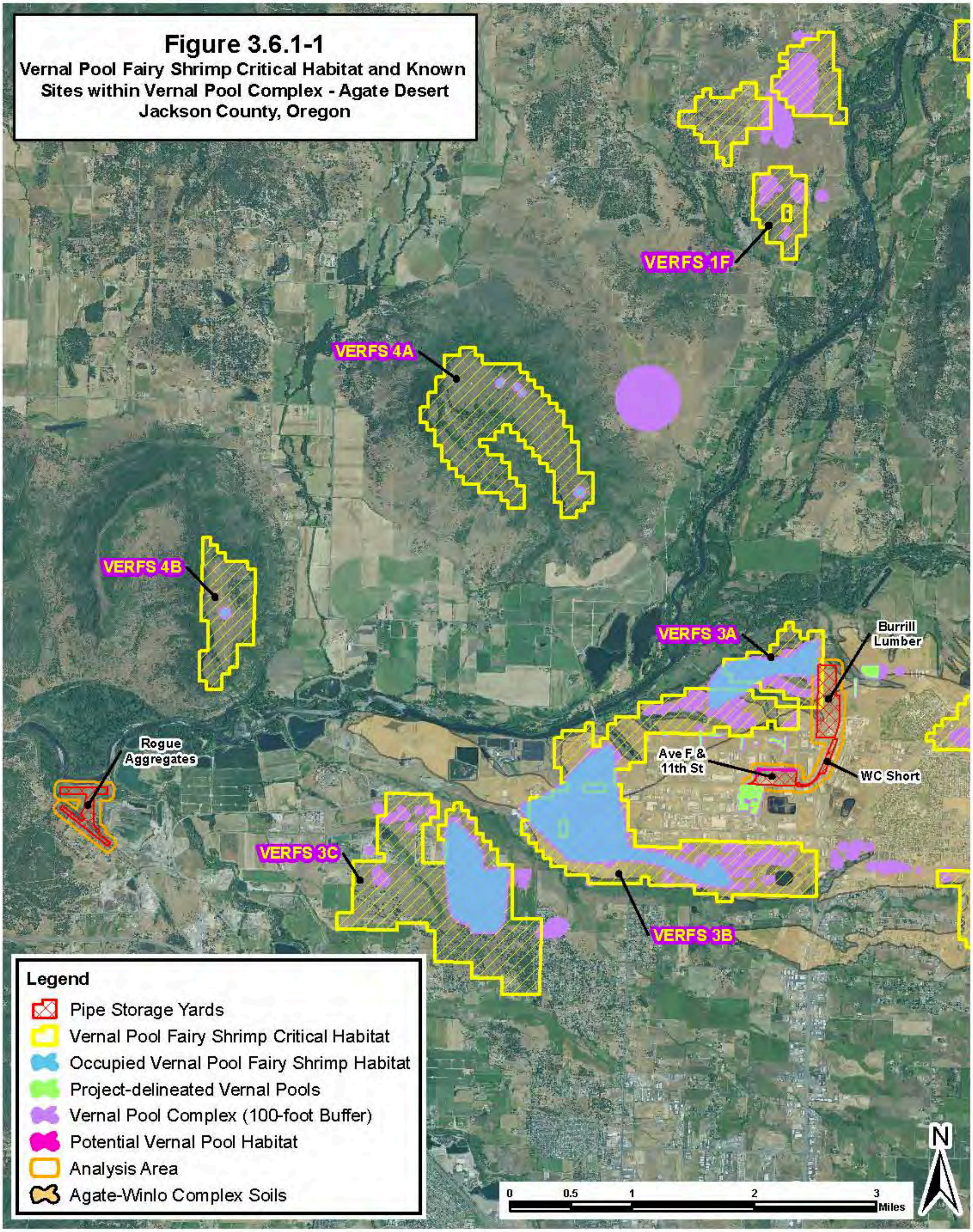


Figure 3.6.1-1
Vernal Pool Fairy Shrimp Critical Habitat and Known Sites within Vernal Pool Complex - Agate Desert
Jackson County, Oregon
VERFS 1F
VERFS 4A
VERFS 4B
VERFS 3A
Burrill Lumber
Rogue Aggregates
Ave F & 11th St
WC Short
VERFS 3C
VERFS 3B
Legend
Pipe Storage Yards
Vernal Pool Fairy Shrimp Critical Habitat
Occupied Vernal Pool Fairy Shrimp Habitat
Project-delineated Vernal Pools
Vernal Pool Complex (100-foot Buffer)
Potential Vernal Pool Habitat
Analysis Area
Agate-Winlo Complex Soils
0 0.5 1 2 3 Miles
N

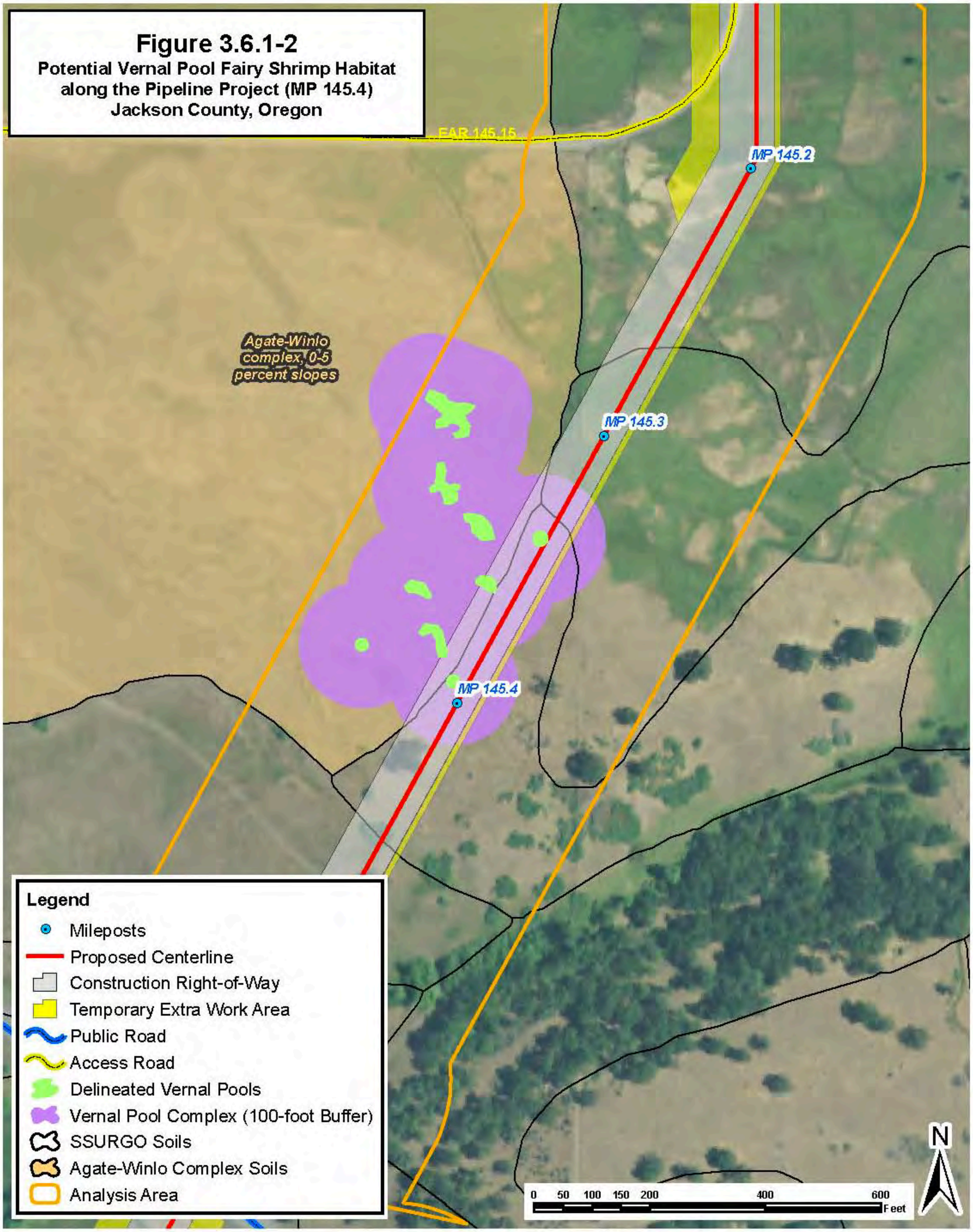


Figure 3.6.1-2
Potential Vernal Pool Fairy Shrimp Habitat along the Pipeline Project (MP 145.4) Jackson County, Oregon
EAR 145.15
MP 145.2
MP 145.3
MP 145.4
Agate-Winlo complex, 0-5 percent slopes
Legend
Mileposts
Proposed Centerline
Construction Right-of-Way
Temporary Extra Work Area
Public Road
Access Road
Delineated Vernal Pools
Vernal Pool Complex (100-foot Buffer)
SSURGO Soils
Agate-Winlo Complex Soils
Analysis Area
0 50 100 150 200 400 600
Feet
N

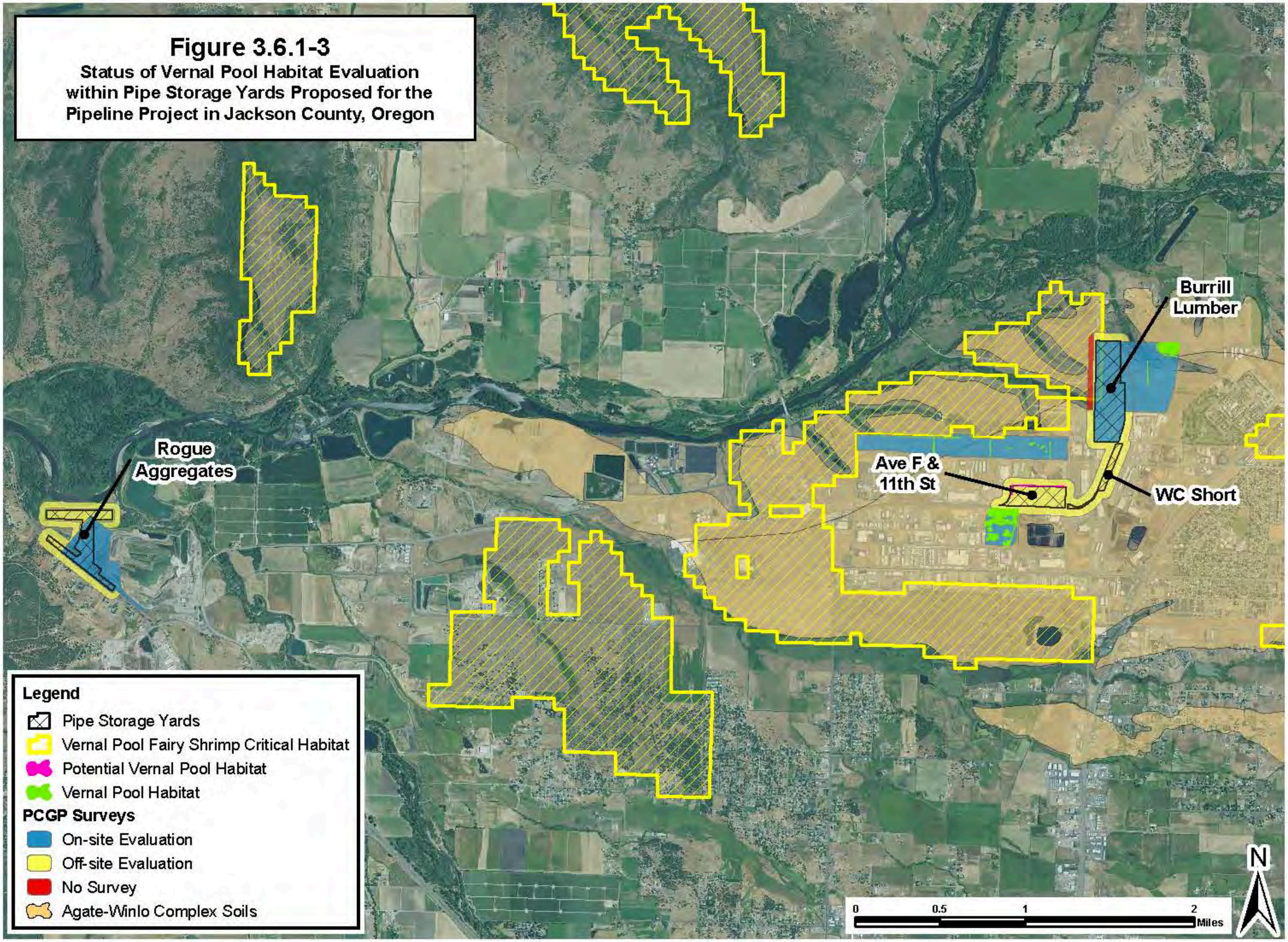


Figure 3.6.1-3
Status of Vernal Pool Habitat Evaluation within Pipe Storage Yards Proposed for the Pipeline Project in Jackson County, Oregon
Rogue Aggregates
Burrill Lumber
Ave F & 11th St
WC Short
Legend
Pipe Storage Yards
Vernal Pool Fairy Shrimp Critical Habitat
Potential Vernal Pool Habitat
Vernal Pool Habitat
PCGP Surveys
On-site Evaluation
Off-site Evaluation
No Survey
Agate-Winlo Complex Soils
0
0.5
1
2
Miles
N

TABLE 3.6.1-1

Summary of Habitat Evaluated for Potential Vernal Pool Habitat within the Analysis Area a/

General Landowner	Vernal Pool Habitat Status	Acres Surveyed for ESA Plants b/			Acres Not Surveyed c/		
		Project d/	Buffer e/	Total	Project d/	Buffer e/	Total
Jackson County Pipe Yards f/; MPs 145.3-145.4 (355 acres within botanical analysis area) e/							
Federal	Vernal Pool g/			0			0
	Vernal Pool Complex h/			0			0
	Not Habitat			0			0
	Total	*0*	*0*	*0*	*0*	*0*	*0*
Non-Federal	Vernal Pool g/	0.03	2.92	2.94	0.12	0.36	0.46
	Vernal Pool Complex h/	1.37	3.44	4.81	5.8	9.75	15.55
	Not Habitat	89.39	51.83	141.22	44.79	129.47	174.26
	Total	*90.79*	*58.18*	*148.97*	*50.71*	*139.58*	*190.29*
Total	Vernal Pool g/	0.03	2.92	2.94	0.12	0.36	0.46
	Vernal Pool Complex h/	1.37	3.44	4.81	5.8	9.75	15.55
	Not Habitat	89.39	51.83	141.22	44.79	129.47	174.26
	Total	***90.79***	***58.18***	***148.97***	***50.71***	***139.58***	***190.27***

a/ Area evaluated for vernal pool dependent ESA species analyzed in this BA (large-flowered woolly meadowfoam, Cook's lomatium, and vernal pool fairy shrimp) included habitat in Agate-Winlo soil complex, within 250 feet of proposed Pipeline components located in Jackson County; area was evaluated on-site, where permitted, or off-site from existing roads and/or 2016 aerial photography to identify vernal pool habitat. Surveys for botanical species occurred in vernal pools documented during on-site evaluations; no surveys have been conducted to-date for vernal pool fairy shrimp.

b/ Acres Surveyed for ESA plants: includes area within 250 feet of the Pipeline (right-of-way and pipe yards) that had habitat evaluated on-site for vernal pool habitat. Protocol surveys were conducted within identified vernal pool habitat for ESA botanical species (large-flowered woolly meadowfoam and Cook's lomatium); no surveys have been conducted to-date for vernal pool fairy shrimp.

c/ Acres Not Surveyed: includes areas evaluated off-site that were either denied access or are outside of the targeted survey area (Jackson County pipe yards); the majority of habitat that occurs within 250 feet of Jackson County pipe yards is industrial. Off-site observations identified potentially suitable vernal pool habitat (0.46 acre) that would require surveys once access is permitted; all other habitat is not suitable for ESA species. Area (acres) does not include suitable vernal pool habitat that occurs within 250 feet of Burrill Lumber pipe yard within Ken Denman State Game Management Reserve; habitat is located across Agate Road (paved and raised) from Burrill Lumber pipe yard (9.45 acres).

d/ Project includes: right-of-way, temporary extra work area, and pipe yards.

e/ Buffer (botanical analysis area) includes area within 250-foot buffer around the pipe yards in Jackson County, as well as between MPs 145.3 and 145.4 along the Pipeline right-of-way that crosses Agate-Winlo soil complex.

f/ Jackson County Pipe Storage Yards considered: Burrill Lumber, Ave F and 11th Street, WC Short, and Rogue Aggregates.

g/ Vernal pool habitat observed during on-site and off-site evaluations: includes all vernal pool wetlands documented, including ditches with vernal pool characteristics.

h/ Vernal Pool Complex includes upland habitat within 100 feet of vernal pool habitat (see footnote g/).

Note: Most area that remains to be surveyed occurs on private lands; surveys would continue as access becomes available.

Critical Habitat

One CHU (VERFS 3A), which is centered on the Ken Denman WMA, was delineated such that it crosses over the top of Agate Road (paved surface) and encompasses a 25-foot-wide band of previously disturbed areas used for lumber processing within the western portion of proposed Burrill Lumber pipe storage yard. However, FWS (2017d) indicated that CHU VERFS 3A was incorrectly delineated and should be delineated to the western edge of Agate Road right-of-way and not cross over the road and into Burrill Lumber property. Burrill Lumber pipe storage yard and its surrounding was surveyed for vernal pool habitat in 2007; no suitable habitat for vernal pool fairy shrimp was observed within the proposed Burrill Lumber pipe storage area (SBS 2008b).

3.6.1.3 Effects of the Proposed Action

Direct and Indirect Effects

Direct effects to the shrimp and its habitat could be expected in vernal pools and upland habitat 100 feet from delineated vernal pools (vernal pool complex; FWS 2011f). Examples of potential direct effects could include possible disturbance to pools from driving or storing equipment or pipes near or on vernal pools or wetlands, pipeline construction through vernal pools, or draining or modifying hydrology to pools containing live shrimp or their cysts. Those actions could directly destroy or disturb vernal pool fairy shrimp cysts (during the dry season) or live shrimp (during the wet season).

Proposed pipe storage yards in Jackson County are located on lands where past heavy industrial uses have occurred. Because no vernal pool habitat has been documented in surveyed Jackson County proposed pipe storage yards, and because vernal pool habitats would be avoided in unsurveyed pipe storage yards by at least 250 feet (see section 3.6.1.4, below), no vernal pool fairy shrimp or potentially suitable vernal pool habitat would be directly affected by use of pipe storage yards. However, direct effects on vernal pool fairy shrimp could occur if fairy shrimp or hibernating cysts are present in nine vernal pools within and adjacent to the Pipeline right-of-way (MPs 145.34 to 145.40). Although the vernal pools identified along the right-of-way are outside the known range of vernal pool fairy shrimp, these pools may support vernal pool fairy shrimp because they are within the soils (Agate-Winlo) appropriate for this species (see figure 3.6.1-2) and occur near (i.e., within 8.2 miles of) the known and relatively recently (1998) expanded range of the species, and the species' absence has not been confirmed. Based on the relatively recent expansion of the known range of this species and the presence of potentially suitable habitat (including soil type) that has not been surveyed, there is potential for this species to be present within the right-of-way and be affected by pipeline construction. Therefore, Pacific Connector has indicated they would assume presence of vernal pool fairy shrimp within the boundaries of vernal pools unless future wetland delineations determine no vernal pool presence and/or protocol surveys for the species determine fairy shrimp absence.

Indirect effects to vernal pool fairy shrimp and their habitat could occur with increased road use for access to pipe storage yards, truck and heavy equipment use within pipe yards, as well as construction and restoration activities where these activities occur near or are adjacent to suitable or potentially suitable habitat. Increased dust deposition in vernal pool habitats could affect vegetation and vernal pool physical or chemical properties (pH, water quality, turbidity, sedimentation, temperature). Soil compaction and sediment mobilization during use of pipe storage yards or construction of the Pipeline along the right-of-way may indirectly affect hydrology upon which vernal pools and associated vegetation are dependent. Indirect effects to hydrology could occur to vernal pools within 250 feet of proposed activities (FWS 2011f). Run-off from proposed pipe storage yards may result in the delivery of harmful elements to habitats, including increased sediment loading, because pipe yards were often previously used for industrial or timber processing, and soils may contain residual components which could negatively affect fairy shrimp or their habitats. Also, road use adjacent to or near suitable or potentially suitable vernal pool fairy shrimp habitat may increase the risk of introduction of non-native, weedy species that could compete with native plant species associated with the vernal pool fairy shrimp. Construction of the Pipeline near potentially suitable vernal pools near MPs 145.34 and 145.40 could also indirectly affect this species, if vernal pool wetlands (and vernal pool complex [upland habitat within 100 feet of vernal pool wetlands]) are present within 250 feet of Pipeline construction.

Based on the above analysis, construction and operation of the Pipeline between MPs 145.3 and 145.4 could directly or indirectly affect fairy shrimp associated with up to 0.19 acre of vernal pool wetlands (and 4.59 acres of vernal pool complex [upland habitat within 100 feet of vernal pool wetlands]) located within 250 feet of proposed Pipeline activities. Of this acreage, 0.03 acre of vernal pool habitat (and 1.18 acres of vernal pool complex) would be directly affected within the Pipeline right-of-way (see table 3.6.1-2). Pacific Connector would implement a number of BMPs to minimize direct and indirect potential impacts to vernal pool wetlands during Pipeline construction (see section 3.6.1.4).

TABLE 3.6.1-2

Vernal Pool Habitat Directly and Indirectly Affected by the Pipeline Project within 250 feet of the Pipeline Right-of-Way (MPs 145.3–145.4)

Vernal Pool Complex	Pipeline Right-of-Way	Buffer (250 feet)	Total
Vernal Pool / Wetlands	0.03	0.16	0.19
Upland Habitat (100-foot Buffer)	1.18	3.41	4.59
Total	**1.21**	**3.57**	**4.78**

No direct or indirect effects to potential vernal pools are expected from use of proposed pipe storage yards in Jackson County, including 0.46 acre of potential vernal pool wetlands (and 15.55 acres of vernal pool complex) identified from off-site observations within or adjacent to proposed pipe yards (see table 3.6.1-1). Within the vicinity of Jackson County pipe yards, vernal pool habitat is within 250 feet of Burrill Lumber pipe yard and Avenue F & 11th Street pipe yard; however, all vernal pool habitat is either separated by an existing paved access road (west of Burrill Lumber) or an existing railroad bed (south of Avenue F & 11th Street), and activities within proposed pipe yards would not be expected to adversely affect vernal pool wetlands. Although a drainage has been identified on the north and west edges of the Avenue F & 11th Street pipe yard, Pipeline use, if any, would be located farther than 250 feet from the potential vernal pool habitat. Although no direct or indirect effects from use of pipe yards by the Pipeline Project would be expected, road use adjacent to or near suitable habitat could increase the risk of introduction or spread of noxious weeds (see section 3.6.1.4).

Pacific Connector would control fugitive dust along the construction right-of-way and at proposed pipe storage yards, as described in the *Air, Noise and Fugitive Dust Control Plan* (see Appendix B to Pacific Connector's POD [appendix B to this BA]). Applying water to pipe yards and along the right-of-way near MPs 145.34 to 145.40 would reduce the potential for adverse effects from fugitive dust to vernal pool habitat that is in proximity to the Pipeline. Pacific Connector would also implement site-appropriate BMPs outlined in their stormwater management plan to mitigate the potential for increased sediment mobilization thereby reducing any potential impacts to water quality in vernal pools. To minimize the potential spread of invasive species to vernal pool habitats, Pacific Connector would implement BMPs outlined in the IPM (see Appendix N to Pacific Connector's POD [appendix B to this BA]). Adherence to dust control, stormwater management, and weed management plans would minimize indirect effects to vernal pool fairy shrimp and their habitat.

Critical Habitat

As described previously, one proposed pipe storage yard (Burrill Lumber) is located within the far eastern edge of FWS-delineated CHU VERFS 3A; however, FWS (2017d) indicated that this CHU was incorrectly delineated and its eastern border should have been delineated on the western edge of Agate Road right-of-way. No other pipe yards are located within 250 feet (distance of potential indirect effects to vernal pool wetlands) of delineated critical habitat (see figure 3.6.1-1). No direct impacts from the Project to vernal pool fairy shrimp critical habitat are expected because equipment and pipe storage would not occur on pools or wetlands (or vernal pool complex – upland habitat within 100 feet of vernal pool wetlands) in delineated critical habitat, nor would traffic to and from the pipe storage yards drive near or on pools within the designated CHUs.

Possible indirect effects to the CHUs may occur as a result of increased dust deposition and stormwater runoff, and the potential for an increased risk of accidental spills in areas that are adjacent to the CHUs. Increased fugitive dust might impact vernal pool habitat within VERFS 3A as dust settles, affecting associated vegetation and vernal pool physical or chemical properties (pH, water quality, turbidity, sedimentation, and temperature). Indirect effects to hydrology within 250 feet of suitable or potentially suitable vernal pool habitat within VERFS 3A is not expected because existing, paved Agate Road occurs between currently disturbed Burrill Lumber pipe yard and VERFS 3A. Use of Agate Road adjacent to the CHU and use of Burrill Lumber pipe storage yard may increase the introduction of non-native, weedy species. However, Pacific Connector would apply the conservation measures identified below (section 3.6.1.4), which would minimize effects to vernal pool habitat and/or vernal pool fairy shrimp within VERFS 3A.

3.6.1.4 Conservation Measures

When and if survey access is permitted along the right-of-way between MPs 145.34 and 145.40, Pacific Connector would conduct wetland delineations according to appropriate protocols to confirm vernal pool (wetland) presence/absence. If wetland delineations confirm the presence of vernal pools along the right-of-way, Pacific Connector would have a certified surveyor conduct surveys for vernal pool fairy shrimp following the 2015 FWS vernal pool fairy shrimp survey protocol (FWS 2015c). Surveys would not commence until a permit for surveys is obtained from the FWS. If this species is identified during survey efforts, or if vernal pool fairy shrimp survey efforts do not occur at this location due to construction time constraints, Pacific Connector would evaluate a potential reroute to avoid vernal pools by at least 250 feet with the landowner.

If a reroute between MPs 145.34 and 145.40 is not possible, Pacific Connector has indicated they would discuss potential mitigation options with FWS to offset direct and indirect effects from pipeline construction to potential vernal pool fairy shrimp within vernal pools (0.19 acre) (and vernal pool complex [4.59 acres] – upland habitat within 100 feet of vernal pools) within 250 feet of the Pipeline (see table 3.6.1-2). Additionally, Pacific Connector has indicated they would erect a silt fence on the west side of the right-of-way within 250 feet of the vernal pools located between MPs 145.27 and 145.44 to avoid or minimize any potential effects to surface drainage or current hydrologic conditions (FWS 2012j) and to prevent construction personnel and vehicles from incidentally disturbing the vernal pools complex outside of the permitted right-of-way. FWS has requested that any impacts be addressed consistent with the FWS's Vernal Pool Conservation Strategy for Jackson County, Oregon, as amended December 29, 2015 (FWS 2011f, 2015d).

3.6.1.5 Determination of Effects

Species

The Project **may affect** vernal pool fairy shrimp because:

- potentially suitable habitat for vernal pool fairy shrimp has been identified near four proposed Jackson County pipe storage yards, as well as within and adjacent to the Project right-of-way from MPs 145.34 and 145.40.

The Project is **likely to adversely affect** vernal pool fairy shrimp because:

- effects on vernal pool fairy shrimp are possible due to the Project's crossing of potentially suitable, unsurveyed habitat within the pipeline right-of-way between MPs 145.34 and 145.40.

Critical Habitat

The Project **may affect** vernal pool fairy shrimp critical habitat because:

- the Project occurs adjacent to designated vernal pool fairy shrimp critical habitat; and
- the Project may affect suitable habitat within designated critical habitat adjacent to the Project.

However, the Project is **not likely to adversely affect** vernal pool fairy shrimp critical habitat because:

- although the proposed Burrill Lumber pipe yard occurs within 250 feet from a designated vernal pool fairy shrimp CHU (VERFS 3A), it is separated from the CHU by Agate Road, which is a two-lane paved road that acts as a barrier to hydrologic connectivity that is considered a definitive boundary to the area of effects;
- Burrill Lumber pipe yard has been previously disturbed, and additional surface disturbances and/or soil compaction by heavy machinery from use within the Burrill Lumber pipe storage yard would be minimal. Also, Agate Road is located between the Burrill Lumber pipe yard and CHU VERFS 3A, which is raised and paved, and would serve as an existing barrier between the pipe yard and CHU. Therefore, use of the Burrill Lumber pipe storage yard is not expected to adversely modify geographic, topographic, and edaphic features potentially within 250 feet of the yard that support systems of hydrologically interconnected pools, swales, and other ephemeral wetlands and depressions within the matrix of surrounding uplands (PCE 2); and
- proposed conservation measures would reduce the potential for increased sediment mobilization, increased fugitive dust, and the potential spread of invasive species to suitable vernal pool habitats.

3.7 PLANTS

3.7.1 Applegate's Milk-Vetch

The Applegate's milk-vetch (*Astragalus applegatei*) is a slender perennial of the pea (Fabaceae) family. It is known only from Klamath County, Oregon. The plant can be found in flat-lying, seasonally moist, alkaline soils dominated by greasewood (*Sarcobatus vermiculatus*) and with sparse native grasses.

3.7.1.1 Species Account and Critical Habitat

Status

Applegate's milk-vetch was listed as endangered on July 28, 1993 (FWS 1993c). It was believed to be extinct until its rediscovery in 1983 and at the time of listing was only known from two extant sites.

Threats

In the five-year review of Applegate's milk-vetch, the FWS identified continued destruction, modification, or curtailment of its habitat or range due to urban and commercial development, and loss of habitat through competition with non-native weeds as the principal threats to the species survival (FWS 2009d). Several other factors were identified in the decision to list the Applegate's milk-vetch. Overutilization for commercial, recreational, and scientific purposes was a potential threat at the time of listing because the known locations of these rare plants are easily accessible by road. The FWS also identified predation from rabbits and cattle as obstacles to the plant's survival (FWS 1993c). Additionally, because of the small number and size of populations and a limited gene pool, the FWS determined that the potential for extinction from stochastic events (fires or floods) is a threat to the species (FWS 1993c). Additionally, construction of ditches and dikes in the Klamath Basin alter the hydrologic character of Applegate's milk-vetch habitat. The FWS concluded that these changes could result in lethally dry conditions, or may indirectly impact the species by introducing drought-tolerant and exotic plants (FWS 1998b).

Species Recovery

The *Applegate's Milk-Vetch Recovery Plan* (FWS 1998b) was drafted with the goal to increase the stability of Applegate's milk-vetch so that it can be down-listed. The two main objectives of the recovery plan are to:

- increase the species' representation to at least six self-sustaining populations, with a minimum of two populations occurring at each of the three recovery areas identified in the plan; and
- develop management strategies that provide for long-term stability.

To achieve these objectives, the recovery plan recommends the following actions:

- conserve natural and introduced Applegate's milk-vetch populations;
- develop long-term, off-site seed storage;
- conduct research on population sustainability, population establishment and augmentation techniques, efficacy of habitat management strategies, and the plant's edaphic and hydrologic requirements; and
- develop and implement an outreach program.

Specifically, the recovery plan suggests that Applegate's milk-vetch would be considered for downlisting to threatened status when:

> *At least two natural and/or introduced self-sustaining populations are preserved in each of the three recovery areas (Ewauna Flat, Miller Island, and Worden), for a total of six or more populations in habitat permanently secured and managed for the benefit of the species. A minimum of 4,500 reproductive plants is needed for a recovery area to meet the downlisting threshold. Self-sustaining populations are defined as containing a minimum of 1,500 reproductive plants, plus sufficient individuals in younger age classes to suggest population stability or growth.*

The five-year review of Applegate's milk-vetch (FWS 2009d) reported that since the recovery plan was published, three new occurrences of Applegate's milk-vetch have been found. The review states that recovery criteria should be modified to include opportunities to achieve self-sustaining populations at the newly discovered sites.

Applegate's milk-vetch population establishment techniques have not been successful and additional transplantation methods will continue to be investigated (Gisler 2002; ORBIC 2007). The FWS also recommended further research on the impacts of weed competition on Applegate's milk-vetch, pollination and self-fertilization processes, and herbivory and predation processes (FWS 1998b).

Life History, Habitat Requirements, and Distribution

Soils in typical Applegate's milk-vetch habitats are characterized as being gray in color, slightly alkaline, with a shallow water table and groundwater with a relatively high salinity due to periodic flooding and evaporation (TNC 1999). Applegate's milk-vetch grows only in flat-lying, seasonally moist, alkaline soils with underlying clay hardpans. The underlying clay hardpans provide seasonal soil moisture, saturation and retention, forming a hydrological regime which may be a requirement for dry summer months when flowering and seeding occur (FWS 1998b). Alkaline soils may support mycorrhizal fungi and rhizobium bacteria beneficial to the survival and growth of the milk-vetch (FWS 1998b). As with other plants growing under extreme conditions of alkalinity, heavy metals, and/or salinity, Applegate's milk-vetch may benefit from alkaline soils to help reduce competition from other species (FWS 1998b).

The vegetative community in which Applegate's milk-vetch sites occurs is classified as interior alkali grassland (TNC 1999). The species' habitat was historically characterized by sparse, native bunchgrasses and patches of bare soil, allowing for some seed dispersal by wind. Today, dense coverage of the habitat by introduced grasses and weeds means seed dispersal is highly localized, with most seedling establishment found adjacent to mature plants (FWS 1998b). Flowering usually begins in early June and ends in August. Reproduction takes place exclusively by seeds, which are shed soon after flowering. Pollination is thought to be mediated by butterflies (e.g., Reverdin's blue [*Plebejus argyrognomon]* and Melissa blue butterfly [*Plebejus melissa*]) and polylectic bees (Yamamoto 1985), although the plant is also capable of seed production through self-fertilization.

Since the publication of the recovery plan in 1998, there have been numerous cooperative efforts made by the ODA, ORBIC, The Nature Conservancy (TNC), FWS, and private landowners to conduct inventories for Applegate's milk-vetch throughout most of its historical range. It is known to occur only in the Lower Klamath Basin, near the city of Klamath Falls in southern Oregon.

Population Status

At the time of listing, this species was known from only two extant sites (Miller Island and Ewauna Flat) that supported approximately 30,000 plants and one historical site (Keno; FWS 1993c). One additional site (Klamath Falls) was documented shortly after the listing, but this site was extirpated in 1992 prior to the completion of the 1998 recovery plan (FWS 2009d). In the 1998 recovery plan, there were three known extant populations in Klamath County, numbering about 12,000 plants (FWS 1998b): the Ewuana Flat population contained an estimated 11,500 individuals within three sub-populations, the Miller Island population contained less than 500 plants within four small sub-populations on approximately one acre, and the Worden population that included three plants (FWS 1998b). Since publication of the recovery plan, five additional sites have been discovered (Collins Tract, Klamath Falls Airport, Washburn Way-Railroad, Mallard, and OC&E Woods Line State Trail) for a total of eight known extant sites and an estimate of approximately 75,000 plants (table 3.7.1-1). The largest populations include the Klamath Falls Airport, where surveys in 2012 and 2013 documented an estimated 24,000 plants (FAA 2015) and the Collins Tract site, where approximately 47,516 plants were documented in 2013 (Spaur pers. comm. 2019). Table 3.7.1-1 provides a summary of Applegate's population status at the time of federal listing in 1993, the draft recovery plan in 1998, and latest available status (FWS 2009d; FAA 2015; ORBIC 2017b; Spaur pers. comm. 2019).

TABLE 3.7.1-1

Summary of Applegate's Milk-vetch Population Status by Site at the Time of Federal Listing (1993), Publication of the Recovery Plan (1998), and Most Recent

Site Name	Ownership	Number of Plants at Time of Listing (1993)	Number of Plants at Time of Recovery Plan (1998)	Most Recent	Current Status
Ewauana Flat Preserve	The Nature Conservancy	Up to 30,000 plants	Approximately 11,500 plants	Approximately 2,197 plants	Declining
OC&E Woods Line State Trail	State of Oregon	Undiscovered	Undiscovered	100 to 200+ plants	Unknown
Mallard	City of Klamath Falls & Private	Undiscovered	Undiscovered	675 plants	Unknown
Miller Island	State of Oregon	30 to 80 plants	Fewer than 500 plants	112 plants	Unknown
Keno	Private	Historical (extirpated)	Historical (extirpated)	Historical (extirpated)	Extirpated
Worden	Private	Undiscovered	3 plants	9 plants	Unknown
Collins Tract	Private	Undiscovered	Undiscovered	47,516 plants	Unknown
Klamath Falls Airport	City of Klamath Falls	Undiscovered	Undiscovered	24,000 plants	Unknown
Washburn Way-Railroad	Private	Undiscovered	Undiscovered	307 plants	Unknown
Klamath Falls	Private	Believed to have been extirpated	13 plants found in 1994	Extirpated	Extirpated

Sources: FWS 1993c, 1998b, 2009d; FAA 2015; ORBIC 2017b; Spaur pers. comm. 2019.

Populations range in size from nine plants in the Worden site to several thousands of plants at the Klamath Airport and Collins Tract sites (table 3.7.1-1). Multi-year trend data collected at The

Nature Conservancy Preserve site near Ewauna Lake has documented a downward decline in the Ewauna Flat population from 30,000 plants at the time of listing to approximately 2,200 plants in 2008 (FWS 2009d).

Critical Habitat

Critical habitat has not been designated for Applegate's milk-vetch.

3.7.1.2 Environmental Baseline

Analysis Area

The botanical analysis area extends to 30 meters (98 feet) each side of the Pipeline Project (construction right-of-way, TEWAs, UCSAs, rock source and disposal sites, and proposed storage yards) on lands that have potential habitat for listed plant species. This area generally corresponds to the extent of the area surveyed for sensitive and listed plant species during surveys conducted between 2007 and 2018 (i.e., at least 100 feet from habitat removal on federal lands and at least 50 feet from habitat removal on non-federal, private lands and along access roads where road improvements are proposed), and correlates to a distance that indirect effects to plants would be expected. Surveys for this species targeted all flat areas with moist alkaline soils with native grasses and greasewood, where access was granted.

Species Presence

The Pipeline Project is located within known or historic Applegate's milk-vetch range between MPs 191.20 to 214.30 within the Lake Ewauna-Klamath River fifth-field watershed. Herbarium records indicate that a known historical population, now presumed extirpated (ORBIC 2017b), occurred in the vicinity of the pipeline near MP 191.2 to MP 191.97. It was last reported in 1937, approximately 2 miles east of the town of Keno, Oregon. Efforts to relocate this species in the historic area have been unsuccessful (FWS 1998b; SBS 2008b and 2017). The Pipeline Project also occurs within the Collins Tract population between approximately MPs 195.35 and 196.70. Plants have been documented north and south of the proposed Pipeline in this areas (ORBIC 2017b; SBS 2008b and 2017). Estimates of more than 10,000 plants at multiple sites in the Collins Tract area were made in 2008, extending from across the Klamath River from and adjacent to the Lower Klamath NWR and State Wildlife Area (FWS 2009d; ORBIC 2017b). Botanical surveys conducted by Pacific Connector between 2007 and 2008 located three new sites for Applegate's milk-vetch in the Collins Tract (SBS 2008b), discussed further below. The Collins Tract site was revisited in 2013 by the FWS, and approximately 47,516 plants were documented in the area (Spaur pers. comm. 2019).

Additionally, TNC and FWS documented approximately 675 plants in 2009 at a location within and adjacent to the proposed Klamath Falls Memorial Drive 2 pipe storage yard. Plants were observed near the Klamath River on either side of railroad tracks (ORBIC 2017b).

Most surveys for this species were conducted in 2007 and 2008, but additional surveys have been conducted since 2008 in areas of reroutes, minor route adjustments, and areas where survey permission was obtained. Areas where Applegate's milk-vetch plants were documented during survey efforts in 2007 and 2008 were also resurveyed. Surveys have continued through 2018 and the 2018 data are currently under review.

Overall, 728.48 acres have been identified as potential habitat requiring surveys within the botanical analysis area between MPs 191.7 and 214.3 in Klamath County, including habitat identified in and around proposed pipe storage yards (table 3.7.1-2). Of this potential habitat, access was granted to about 553.14 acres (307.47 acres within the Pipeline right-of-way), of which 109.05 acres (61.82 acres within the Pipeline right-of-way) were considered suitable habitat for Applegate's milk-vetch.

TABLE 3.7.1-2

Summary of Potential Suitable Applegate's Milk-Vetch Habitat within the Botanical Analysis Area

General Landowner	Suitable Habitat Status	Acres Surveyed: Project b/	Acres Surveyed: Buffer c/	Acres Surveyed: Total	Acres Not Surveyed a/: Project b/	Acres Not Surveyed a/: Buffer c/	Acres Not Surveyed a/: Total
MPs 191.7 – 214.3 (1,270.35 acres within botanical analysis area)							
Federal	Suitable Habitat	0	0	0	0	0	0
	Not Habitat	0	0	0	0	0	0
	Unknown	N/A	N/A	N/A	N/A	N/A	N/A
	Total	*0*	*0*	*0*	*0*	*0*	*0*
Non-Federal	Suitable Habitat	61.82	47.23	109.05	0.35	1.34	1.70
	Not Habitat	245.66	198.44	444.09	N/A	N/A	N/A
	Unknown	N/A	N/A	N/A	76.60	97.04	173.64
	Total	*307.48*	*245.67*	*553.14*	*76.95*	*98.38*	*175.34*
Total	Suitable Habitat	61.82	47.23	109.05	0.35	1.34	1.70
	Not Habitat	245.66	198.44	444.09	N/A	N/A	N/A
	Unknown	N/A	N/A	N/A	76.60	97.04	173.64
	Total	**307.47**	**245.67**	**553.14**	**76.95**	**98.38**	**175.34**

a/ Areas not surveyed were either 1) denied access , 2) not surveyed because of modifications to the pipeline alignment that occurred after the flowering season, or 3) areas of the 30-meter (98-foot) botanical analysis area outside of the targeted 50-foot survey area on non-federal lands. "Not Habitat" was determined from adjacent survey parcel information, aerial photography, or "drive-by;" no surveys would be necessary and acres are not included.

b/ Project includes: right-of-way, TEWAs, UCSAs, rock storage, pipe yards, aboveground facilities.

c/ Buffer (botanical analysis area) includes area within 30 meters (98 feet) of habitat removal and within 50 feet either side of existing access roads identified with potential road improvements.

Approximately 175.34 acres (76.95 acres within the Pipeline Project) of potentially suitable habitat for Applegate's milk-vetch have not been surveyed within the botanical analysis area; either where survey access has not been granted, or within areas of recent Pipeline modifications. Pacific Connector will continue to survey habitat where permission is granted. However, because permission to survey on non-federal lands only targeted an area of 50 feet from the Pipeline Project, it is very likely that habitat outside the targeted area but within the "30-meter botanical analysis area ("buffer") on non-federal lands would not be surveyed. Where survey access has been denied, Pacific Connector would conduct one year of surveys in suitable habitat within the Pipeline Project right-of-way prior to construction. For purposes of this analysis, a conservative assumption can be made that a similar percent of the unsurveyed area would contain suitable habitat (compared to the areas where surveys have been completed in the botanical analysis area); which means that approximately 34.21 acres of unsurveyed habitat within the botanical analysis

(19.7 percent of 175.34 acres; 15 acres within the Pipeline right-of-way) are likely suitable Applegate's milk-vetch habitat.

Applegate's milk-vetch plants were documented by SBS (and FWS) during surveys in 2008 in the vicinity of MPs 195.5 through 196.6; all observations were associated with the previously documented Collins Tract population (SBS 2008b). In 2008, the entire Collins Tract was found to contain 10,133 plants within 19 subpopulations on 32.3 acres within a larger 250-acre area (see figure 3.7.1-1). The 19 subpopulation clusters ranged from a single plant to thousands of plants. Habitat at the Collins Tract site is slightly different than locations of other known populations of Applegate's milk-vetch. The soil is less alkaline and not associated with the usual vegetative structure (i.e., very little or no rabbitbrush present). Weeds present within this area include cheatgrass (*Bromus tectorum*), mouse barley (*Hordeum murinum*), and sweet clover (*Melilotus officinalis;* SBS 2008b).

The Pipeline route was revised to avoid plants documented during the 2008 surveys and, in 2013 and 2014, SBS resurveyed around the Collins Tract site, but no Applegate's milk-vetch plants were observed within 100 feet of the revised Pipeline route (SBS 2013a, 2014). However, plants in a larger subpopulation documented in 2008 (#15), approximately 100 feet southeast of MP 195.6, were observed within a fence. Also in 2014, surveyors noted that one smaller sub-population (#17), documented in 2008 south of MP 195.9, was at the site of a salt lick where the ground had been trampled to bare dirt and this subpopulation was likely extirpated. This area was revisited in 2018 and no new sites were documented; data from the 2018 survey efforts are currently under review.

In 2007, a portion of Klamath Falls Memorial Drive 2 proposed pipe storage yard was surveyed, where access was permitted. No Applegate's milk-vetch plants or suitable habitat were observed within the surveyed area (SBS 2008b; figure 3.7.1-2). Subsequently to these surveys, the proposed pipe yard configuration was modified. As noted above, plants were documented by the FWS and TNC in 2009 within the area where the pipe storage yard is now proposed (figure 3.7.1-2; ORBIC 2017c). The area where plants were documented by FWS and TNC in 2009 was not surveyed for the Pipeline Project in 2008 due to a lack of landowner permission and a different pipe yard configuration.

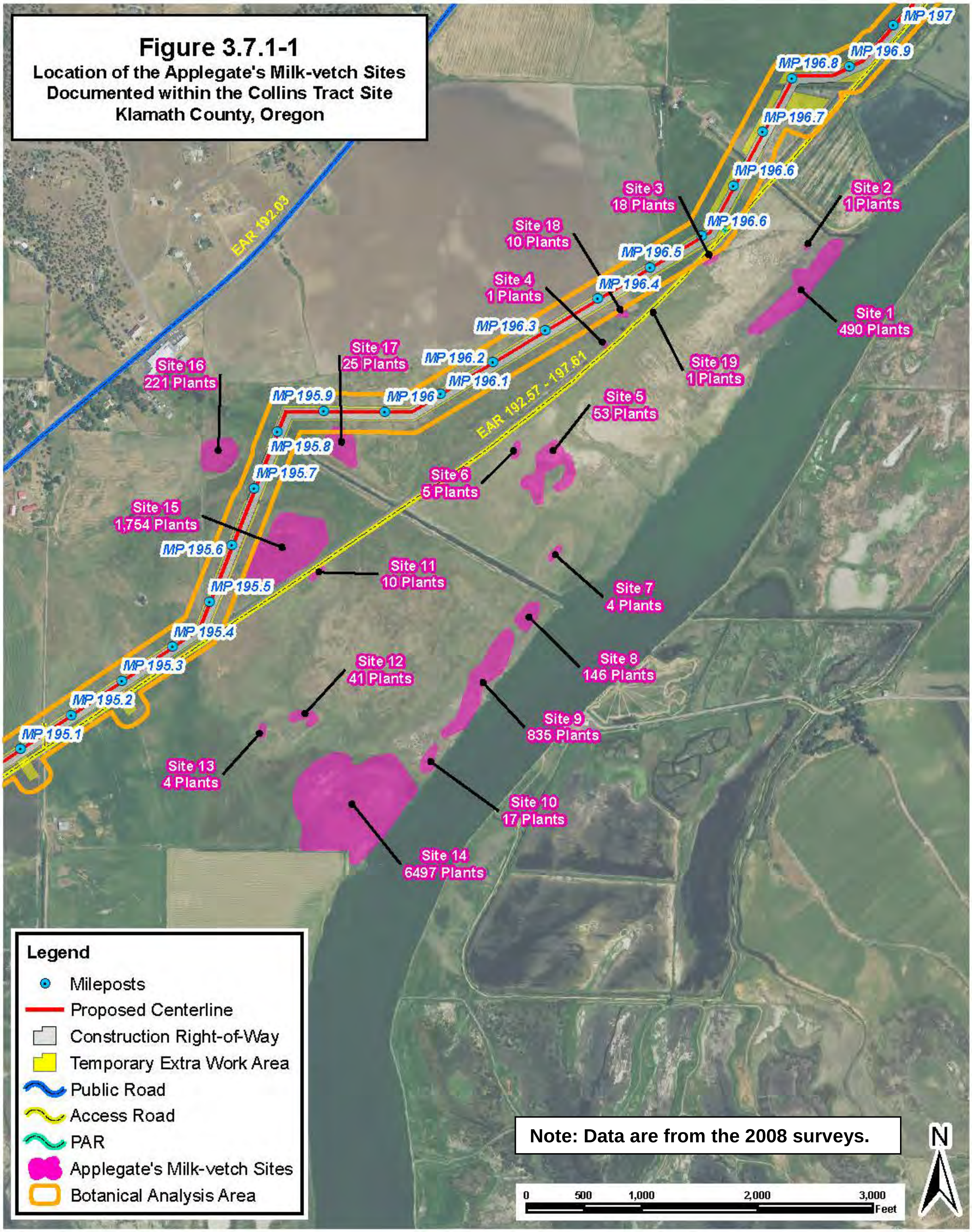


Figure 3.7.1-1
Location of the Applegate's Milk-vetch Sites
Documented within the Collins Tract Site
Klamath County, Oregon
EAR 192.03
EAR 192.57 - 197.61
MP 197
MP 196.9
MP 196.8
MP 196.7
MP 196.6
MP 196.6
MP 196.5
MP 196.4
MP 196.3
MP 196.2
MP 196.1
MP 196
MP 195.9
MP 195.8
MP 195.7
MP 195.6
MP 195.5
MP 195.4
MP 195.3
MP 195.2
MP 195.1
Site 1
490 Plants
Site 2
1 Plants
Site 3
18 Plants
Site 4
1 Plants
Site 5
53 Plants
Site 6
5 Plants
Site 7
4 Plants
Site 8
146 Plants
Site 9
835 Plants
Site 10
17 Plants
Site 11
10 Plants
Site 12
41 Plants
Site 13
4 Plants
Site 14
6497 Plants
Site 15
1,754 Plants
Site 16
221 Plants
Site 17
25 Plants
Site 18
10 Plants
Site 19
1 Plants
Legend
Mileposts
Proposed Centerline
Construction Right-of-Way
Temporary Extra Work Area
Public Road
Access Road
PAR
Applegate's Milk-vetch Sites
Botanical Analysis Area
Note: Data are from the 2008 surveys.
0
500
1,000
2,000
3,000
Feet
N

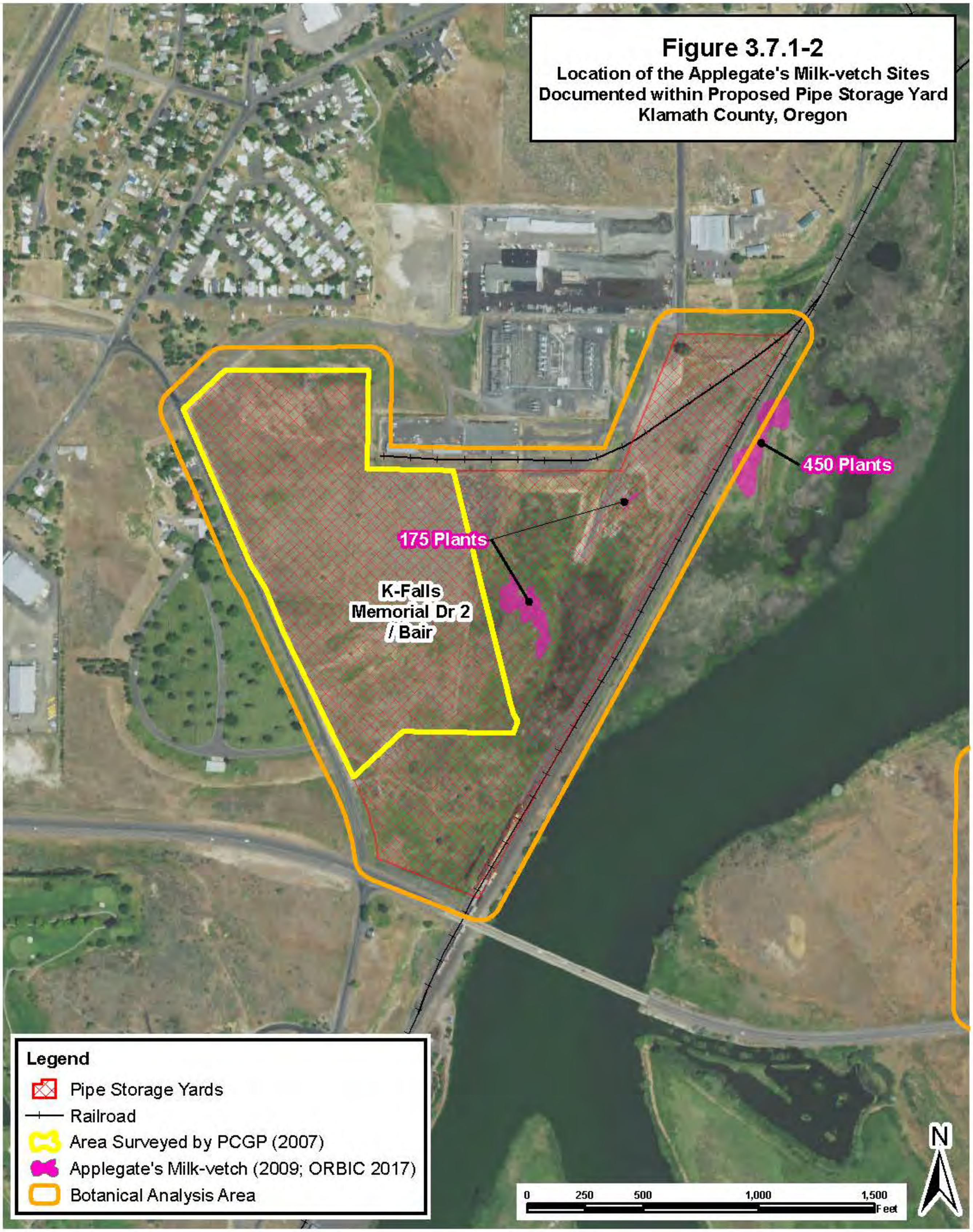


Figure 3.7.1-2
Location of the Applegate's Milk-vetch Sites
Documented within Proposed Pipe Storage Yard
Klamath County, Oregon
450 Plants
175 Plants
K-Falls
Memorial Dr 2
/ Bair
Legend
Pipe Storage Yards
Railroad
Area Surveyed by PCGP (2007)
Applegate's Milk-vetch (2009; ORBIC 2017)
Botanical Analysis Area
0
250
500
1,000
1,500
Feet
N

Critical Habitat

Critical habitat has not been designated for Applegate's milk-vetch.

3.7.1.3 Effects of the Proposed Action

The proposed action could affect federal threatened and endangered plant species discussed in this BA, through one or more of the following pathways:

1. Direct mortality of plants and/or destruction of seed banks during clearing and grading, construction, and reclamation.
2. Fragmentation and isolation of existing populations and areas of suitable habitat.
3. Introduction and spread of invasive plants and noxious weed species that interfere with growth and survival of listed plants.
4. Damage or mortality of individual plants by dust deposited on photosynthetic surfaces during construction.
5. Changes in characteristics (shade, temperature, soil moisture, species composition, etc.) that alter suitable habitat.
6. Accidental release of toxic compounds during construction and/or operation.

Direct and Indirect Effects

No direct effects to individual plants in the Collins Tract population are expected from the current pipeline alignment (figure 3.7.1-1). Surveys by the FWS and TNC in 2009 identified approximately 175 plants within the proposed Klamath Falls Memorial Drive 2 pipe storage yard (figure 3.7.1-2; ORBIC 2017b). Pacific Connector would conduct surveys for Applegate's milk-vetch within this pipe storage yard prior to construction and would avoid using portions of the pipe storage yard within 98 feet (30 meters) of documented and previously documented (i.e., ORBIC 2017b, 2017c) Applegate's milk-vetch plants. Therefore, no direct impacts to individual plants at this pipe storage yard would be expected.

Although no known plants would be directly impacted by the Pipeline Project, surveys of all potential suitable habitats within the Pipeline Project area have not been completed to date due to lack of access granted by landowners or pipeline alignment revisions; therefore, it is possible that unidentified plants may occur within the proposed construction right-of-way or work areas. These plants could be in areas that would be directly impacted by the Pipeline Project; however, Pacific Connector has developed measures aimed at avoiding or minimizing the risk of impacting unidentified plants (section 3.7.1.4, Conservation Measures and the *Applegate's Milk-vetch Mitigation Plan*, appendix V.2).

Travel along the existing paved access road (EAR 192.57-197.61) should not affect Applegate's milk-vetch plants within the Collins Tract site located adjacent to the access road. Indirect effects to plants within the Klamath Falls Memorial Drive 2 pipe storage yard would be minimized because Pacific Connector would not utilize portions of the yard within 98 feet (30 meters) of documented plants. However, indirect effects to unidentified Applegate's milk-vetch plants and potentially suitable habitat could still occur in the vicinity of the Pipeline Project that has not been surveyed to date.

Suitable habitats as well as plants within 98 feet (30 meters) of the Pipeline Project may also be indirectly affected as a result of: 1) changes in hydrology and soil characteristics, 2) introduction and spread of invasive plants and noxious weeds, and 3) alteration of vegetation cover and species composition of associated habitat. Impacts from fugitive dust created during construction and travel on unpaved access roads could also affect the photosynthetic surfaces of Applegate's milkvetch plants in the Pipeline vicinity; These indirect impacts could negatively affect Applegate's milk-vetch plants and habitat within the Collins Tract site, because plants are located within 98 feet (30 meters) of the Pipeline Project. The closest mapped subpopulation (#17) is approximately 63 feet south of MP 195.9 (figure 3.7.1-1).

Dust abatement measures implemented during construction, in accordance with Pacific Connector's *Air, Noise and Fugitive Dust Control Plan* (Appendix B to Pacific Connector's POD [appendix B to this BA]), would minimize the potential for fugitive dust impacts. Additionally, implementation of measures within Pacific Connector's IPM (Appendix N to Pacific Connector's POD [appendix B to this BA]) would minimize adverse impacts from noxious weeds. Construction of the pipeline could also affect groundwater flow patterns located at the Collins Tract site. However, the pipeline would be constructed outside of the irrigation season between MPs 195.4 and 196.6; therefore, shallow groundwater perched on top of restrictive subsoil horizons is not expected to be present during construction. Additionally, to minimize potential impacts to critical life cycles, construction of the pipeline between MPs 195.4 and 196.6 would occur outside of the growing and reproductive season for Applegate's milk-vetch (after September 15 but before April 30).

After construction, Pacific Connector would restore the construction right-of-way back to approximate original contours to ensure that drainage patterns are restored and would reseed the affected area using a species mix recommended by FWS that is appropriate for the area. Impacts to Applegate's milk-vetch related to operation of the Pipeline Project would result from the monitoring and treatment of noxious weeds, which could affect non-targeted species (such as Applegate's milk-vetch) if they are near treatment areas. However, Pacific Connector has included procedures to protect sensitive species and habitats in their IPM (see Appendix N to Pacific Connector's POD [appendix B to this BA]), which would minimize potential impacts to Applegate's milk-vetch related to treatment of noxious weeds. No other maintenance impacts are expected within the range of Applegate's milk-vetch because the permanent easement would be maintained in an herbaceous/shrub state, which would provide conditions similar to Applegate's milk-vetch suitable habitat.

Critical Habitat

Critical habitat has not been designated for Applegate's milk-vetch; therefore, critical habitat for this species would not be impacted by the proposed action.

3.7.1.4 Conservation Measures

Pacific Connector has developed a mitigation plan for Applegate's milk-vetch (see Attachment 2 within the *Federally-listed Plant Conservation Plan*, appendix V.2) to address how avoidance, minimization, seed collection, restoration, and other conservation measures would be applied to protect Applegate's milk-vetch. Measures in the mitigation plan that would minimize or avoid effects to Applegate's milk-vetch plants and habitat include:

- Monitoring revegetation success for five years after construction in the reseeded area between MPs 195.5 to 196.6, and other areas where Applegate's milk-vetch is identified and reseeding is required.
- Collecting and bagging seeds of any affected Applegate's milk-vetch plants prior to seed dispersal (June to July) and providing seeds to a repository agreed upon between FWS, BLM, and Pacific Connector. If permission is granted by the property owner, Pacific Connector would plant the collected seeds outside of the permanent right-of-way after construction in areas where Pacific Connector has secured a conservation easement.

When access to the construction right-of-way is granted, surveys for Applegate's milk-vetch would be conducted in all areas of potential habitat and any plants located during surveys would be avoided, if feasible. The FWS would be notified of the survey results and, if the species is present, the avoidance/conservation measures described above and in the Applegate's milk-vetch mitigation plan (see appendix V.2) would be implemented.

3.7.1.5 Determination of Effects

Species

The Project **may affect** Applegate's milk-vetch because:

- suitable habitat is present within the botanical analysis area; and
- individual plants have been located within the analysis area during survey efforts.

The Project is **likely to adversely affect** Applegate's milk-vetch because:

- approximately 175.3 acres of potential suitable habitat that has not been surveyed occurs within the botanical analysis area, which includes approximately 77 acres within the pipeline right-of-way; therefore, it is possible that unidentified plants occur within the proposed construction right-of-way and work area; and
- surface disturbance and excavation would occur within potentially suitable habitat and could impact unidentified plants (including in areas where surveys have not been completed); and
- indirect effects, including potential changes in hydrology and soil characteristics, introduction and spread of invasive plants and noxious weeds, alterations to vegetation cover and species composition of associated habitat, and effects from fugitive dust, could impact documented or suspected plants and habitat outside the construction right-of-way, but within 30 meters (98 feet) of the Pipeline Project.

Critical Habitat

Critical habitat has not been designated for Applegate's milk-vetch.

3.7.2 Gentner's Fritillary

The Gentner's fritillary (*Fritillaria gentneri*) is a perennial in the lily family *(*Liliaceae). The plant grows on the edge of woodlands, with an overstory of Oregon white oak (*Quercus garryana*) and Pacific madrone (*Arbutus menziesii*), and also occurs in open chaparral and grassland environments, at elevations between 300 to 1,230 meters (approximately 1,000 to 4,200 feet). It is found in small, scattered locations in the Rogue and Klamath River watersheds in Jackson and

Josephine counties, Oregon, with one small population recently discovered in northern California (FWS 2003c and 2016e).

3.7.2.1 Species Account and Critical Habitat

Status

Gentner's fritillary was listed as endangered on December 10, 1999 (FWS 1999b). Although this lily may have originated as a result of hybridization, it is considered a valid species.

Threats

A key factor in the FWS 1999 listing of Gentner's fritillary was the present or threatened destruction, modification, or curtailment of its habitat and range. The FWS identified residential and utility development and agricultural conversion as the cause for destruction of at least five known locations of this species (FWS 1999b). At the time of listing, 73 percent of the known plants were in a central core area within a 7-mile radius of the Jacksonville Cemetery. The FWS noted that habitat loss due to ongoing or future development might occur at 42 percent of the occupied sites within the central core area (FWS 1999b). Loss of habitat is still a major threat to Gentner's fritillary. In the species' recovery plan (FWS 2003c), the FWS identified agricultural, urban and residential development, timber harvest, road and trail improvement, and recreation as ongoing threats to the very narrow geographic range and small population size of the plant. The areas most threatened are on private lands. Habitat conversion due to fire suppression, proliferation of invasive plants and noxious weeds, and herbicide use also pose threats to this species. Species persistence and recovery is hampered by the very structure of its remaining populations, which are scattered, isolated, and small in size and number. These small populations are at high risk of decline because they lack reserves to ward off stochastic loss, overutilization for commercial and recreational purposes, diseases, climatic shifts, herbivory, localized natural disturbances, and decrease in genetic diversity (FWS 1999b and 2003c).

Species Recovery

The species recovery plan, released by the FWS in 2003, created four recovery units to delineate areas necessary for the viability and recovery of Gentner's fritillary (FWS 2003c). The objective of the recovery plan is to remove threats to the extent that Gentner's fritillary is no longer in danger of extinction and can be downlisted or delisted. The recommended recovery actions include:

- Provide private landowners with information on identification and management of habitat to maintain Gentner's fritillary.
- Establish, manage, and maintain a minimum of eight Fritillaria management areas, with at least two distributed within each of the four recovery units, where the species will be secure from all threats.
- Conduct surveys and research essential to conservation and recovery.
- Develop off-site germplasm banks to maintain reproductive materials.
- Review and revise recovery plan as needed, based on accumulation of new data.

The recovery strategies for the recovery units include rehabilitation of habitat, restoration of historical sites, and augmentation of existing populations, including expansion into nearby suitable habitat (FWS 2003c). The recovery objective is to have at least 750 flowering plants within each established recovery unit to downgrade its status to threatened or 1,000 plants within each established recovery unit to delist the species, as monitored biannually for at least 15 years. This recovery unit total may consist of many management areas within each recovery unit; however, two of the management areas within each recovery unit must consist of populations of at least 100 flowering individuals each within a 0.8-km (0.5-mile) radius of each other. Maintaining the subpopulations or population clusters within each recovery unit is important to preserve the genetic diversity within the species, ensure its long-term viability, and reduce the vulnerability of the species to extirpation from random catastrophic events (FWS 2003c).

Based on a 2013 monitoring report, only one of the four mapped recovery units (Unit 4) had attained over 1,000 flowering plants in the previous two years; the other three recovery units have been below 750 flowering plants in the past 10 years (FWS 2016e). Eight *Fritillaria* Management Areas (FMAs) have been established, which is one of the recommended actions identified to assist recovery of the species; however, only two recovery unit contain at least two FMAs and one of the FMAs occurs outside of the recovery units (FWS and BLM 2015 in FWS 2016e). Recovery unit boundaries will be revised and additional FMAs will be established to meet the recovery plan criteria (FWS 2016e). Recovery Unit 3, which is located in northeastern Jackson County, is crossed by the Pipeline between about MPs 117.7 to 142.2. The Indian Creek FMA is the closest to the Project and is approximately 1 mile southwest of MP 128.

Life History, Habitat Requirements, and Distribution

Gentner's fritillary is often found in grassland habitats within, or on the edge of dry, mixed forest types where overstory can be dominated by Oregon white oak, madrone, Douglas-fir, and ponderosa pine. It occurs at a wide range of elevations, from 1,000 to 4,200 feet, in the rural foothills of the Rogue River Valley of Josephine and Jackson Counties (FWS 2003c and 2016e; SBS 2008c). It is usually associated with shrubs that provide protection from the wind and sun.

This species reproduces clonally by means of numerous small bulblets that break off larger bulbs and form new plants. Sexual reproduction appears to be a sporadic or episodic event, although observations suggest hummingbirds and some species of bees may pollinate the plant. The blooming season usually lasts from April through May, and plants must reach a minimum size before flowering (FWS 2003c).

The distribution of Gentner's fritillary is characterized by distinct clusters. The species is highly localized, with known populations occurring within a 30-mile radius of Jacksonville, Oregon and approximately 73 percent of the plants occurring within an 11-km (7-mile) radius (FWS 2003c). Since the 2003 publication of the recovery plan, nine new Gentner's fritillary occurrences (approximately 131 flowering plants within 1.6 acres) have been detected outside of the four recovery unit boundaries (FWS 2016e).

Population Status

It is difficult to census populations of Gentner's fritillary because individuals can remain dormant for one or more years underground and not flower. Also, flowering plants can be grazed by deer or cattle before identification and counting can be performed and sometimes this species cannot be distinguished from other non-flowering and co-occurring *Fritillaria* species, such as scarlet fritillary (*F. recurva*) or chocolate lily (*F. affinis;* FWS 2003c). In 2001, Gentner's fritillary was estimated at 1,696 flowering individuals in Jackson and Josephine counties, and just south of the border in California (FWS 2003c). For over 10 years, BLM has monitored Gentner's fritillary flowers and leaves on 58 sites across all four recovery units and has observed that flowering plants at most sites fluctuate annually (FWS 2016e). The results indicate that flowering plant total has been generally increasing over the past seven years, with the exception of 2011 and 2014 (FWS 2016e). In 2013, it was estimated that approximately 2,907 plants occurred within the four recovery units, as well as outside the recovery units (Table 1 in FWS 2016e). Most Gentner's fritillary sites include a small number of individual plants, ranging from one to 450 individual plants (mean of 16 plants). The largest number of plants occurs on BLM lands, with 1,653 counted in 2005 during annual monitoring of 56 known sites (SBS 2008c). Inventories on other monitored sites counted 940 plants on private lands in Jacksonville and 424 at Pickett Creek (SBS 2008c).

Critical Habitat

Critical habitat has not been designated for Gentner's fritillary.

3.7.2.2 Environmental Baseline

Analysis Area

The botanical analysis area extends to 30 meters (98 feet) each side of the Pipeline Project (construction right-of-way, TEWAs, UCSAs, rock source and disposal sites, and proposed storage yards) on lands that have potential habitat for listed plant species. This area generally corresponds to the extent of the area surveyed for sensitive and listed plant species during surveys conducted between 2007 and 2018 (at least 100 feet from habitat removal on federal lands and at least 50 feet from habitat removal on non-federal, private lands and along access roads where road improvements are proposed), and correlates to a distance that indirect effects to plants could occur. Habitats focused on during surveys for this species included grassland habitats near the edge of forests.

Species Presence

The analysis area crosses the species' range from approximately MPs 113 through 155. Between 1948 and 2015, approximately 68 sites of Gentner's fritillary have been reported within 25 miles southwest and 6 miles northwest of the Pipeline Project between MPs 117 and 143, of which many locations are likely extirpated based on habitat conditions (i.e., canopy encroachment) and development (ORBIC 2017c). The Pipeline Project would cross Gentner's fritillary Recovery Unit 3 and one of the most vigorous plant populations in Recovery Unit 3 is approximately 1.2 miles southeast of MP 134.4 in the Obenchain Mountain area within the BLM Medford District (Friedman 2006; ORBIC 2017b; SBS 2008b). In 2005, observations at the site reported 19 plants, but just one plant was observed in 2009 with the population rated as poor viability (ORBIC 2017c). Pipe storage yards in Jackson County are located more than three miles away from several documented populations in Sams Valley (Friedman 2006). None of the previously documented sites discussed above are located within the botanical analysis area of the Pipeline Project; the closest occurrence, as provided by ORBIC (2017c), was documented by Medford BLM in 2010 approximately 500 feet northeast of MP 127.5. Botanical surveys conducted for the Project between 2007 and 2018 located five sites of Gentner's fritillary (described below), three of which are within the botanical analysis area.

Recommended two-year surveys were conducted for Gentner's fritillary where survey permission was granted within the vicinity of the Pipeline Project. Most surveys were conducted in 2007 and 2008, but additional two-year surveys have been conducted since 2008 in areas of reroutes, minor route adjustments, and areas where survey permission was subsequently granted. Additionally, per survey protocol direction included in the 2016 5-year review (FWS 2016e), Pacific Connector initiated two-year survey protocols in 2017 within previously surveyed suitable habitat where Pipeline Project survey efforts are or will be 10 years old prior to the completion of the Project. Surveys continued in 2018 and the 2018 data are currently under review. Most of the area that remains to be surveyed occurs on private lands; surveys will continue as access becomes available.

Within the 30-meter (98-foot) botanical analysis area, approximately 1,708.15 acres between MPs 113 and 155 have been identified as potential suitable habitat requiring surveys (table 3.7.2-1). Of this potential habitat, access was granted to about 1,467.29 acres (588 acres within the Pipeline Project), including within 50 feet of access roads where road improvements have been proposed.

TABLE 3.7.2-1

Summary of Potential Suitable Gentner's Fritillary Habitat within the Botanical Analysis Area

General Landowner	Suitable Habitat Status	Acres Surveyed (RESURVEYED c/) Project a/	Acres Surveyed (RESURVEYED c/) Buffer b/	Acres Surveyed (RESURVEYED c/) Total	Acres Not Surveyed d/ Project a/	Acres Not Surveyed d/ Buffer b/	Acres Not Surveyed d/ Total
MPs 113.0 - 155.0 (1,720.45 acres within botanical analysis area)							
Federal	Suitable Habitat	196.01 (128.14)	300.78 (208.23)	496.78 (336.36)	0	8.56	8.56
	Not Habitat	52.57	63.74	116.31	N/A	N/A	N/A
	Unknown	N/A	N/A	N/A	0	0	0
	Total	*248.58*	*364.52*	*613.10*	*0.00*	*8.56*	*8.56*
Non-Federal	Suitable Habitat	290.96	439.64	730.60	49.92	92.02	141.94
	Not Habitat	48.46	75.14	123.59	N/A	N/A	N/A
	Unknown	N/A	N/A	N/A	0.48	89.89	90.37
	Total	*339.41*	*514.78*	*854.19*	*50.40*	*181.91*	*232.31*
Total	Suitable Habitat	486.96 (128.14)	740.42 (208.23)	1,227.38 (336.36)	49.92	100.57	150.49
	Not Habitat	101.03	138.88	239.91	N/A	N/A	N/A
	Unknown	N/A	N/A	N/A	0.48	89.89	90.37
	Total	**587.99 (128.14)**	**879.30 (208.23)**	**1,467.29 (336.36)**	**50.40**	**190.46**	**240.86**

Note: column and row totals may not sum exactly due to rounding.

a/ Project includes: right-of-way, temporary extra work area, uncleared storage area, rock storage, pipe yards, aboveground facilities.

b/ Buffer (botanical analysis area) includes area within 30 meters (98 feet) of habitat removal and within 50 feet either side of existing access roads identified with possible road improvements.

c/ Per FWS request (May 2017), Pacific Connector has reinitiated surveys in suitable habitat where survey effort was or would be 10 years old (acres resurveyed). Survey efforts began in 2017 and will continue into 2019 where access is permitted.

d/ Areas not surveyed were either: 1) denied access; 2) not surveyed because of recent modification to the proposed route that occurred after the flowering season; or 3) portions of the 30-meter (98-foot) botanical analysis area outside of the targeted 50-foot survey area on non-federal lands. "Not Habitat" was determined from adjacent survey parcel information, aerial photography, or "drive-by;" no surveys would be necessary and acres are not included.

Of the 1,467.29 acres of potential habitat within the botanical analysis area where survey access was granted, about 1,227.38 acres (486.96 acres within the Pipeline Project footprint) were considered suitable habitat for Gentner's fritillary. Habitat suitability was assessed based on standards from a state-wide Gentner's fritillary habitat analysis protocol (SBS 2001). Habitat found to be "suitable" supported characteristics as detailed in the previous sections (SBS 2008a).

Approximately 240.86 acres (50.40 acres within the Pipeline Project footprint) of potentially suitable habitat (or unknown habitat status) within the botanical analysis area was denied access by the landowner, or occurs within recent modifications of the Pipeline Project. Most of this unsurveyed habitat occurs on non-federal (private) lands (table 3.7.2-1). Unsurveyed habitat on federal lands includes an area within a recently proposed reroute and surveys were initiated in 2018. Because permission to survey on non-federal lands only targeted an area of 50 feet from the Pipeline Project, habitat outside the targeted area but within the 30-meter (98-foot) botanical analysis area (buffer on non-federal lands) would likely not be surveyed. Pacific Connector will continue to survey habitat following the two-year survey protocol where permission is granted. Where survey access has been denied, Pacific Connector would conduct one year of surveys in suitable habitat prior to construction. Until survey data are obtained, for purposes of analysis, a conservative assumption can be made that a similar percent of the unsurveyed area would contain suitable habitat (compared to the areas where surveys have been completed), which means approximately 201 acres within the botanical analysis area (83.6 percent of 241 acres; 42 acres within the Project right-of-way) could be suitable Gentner's fritillary habitat.

Survey Results

Surveys for Gentner's fritillary have occurred within suitable habitat in the vicinity of the Pipeline Project from 2007 through 2018. Surveys are expected to continue to complete second year survey efforts where necessary, as well as initiate surveys in other areas where survey permission is granted. Since 2007, Project-specific surveys have identified five sites with Gentner's fritillary, of which three sites are within the botanical analysis area (SBS 2008a, 2011, 2013b):

- In 2011, three flowering plants and nine *Fritillaria* spp. leaves were documented approximately 21 feet southeast of TEWA 128.01-W near MP 128.1; subsequent surveys for an unrelated BLM Project identified approximately 150 *Fritillaria* spp. leaves (figure 3.7.2-1).
- In 2013, two flowering plants were documented near MP 129.1 approximately 54 feet northeast of TEWA 128.96-N. Additionally, at least 500 *Fritillaria* spp. leaves, of which some could be Gentner's fritillary, were observed in this approximately 0.30-acre area (figure 3.7.2-2). One flowering plant was observed in this area again in 2015 (ORBIC 2017c; SBS 2015).
- In 2008, one flowering Gentner's fritillary plant was located near MP 142.10 within 21 feet of proposed TEWA 142.07-N. Pacific Connector subsequently modified TEWA 142.07-N to avoid the documented flowering Gentner's fritillary plant. There were 18 additional *Fritillaria* spp. leaves located within 150 feet of the flowering site, as well as two other flowering fritillary species (scarlet fritillary and chocolate lily). It is possible that some of the leaves located within this area could be Gentner's fritillary; therefore, a larger area (approximately 0.83 acre) which includes all unidentified *Fritillaria* spp. leaves documented is considered part of the potential Gentner's fritillary population area that occurs within TEWA 142.07-N and the construction right-of-way (figure 3.7.2-3).

- Two additional sites were documented during 2008 surveys along existing roads, including one flowering plant and two *Fritillaria* spp. leaves approximately 0.38 mile north of MP 128.05 near Indian Creek and 50 feet below a four-wheel-drive road, and four flowering plants 1.0 mile southwest of MP 128.2 and 100 feet from the existing road, which was verified again in 2010 (ORBIC 2017a). These sites are located along roads that will no longer be used for the Pipeline Project.

The five sites identified during survey efforts for the Pipeline are 0.4 to 11.2 miles from each other and therefore are not considered a "population center" by the recovery plan definition (four or more locations must occur within 0.3 mile of each other; FWS 2003c). However, the BLM and Forest Service have indicated that additional populations have been observed in the vicinity of the Pipeline Project during survey efforts for unrelated projects, and, in conjunction with the sites located for the Pipeline Project, would be considered a population center.[47]

[47] The Gentner's fritillary sites in Township (T.) 34S, Range (R.) 1E, Section 25 are considered a "population center" because there are four known locations within 0.3 mile of each other, with another three locations within 0.4 mile of the group of four. This cluster of populations is located in the center of Recovery Unit 3, which consists of intersecting circles around a cluster of populations in the Antioch Road area and a cluster of populations in the Cobleigh Road area. The "Indian Creek" cluster and additional sites within 1.5 miles in Section 19, T.34S., R.1E and Section 29, T.34S., R.1E, create a third cluster of populations within Recovery Unit 3. Although FMAs have not been identified in this area, it is assumed that the Indian Creek cluster would be considered for designation as a management area. Hence, the BLM has an interest in protecting and augmenting these populations. Most of these populations were discovered by the BLM during botany clearance surveys conducted in preparation for renewing a grazing allotment permit (not connected with this Pipeline Project).

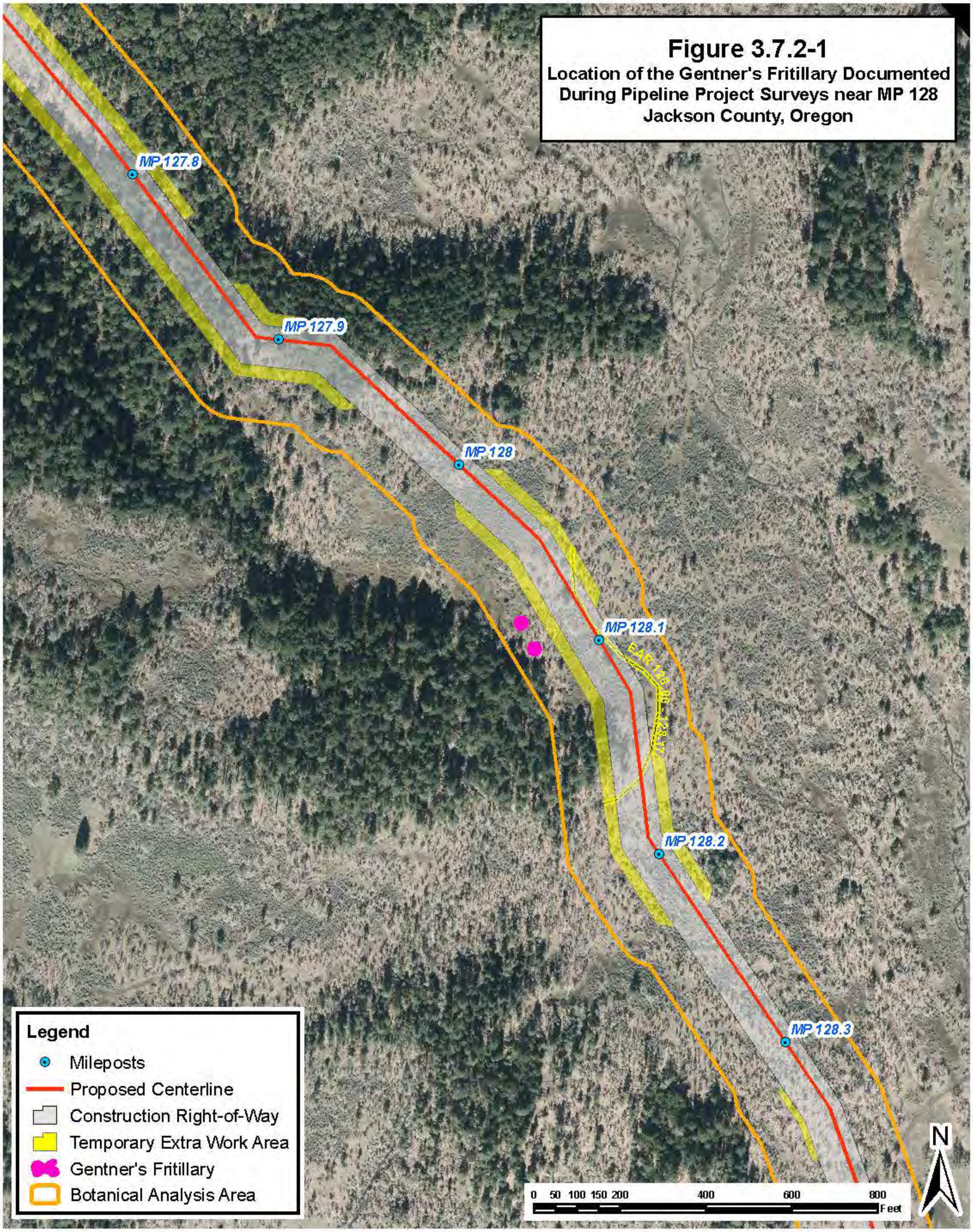


Figure 3.7.2-1
Location of the Gentner's Fritillary Documented
During Pipeline Project Surveys near MP 128
Jackson County, Oregon
MP 127.8
MP 127.9
MP 128
MP 128.1
MP 128.2
MP 128.3
Legend
Mileposts
Proposed Centerline
Construction Right-of-Way
Temporary Extra Work Area
Gentner's Fritillary
Botanical Analysis Area
0 50 100 150 200 400 600 800
Feet
N

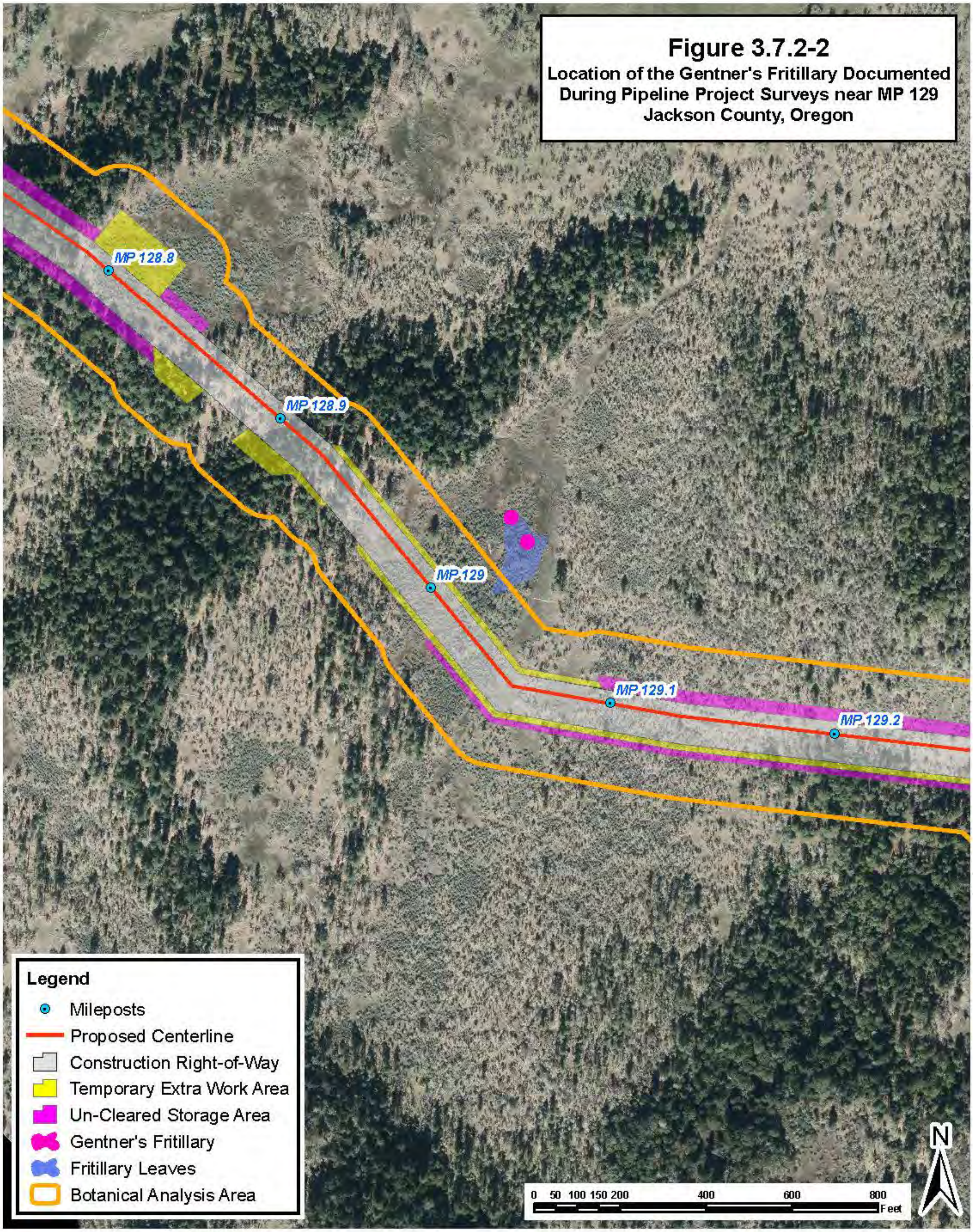


Figure 3.7.2-2
Location of the Gentner's Fritillary Documented
During Pipeline Project Surveys near MP 129
Jackson County, Oregon
MP 128.8
MP 128.9
MP 129
MP 129.1
MP 129.2
Legend
Mileposts
Proposed Centerline
Construction Right-of-Way
Temporary Extra Work Area
Un-Cleared Storage Area
Gentner's Fritillary
Fritillary Leaves
Botanical Analysis Area
0 50 100 150 200 400 600 800
Feet
N

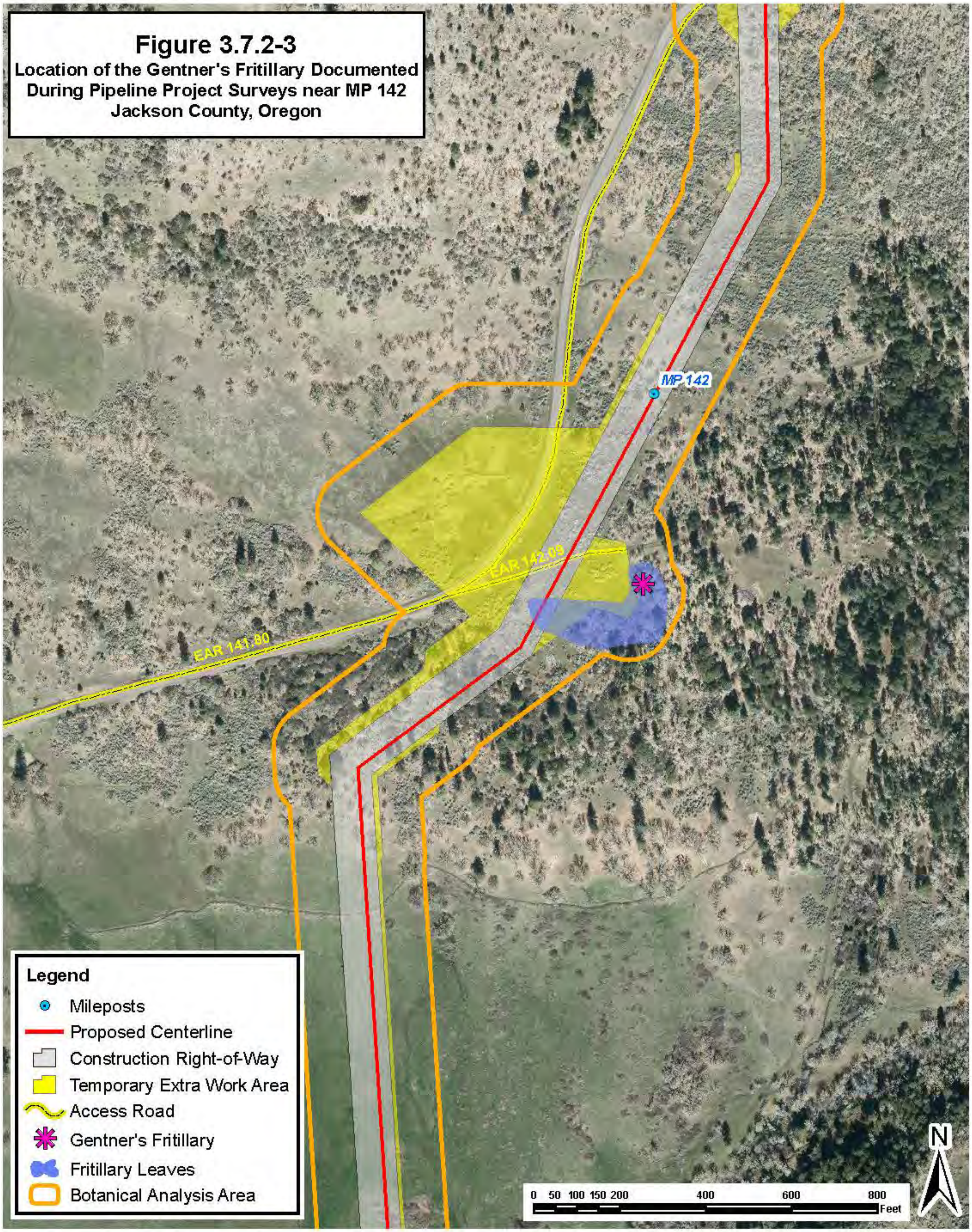


Figure 3.7.2-3
Location of the Gentner's Fritillary Documented
During Pipeline Project Surveys near MP 142
Jackson County, Oregon
MP 142
EAR 142.09
EAR 141.80
Legend
Mileposts
Proposed Centerline
Construction Right-of-Way
Temporary Extra Work Area
Access Road
Gentner's Fritillary
Fritillary Leaves
Botanical Analysis Area
0 50 100 150 200 400 600 800
Feet
N

Critical Habitat

Critical habitat has not been designated for Gentner's fritillary.

3.7.2.3 Effects of the Proposed Action

Direct and Indirect Effects

Five new Gentner's fritillary locations (supporting 11 flowering plants and 679 *Fritillaria* spp. leaves) were identified during surveys conducted for the Pipeline Project, of which three sites (six flowering plants, and 677 *Fritillaria* spp. leaves) occur within the botanical analysis area (figures 3.7.2-1, 3.7.2-2, and 3.7.2-3). As this species has very low overall population numbers, any loss of individual plants could be considered a substantial impact to the species.

No direct effects are expected at the two sites that are located within the 30-meter botanical analysis area but are 21 to 54 feet from the Pipeline project right-of-way near MP 128.1 and MP 129.1, respectively (figures 3.7.2-1 and 3.7.2-2). At the third site, near MP 142.1, Pacific Connector removed a portion of TEWA 142.07-N to avoid direct impact to the one flowering Gentner's fritillary plant documented at this site, following recommendations of the Habitat Quality Subtask Group on July 24, 2008. However, several unidentified *Fritillaria* spp. that could be Gentner's fritillary plants would be directly affected by construction of the Pipeline Project (figure 3.7.2-3 and figure G-3 in appendix V.2). Because the site near MP 142.1 consists of a single plant or perhaps a small cluster of plants, it is more vulnerable to extirpation due to even small-scale losses of habitat or plants (FWS 2003c). Pacific Connector has determined that a minor route adjustment of the proposed alignment at this location could be implemented to completely avoid direct effects to the potential Gentner's fritillary sub-population, including the unidentified *Fritillaria* spp. leaves; however, Pacific Connector would need to consult with the landowner to determine if the landowner is agreeable to the revised route. Pacific Connector would conduct additional surveys of this area prior to construction to verify species and/or locate the extent of the potential subpopulation and/or additional *Fritillaria* spp. leaves and incorporate additional survey information within a route adjustment prior to construction.

Because Gentner's fritillary does not flower every year and remains dormant underground for one or more years, it is likely that not all plants within areas surveyed for the Pipeline Project were documented during the two-year survey effort. Therefore, although no direct impacts are expected to identified plants, it is possible that construction activity within identified suitable habitat could directly impact currently unidentified plants. However, Pacific Connector intends to conduct at least one year of additional surveys prior to construction and, if plants are documented, direct impacts would be avoided or minimized where possible following measures outlined in the Gentner's Fritillary Mitigation Plan (see Attachment 3 within the *Federally-listed Plant Conservation Plan*, appendix V.2).

Approximately 241 acres (table 3.7.2-1) of suitable and potentially suitable habitat between MPs 113 and 155 would be disturbed by construction of the Pipeline. Construction could result in indirect impacts to Gentner's fritillary plants and habitat within 30 meters of the Pipeline Project, which would include: 1) changes in hydrology and soil characteristics; 2) a potential increase in invasive plants and noxious weeds, which could create additional competition for Gentner's fritillary plants; 3) increased fugitive dust, which could clog stomatal openings in leaves and impede gas exchange, as well as reduce light availability at the leaf surface that could affect plant growth and seed production; and 4) alterations of vegetation cover and species composition, which could alter habitat or impact shading and other interspecific interactions that could negatively impact this species or its ability to re-colonize disturbed areas.

The suitable habitat in the analysis area that would be affected represents a very small portion of total suitable habitat in the species' range (SBS 2008c); therefore, direct or indirect disturbance to habitats within or adjacent to the Pipeline Project is not expected to impede recovery of the species. To control the potential introduction and spread of invasive plants and noxious weed, Pacific Connector would implement the procedures outlined in their IPM (see Appendix N to Pacific Connector's POD [appendix B to this BA]). Application of dust abatement measures included in Pacific Connector's *Air, Noise and Fugitive Dust Control Plan* (see Appendix B to Pacific Connector's POD [appendix B to this BA]) would minimize the potential for fugitive dust impacts to Gentner's fritillary plants and its habitat during construction.

Operation and maintenance of the Pipeline Project would occur within suitable Gentner's fritillary habitat. Vegetation within the 30-foot operational corridor would be periodically maintained using mowing, cutting, trimming, and selective herbicide use. Maintenance activities are expected to occur approximately every three to five years depending on vegetation growth rate. However, these activities should not have an adverse effect on Gentner's fritillary because Pacific Connector has indicated maintenance activities within suitable habitat, if necessary, would occur outside the critical growing and flowering season (April through May). If noxious weed infestation occurs within the 50-foot permanent easement, selective use of herbicides or mechanical treatments would be used to control weeds within proximity to the species. The Applicant's procedures to protect sensitive species and habitats are outlined in their IPM (see Appendix N to Pacific Connector's POD [appendix B to this BA]).

Critical Habitat

Critical habitat has not been designated for Gentner's fritillary; therefore, no designated critical habitat for this species would be impacted.

3.7.2.4 Conservation Measures

As described above for the Applegate's milk-vetch (see section 3.7.1.4), Pacific Connector has developed a *Federally-listed Plant Conservation Plan* to address how avoidance, minimization, propagation, seed collection, restoration, and other conservation measures would be applied to protect listed plant species, as well as how potential impacts on un-surveyed lands would be addressed. This plan also contains a *Gentner's Fritillary Mitigation Plan* that specifically addresses how avoidance and minimization measures would be implemented for Gentner's fritillary (see Attachment 3 within the *Federally-listed Plant Conservation Plan*, appendix V.2).

If additional plants are observed during surveys, the avoidance/conservation measures included in the *Gentner's Fritillary Mitigation Plan* would implemented, where feasible (appendix V.2). Avoidance measures may include necking down the construction right-of-way, excluding a portion of an identified TEWA or pipe storage yard, or erecting a protective fence to avoid impact to plants from construction debris. If it is determined that avoidance is not possible, propagation of collected bulblets followed by offsite cultivation for population augmentation could be a viable conservation measure (SBS 2008a). This procedure would include:

- identification and tagging plants for propagation during spring flowering (April in lower elevation, May in higher elevations);
- collection of bulblets during dormant season (August through November);
- cultivation of bulblets off-site; or
- replanting of grown-out bulbs in subsequent years' dormant season.

Additionally, similar avoidance and conservation measures described above in section 3.7.1.4 for Applegate's milkvetch and as described in the *Gentner's Fritillary Mitigation Plan* (appendix V.2) would be implemented, to avoid or minimize effects to Gentner's fritillary plants and habitat.

3.7.2.5 Determination of Effects

Species

The Project may affect Gentner's fritillary because:

- suitable habitat occurs within the botanical analysis area, and
- individual plants have been located within the analysis area during survey efforts.

The Project is **likely to adversely affect** Gentner's fritillary because:

- approximately 241 acres of potential suitable habitat that has not been surveyed occurs within the botanical analysis area along the pipeline route, which includes 50.4 acres within the Pipeline right-of-way; therefore, it is possible that unidentified plants occur within the construction right-of-way and workspace;
- Gentner's fritillary can remain dormant underground for one year or longer, does not flower every year, and has been documented to not flower for several years; therefore, it is possible that protocol surveys conducted for the Pipeline project did not locate this species;
- *Fritillaria* spp. have been identified within and adjacent to the Pipeline Project, and could be affected by the Project; and
- indirect effects, including potential changes in hydrology and soil characteristics, introduction and spread of invasive plants and noxious weeds , alterations to vegetation cover and species composition of associated habitat, and effects from fugitive dust, could impact documented or suspected plants and habitat outside the construction right-of-way, but within 30 meters (98 feet) of the Project pipeline.

Critical Habitat

Critical habitat has not been designated for Gentner's fritillary.

3.7.3 Large-Flowered Woolly Meadowfoam

The large-flowered woolly meadowfoam (*Limnanthes pumila* ssp. *grandiflora*) is an annual plant species in the meadowfoam family (Limanthaceae). It is restricted to the wetter, inner fringes of vernal pools at elevations between 1,220 and 1,540 feet. The plant is found in the Agate Desert in the Rogue River Valley of Jackson County, Oregon (FWS 2002b and 2010c).

3.7.3.1 Species Account and Critical Habitat

Status

The large-flowered woolly meadowfoam was listed as endangered on November 7, 2002 (FWS 2002b). In 2010, FWS (2010c) designated eight CHUs (5,840 acres) for this species in Jackson County, Oregon in the Agate Desert complex.

Threats

A major factor in the FWS 2002 listing of the large-flowered woolly meadowfoam was the present or threatened destruction, modification, or curtailment of its habitat (vernal pools) and range (FWS 2002b). Due to recent rapid population increases in the region, the primary threats to the plant's habitat and range in the Agate Desert (Jackson County, Oregon) are industrial, commercial, and residential development and their residual road and utility construction and maintenance that include mowing, herbicide use, firebreak construction, and hydrologic alteration (mostly for agriculture) (FWS 2002b). Other threats to this species include competition, particularly from introduced annual grass species, and grazing, which can reduce or eliminate populations of this species (FWS 2002b).

Grazing can have a mixed effect on large-flowered woolly meadowfoam. The effect of grazing on suitable habitat depends on how the grazing is managed. There are various reports showing that grazing practices can positively or negatively affect native plant species' richness (Marty 2005). Wet season grazing resulted in a decrease of native forb species at vernal pool edge habitat, but year-round or off-season grazing improved species' richness through reducing competition with rough/weedy species (Marty 2005).

Although disease (e.g., fungal infections), herbivory, and the meadowfoam fly (*Scaptomyza apicalis)* have been identified as potential problems, no data other than casual observations exist to suggest that these factors currently pose a substantial threat to the species (FWS 2012j).

Species Recovery

In November 2012, the FWS finalized the *Recovery Plan for Rogue and Illinois Valley Vernal Pool and Wet Meadow Ecosystems* that identifies nine core areas for protection of large-flowered woolly meadowfoam in the Rogue Valley (FWS 2012j). Four Priority 1 core areas are identified by the FWS as areas essential to prevent extinction or irreversible decline of this species, and five Priority 2 core areas are identified as areas necessary to prevent a significant decline in the species population or habitat quality or some other significant negative impact (FWS 2012j). The recovery objectives outlined in the recovery plan specific to the large-flowered woolly meadowfoam include:

- stabilize and protect populations of large-flowered woolly meadowfoam in core areas so further decline in the species' status and range are prevented;
- minimize or eliminate the threats that caused the species to be listed, and any other newly identified threats, in order to be able to delist the species;
- conduct research necessary to refine downlisting and recovery criteria;
- promote natural ecosystem processes and functions by protecting and conserving, in identified core areas, intact vernal pool-mounded prairie complexes and seasonally wet

serpentine-derived grassland meadows, sloped mixed-conifer forest openings, and shrub dominated plant communities.

Delisting criteria specific to large-flowered woolly meadowfoam include:

- At least 17 of 18 occurrences for large-flowered woolly meadowfoam (approximately 95 percent of documented/extant occurrences) should be protected from development.
- At least 95 percent of suitable vernal pool habitat acreage within the four Rogue Valley Priority 1 core areas and at least 90 percent of suitable vernal pool habitat acreage within the five Priority 2 core areas for the species has been protected from development. All suitable habitat must include soils and hydrology that support the plant species.
- Development of conservation oriented management plans for each protected core area to guide protection and conservation; management plans should address vegetation control such as noxious weed control, monitoring, and maintenance of hydrological function.
- Additional species occurrences identified through future site assessments, GIS, other analyses, or status surveys, and that are determined essential to recovery, are protected.
- Status surveys, status reviews, and population monitoring show achievement of self-sustaining populations, as confirmed through species monitoring and status surveys in each protected occurrence. Population trends must be shown to be stable, increasing, or exhibiting only slight declines from high population levels during a 10-year period prior to consideration for delisting following downlisting, and implementation of management plans is effectively managing or eliminating threats.
- Seeds from each core area should be collected and stored as insurance against the risk of extirpations and to ensure that genetic lines are preserved. Seed banking is also necessary to complete the reintroductions or introductions that can contribute to meeting recovery criteria.

Life History, Habitat Requirements, and Distribution

The large-flowered woolly meadowfoam is an annual herb endemic to the Agate Desert area, primarily in the Rogue River Valley, in southern Oregon. It typically grows on the wetter, inner edges of vernal pools, and is not known from wet meadows; however, in some areas it has been observed on low upland mounds (FWS 2012j). Vernal pool-mounded prairie habitats sustain wet soils needed for growth and flowering, and the shallow pools provide for nutlet dispersal for this species' relatively short life cycle (FWS 2006f). The plant is capable of self-fertilization and self-pollination. Flowering occurs between March and May, with flowers producing nutlets. These nutlets may be dispersed by water, but normally only for short distances; therefore, it is likely that they do not disperse beyond their pool or swale of origin without transportation of mud or substrates containing nutlets (such as on the legs or feet of water birds, or on animal fur).

Large-flowered woolly meadowfoam occupies a limited portion of the Rogue Valley. The plant typically occurs in areas mapped with Agate-Winlo soils (FWS 2012j). There are no major ecological, genetic, or geographic barriers separating extant and historical large-flowered woolly meadowfoam occurrences, apart from agricultural and rural development and road systems. All known populations comprise approximately 440 acres, and are grouped into nine core areas that are separated by at least 1 km (0.7 mile; FWS 2012j). In the Rogue River Valley, large-flowered woolly meadowfoam is found in the same vernal pool habitats as Cook's lomatium and the vernal pool fairy shrimp.

Population Status

Since listing of the large-flowered woolly meadowfoam in 2002, the number of known populations (or occurrences) has increased. At the time of listing in 2002, there were 15 known occurrences of large-flowered woolly meadowfoam. In 2006, a draft recovery plan for listed species of the Rogue Valley vernal pool ecosystem was developed that indicated 22 occurrences were known (FWS 2006f). The most recent five-year review of the species in 2011 noted that 23 occurrences are known (FWS 2011g). Portions of 12 occurrences occur on public lands, within conservation easements, or on lands managed by TNC (FWS 2009e), and thus are protected from development. The population of this species fluctuates annually depending on precipitation and temperature, and so fluctuating populations at the various sites of occurrence have a broad range of approximately 100 to 100,000 (FWS 2006f). In April of 2017, the FWS initiated a 5-Year Status Review (FWS 2017c).

Critical Habitat

Critical habitat was designated in 2010 and included eight CHUs in Jackson County totaling 2,363 hectares (5,840 acres; FWS 2010c). The PCEs for large-flowered woolly meadowfoam critical habitat include (FWS 2010c):

1. Vernal pools or ephemeral wetlands and the adjacent upland margins of these depressions that hold water for a sufficient length of time to sustain large-flowered woolly meadowfoam germination, growth, and reproduction, between elevations of 1,220 to 1,540 feet, a minimum of 20 acres, and associated with specific dominant native plants.
2. The hydrologically and ecologically functional system of interconnected pools, ephemeral wetlands, or depressions within a matrix of surrounding uplands that together form vernal pool complexes within the greater watershed.
3. Silt, loam, and clay soils that are of alluvial origin, with a 0 to 3 percent slope, primarily classified as Agate-Winlo complex soils, but also including Coker clay, Carney clay, Provig–Agate complex soils, and Winlo very gravelly loam soils.
4. No or negligible presence of competitive, nonnative, invasive plant species.

In the Rogue River Valley, large-flowered meadowfoam is found in the same vernal pool habitats as Cook's lomatium and the vernal pool fairy shrimp, and as a result, most of the CHUs designated for large-flowered woolly meadowfoam partially overlap designated habitat for Cook's lomatium and/or vernal pool fairy shrimp. For example, two units designated for the large-flowered woolly meadowfoam in Jackson County are shared by the designated critical habitat for Cook's lomatium (i.e., White City and Whetstone Creek; see below for more details).

3.7.3.2 Environmental Baseline

Analysis Area

For most listed plant species, the botanical analysis area extends to 30 meters (98 feet) each side of the Pipeline Project (construction right-of-way, TEWAs, UCSAs, rock source and disposal sites, and proposed storage yards) on lands that have potential habitat for listed plant species. This area generally corresponds to the extent of the area surveyed for sensitive and listed plant species during surveys conducted between 2007 and 2017 (at least 100 feet from habitat removal on federal lands and at least 50 feet from habitat removal on non-federal, private lands), and correlates to a distance that indirect effects to plants would be expected. However, for the large-flowered woolly meadowfoam, the analysis area was extended 250 feet from the perimeter of four proposed pipe storage yards that are located within the Agate Desert Vernal Pool Complex in Jackson County, Oregon (figure 3.7.3-1), as well as along the Pipeline Project right-of-way where Agate-Winlo complex soils occur. This is a distance within which indirect effects from the proposed action could occur to vernal pools supporting this species (FWS 2011g).

Species Presence

Within the vicinity of the Pipeline Project, large-flowered woolly meadowfoam is known to occur within the Agate Desert and is associated with Agate-Winlo soils in Jackson County, Oregon. There are multiple records of large-flowered woolly meadowfoam within the Agate Desert southwest of the pipeline right-of-way (ORBIC 2017c). The closest recorded occurrence is a population last observed in 1982 approximately 3.3 miles southwest of MP 125.3. Other, more distant populations occur 5.8 to 6.9 miles southwest of the pipeline right-of-way, including, one population of about 400 plants observed in 1995, another population observed in 2000 with approximately 1,000 plants, and a population discovered in 2008 with about 500 plants scattered across 100 acres. ORBIC (2017c) has reported several other subpopulations of large-flowered woolly meadowfoam (16,200 plants) in the vicinity of proposed pipe storage yards (Burrill Lumber, WC Short, Avenue F & 11th Street, and Rogue Aggregates), including within the Ken Denman State Game Management Preserve across an existing paved road and approximately 100 feet east of the Burrill Lumber pipe storage yard (ORBIC 2017b; figure 3.7.3-1).

Project-Specific Surveys

Habitat Surveyed

A habitat review was conducted prior to the beginning of field surveys in 2007 to identify potential habitat and delineate survey areas for large-flowered woolly meadowfoam within the botanical analysis area and along existing roads identified for access to the construction right-of-way. Aerial photographs and knowledge of regional landscape and biological and physical features (e.g., soils, geology, topography, elevation, target species habitat, and plant community habitat) were used to determine potential habitat. These same methods were applied to determine areas of suitable habitat in new locations where the proposed right-of-way and facilities have been relocated or altered since 2007. Habitat found to be "suitable" during surveys included areas with some of the characteristics detailed in the Life History, Habitat Requirements, and Distribution section under section 3.7.3.1.

Four pipe storage yards, Burrill Lumber, WC Short, Avenue F & 11th Street, and Rogue Aggregates, have been proposed within the Agate Desert near White City in Jackson County in proximity to known occupied vernal pools and designated large-flowered woolly meadowfoam critical habitat (figure 3.7.3-1). With the exception of Rogue Aggregates, all pipe storage yards proposed occur on Agate-Winlo complex soils. Although the pipe storage yards are within existing industrial sites, protected vernal pools that may support the large-flowered woolly meadowfoam could be present. Where survey access was permitted, pipe storage yards were evaluated on-site to identify vernal pool habitat, and where vernal pools were observed, surveys for large-flowered woolly meadowfoam occurred.

Surveys for large-flowered woolly meadowfoam occurred in the proposed Burrill Lumber pipe storage yard and Rogue Aggregates pipe storage yard in 2007. During these surveys, the area evaluated for the Burrill Lumber pipe storage yard was much larger than the currently proposed configuration. Approximately 4.4 acres of high quality suitable vernal pool habitat, as well as 36 large-flowered woolly meadowfoam were observed during these surveys (figure 3.7.3-1; SBS 2008a, 2008b). This high quality vernal pool habitat and observations of large-flowered woolly meadowfoam are located about 850 to 1,165 feet east of the currently proposed Burrill Lumber pipe storage yard. No vernal pools or individuals of large-flowered woolly meadowfoam were identified in the Rogue Aggregates pipe storage yard or the area currently proposed for the Burrill Lumber pipe storage yard.

In 2018, habitat north of Burrill Lumber pipe storage yard was assessed off-site to determine if possible vernal pools were present within 250 feet of the yard. Based on observations from Agate Road and review of aerial photography, no potential vernal pools are located within 250 feet of Burrill Lumber pipe yard. No vernal pools were observed in the Rogue Aggregates pipe storage yard during surveys conducted in 2007. Although the Rogue Aggregates pipe storage yard has been reconfigured since surveys in 2007, portions not included in previous survey efforts for the Pipeline Project are not expected to provide suitable habitat for large-flowered woolly meadowfoam because they do not contain suitable soil types.

No surveys have been permitted within the Avenue F & 11th Street and WC Short pipe storage yards. Based on aerial photography and off-site observation in April 2018, the Avenue F & 11th Street and WC Short pipe storage yards do not appear to contain vernal pools. The Avenue F & 11th Street pipe yard is highly disturbed and graded, with railroad and docking facilities located on the southern edge of the yard, and the WC short pipe yard is an existing train yard that would assist moving and off-loading pipe. Although vernal pools do not appear to be present in the Avenue F & 11th Street pipe storage yard, there is a long drainage ditch that runs along the northern edge of the pipe storage yard and paved Avenue F road and extends south along the western edge of the yard. The approximately 0.46-acre drainage has very little movement and could be considered low quality vernal pool habitat; however, because of the existing disturbance at this pipe storage yard, this habitat is not expected to support large-flowered woolly meadowfoam. No potential vernal pools have been identified in the WC Short pipe storage yard. Two small exposed drainage ditches (0.02 acre), in an otherwise underground piped drainage system, are present and experience occasional high flow. They are located along an existing access road (Avenue G) within the WC Short pipe storage yard and would not be considered potential vernal pool habitat.

Although out of the expected range of large-flowered woolly meadowfoam, nine vernal pools located in Agate-Winlo soils (approximately 0.2 acre) within and adjacent to the Pipeline Project on private lands between MPs 145.3 and 145.4 were also surveyed in 2007; no large-flowered woolly meadowfoam were documented (SBS 2008a).

Approximately 190.29 acres within 250 feet of proposed pipe storage yards, including Avenue F & 11th Street and WC Short pipe storage yards have not been evaluated on-site for vernal pool habitat. Off-site observations determined that of this 190.29 acres, approximately 174.28 acres did not contain suitable vernal pool habitat, 0.46 acre consists of highly modified, low quality vernal pool habitat, and 15.55 acres consists of a upland habitat within 100 feet of potential vernal pool habitat (i.e., “vernal pool complex”; see table 3.6.1-1). Although the 0.46 acre of potential vernal pool habitat has not been surveyed on-site for large-flowered woolly meadowfoam, the area is associated with active industrial sites or previously disturbed industrial areas and is not expected to provide high quality vernal pool habitat for the large-flowered woolly meadowfoam.

Survey Results

Within the high-quality vernal pool habitat east of the proposed Burrill Lumber pipe yard, four small patches, containing 36 large-flowered woolly meadowfoam plants, were observed (figure 3.7.3-1). This observation is located approximately 850 to 1,165 feet east of the currently proposed pipe storage yard. The site is located on a portion of the property that has not been heavily modified (SBS 2008a). The plants located are suspected to be part of a larger large-flowered woolly meadowfoam population located to the east within critical habitat subunit RV6D. No other large-flowered woolly meadowfoam plants were observed within vernal pool habitat during surveys for the Pipeline Project.

Critical Habitat

Within the vicinity of White City, Oregon where four pipe storage yards are proposed, CHUs RV6 (6A through 6H) and RV8 have been designated; all units are surrounded by industrial parks and agriculture. Both CHUs consist of intact vernal pool-mounded prairie and swale habitats (FWS 2010c). Two of the eight RV6 subunits (i.e., RV6B, RV6C, and RV6D) are near or adjacent to proposed pipe storage yards: unit RV6C is across an existing paved road from Burrill Lumber pipe storage yard and unit RV6D is 590 feet northeast of Burrill Lumber pipe storage yard. CHU RV8 is over 1.8 miles west of the proposed Rogue Aggregates and the other three pipe storage yards (figure 3.7.3-1).

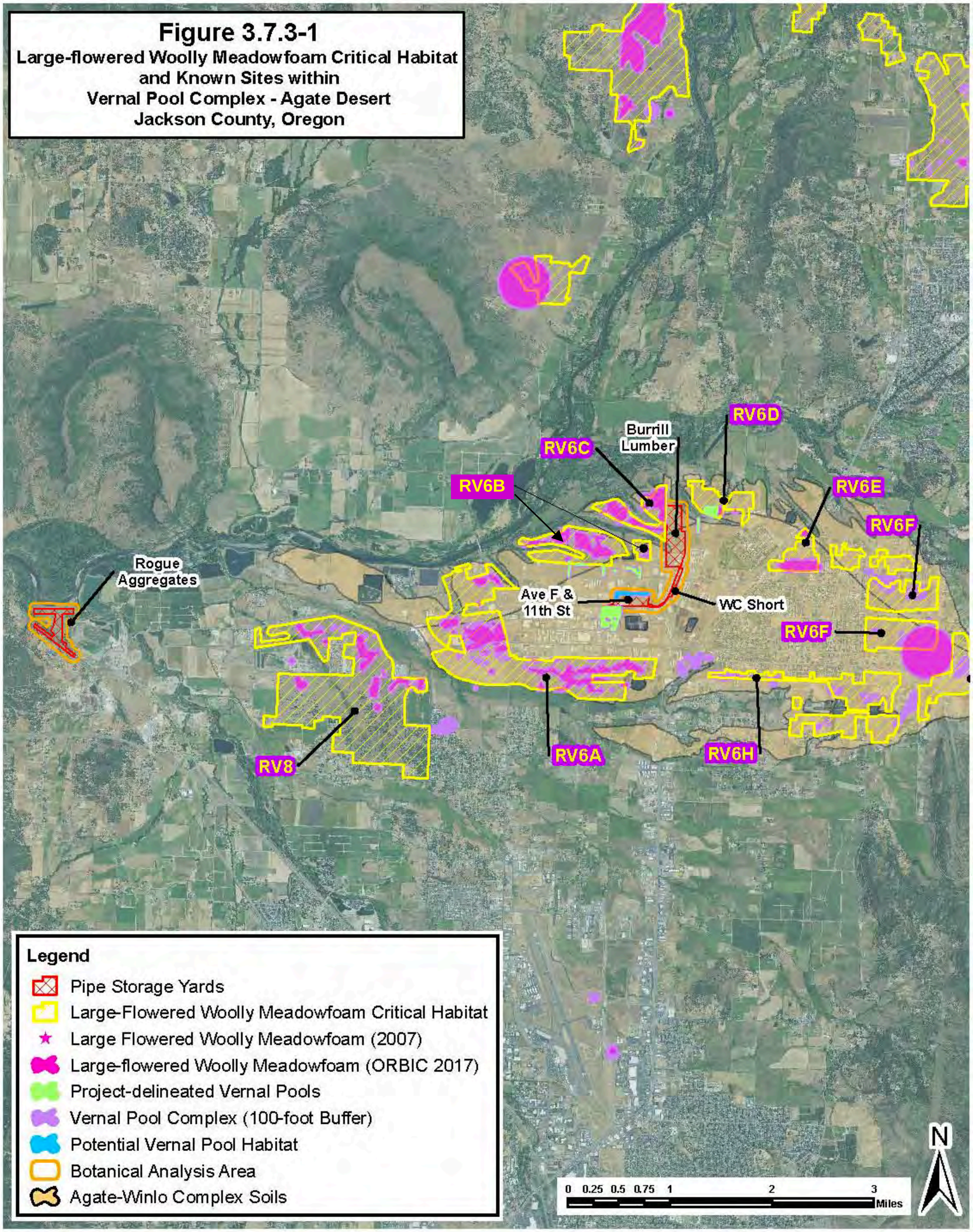


Figure 3.7.3-1
Large-flowered Woolly Meadowfoam Critical Habitat and Known Sites within Vernal Pool Complex - Agate Desert Jackson County, Oregon
Burrill Lumber
RV6D
RV6C
RV6B
RV6E
RV6F
Rogue Aggregates
Ave F & 11th St
WC Short
RV6F
RV8
RV6A
RV6H
Legend
Pipe Storage Yards
Large-Flowered Woolly Meadowfoam Critical Habitat
Large Flowered Woolly Meadowfoam (2007)
Large-flowered Woolly Meadowfoam (ORBIC 2017)
Project-delineated Vernal Pools
Vernal Pool Complex (100-foot Buffer)
Potential Vernal Pool Habitat
Botanical Analysis Area
Agate-Winlo Complex Soils
0 0.25 0.5 0.75 1 2 3
Miles
N

3.7.3.3 Effects of the Proposed Action

Direct and Indirect Effects

Possible direct effects to large-flowered woolly meadowfoam include disturbance to vernal pool habitat from driving on or storing equipment or pipes near or on vernal pools or wetlands associated with this species. Direct effects to the meadowfoam and its habitat could be expected in vernal pools and upland habitat within 100 feet from delineated vernal pool habitat. Because no vernal pool habitat has been documented in surveyed Jackson County proposed pipe storage yards (Burrill Lumber and Rogue Aggregates), and because Pacific Connector has committed to avoiding vernal pool habitats in pipe storage yards by at least 250 feet or would remove a pipe storage yard from further consideration if vernal pool habitat is documented during future surveys (see Conservation Measures, below), no direct impacts to known large-flowered woolly meadowfoam are anticipated from use of pipe storage yards in Jackson County. Additionally, surveys conducted in suitable vernal pool habitat along the pipeline right-of-way between MPs 145.3 and 145.4 did not locate large-flowered woolly meadowfoam plants; therefore, no direct effects to large-flowered meadowfoam along the pipeline right-of-way are expected.

Indirect effects to large-flowered woolly meadowfoam and its habitat could occur with increased road use to access the pipe storage yards, as well as pipe storage yard activities that are adjacent or near suitable or potentially suitable habitat. Although increased road use on paved Agate Road is not expected to increase fugitive dust, pipe storage yard activities and the associated dust created might impact vernal pool habitat within 250 feet of activities as dust settles, affecting vegetation and vernal pool physical or chemical properties (e.g., pH, water quality, turbidity, sedimentation, temperature). Increased dust levels can negatively impact plants by clogging stomatal openings in the leaves, impeding gas exchange and reducing the ability of plants to take in carbon dioxide. Dust on the leaf surface can also effectively reduce light availability at the leaf surface and thereby reduce plant growth and seed production. Given that the nearest known large-flowered woolly meadowfoam plants are approximately 100 feet west of the Burrill Lumber pipe storage yard and are separated by an existing, paved access road, the effects of dust on known plants is likely insignificant and discountable.

Project use of pipe storage yards adjacent to, or within 250 feet of, suitable or potentially suitable habitat may also indirectly affect the hydrology upon which vernal pools and associated vegetation are dependent (e.g., through potential soil compaction from heavy equipment use). Indirect effects to hydrology could be expected within 250 feet of suitable or potentially suitable vernal pool habitat (see FWS 2011g). Effects could include altering hydrologic processes, such as runoff patterns because of soil compaction, as well as the potential for increased abundance of non-native invasive plant species. Any potential compaction that may occur at the yard would likely be insignificant because of the previous industrial use of these areas and associated soil grading. Based on topographic maps, flow patterns in the area are to the northwest, away from the 36 large-flowered woolly meadowfoam plants documented in 2007, and approximately 850 to 1,165 feet east of Burrill Lumber pipe storage yard; therefore, no indirect impact to these plants from hydrologic impact would be anticipated. Additionally, any westerly flow from the Burrill Lumber pipe storage yard into CHU RV6C would be intercepted by the raised roadbed of paved, Agate Road.

No other direct or indirect effects to potential vernal pools are expected from use of unsurveyed pipe storage yards in Jackson County, including the 0.46 acre of potential vernal pool wetlands and 15.55 acres of vernal pool complex identified from off-site observations within or adjacent to Avenue F & 11th Street and WC Short pipe yards. Implementation of conservation measures included in section 3.7.3.4 would minimize impacts to potential vernal pool habitat and large-flowered woolly meadowfoam plants, if present.

Critical Habitat

One designated critical habitat subunit (RV6C) is located approximately 100 feet west of Burrill Lumber pipe storage yard across existing paved, Agate Road; no direct impacts due to the Pipeline Project are anticipated because equipment and pipe storage would not occur near or in vernal pools or wetlands located in the critical habitat subunits, nor would traffic to and from the pipe storage yards drive near or in vernal pools within the CHU. Additionally, the known large-flowered woolly meadowfoam plant sites located in CHU RV6C are over 100 feet from the proposed Burrill Lumber pipe storage yard (Friedman 2006; ORBIC 2017c); therefore, no direct impact to those plant sites are expected. Another subunit, RV6D, is located approximately 590 feet (at its closest point) northeast of Burrill Lumber pipe storage yard, where survey efforts in 2007 located large-flowered woolly meadowfoam. The WC Short, Avenue F & 11th Street, and Rogue Aggregates proposed pipe storage yards are all over 1,500 feet from the nearest designated CHUs (figure 3.7.3-1); no direct impacts to any designated critical habitat from use of those pipe storage yards would occur.

Indirect effects to the designated CHUs in the vicinity of the four pipe storage yards proposed in Jackson County may occur as a result of increased road use to access the pipe storage yards that are adjacent to the CHUs (i.e., Agate Road) and use of Burrill Lumber pipe storage yard that is within 100 feet of critical habitat subunit RV6C. Although increased road use on paved Agate Road is not expected to increase fugitive dust, potential dust created from use of the Burrill Lumber pipe storage yard might impact large-flowered woolly meadowfoam critical habitat as dust settles, affecting associated vegetation and vernal pool physical or chemical properties (e.g., pH, water quality, turbidity, sedimentation, and temperature). PCE 1 specifies that at least 20 acres are essential for intact hydrology, and impacts to hydrology within critical habitat subunit RV6C may be expected if actions in the Burrill Lumber pipe storage yard alter hydrology within 250 feet (FWS 2011g). For example, use of the Burrill Lumber yard that includes ground disturbance such as soil compaction by heavy machinery may alter hydrology in vernal pools within critical habitat subunit RV6C, possibly affecting the frequency or amount of water in adjacent vernal pools, thereby altering the hydrology upon which vernal pools and associated vegetation are dependent. However, RV6C is separated from the Burrill Lumber pipe yard by the raised roadbed of Agate Road; therefore, it is highly unlikely that hydrology within RV6C would be impacted by use of the Burrill Lumber pipe storage yard. Additionally, the use of the roads adjacent to the CHUs and the pipe storage yards may increase the introduction of non-native, weedy species. PCE 4 specifies that no or negligible presence of competitive nonnative invasive plant species be present for the continued survival and recovery of large-flowered woolly meadowfoam. Pacific Connector has developed an IPM (Appendix N to the POD [appendix B to this BA]) that includes measures that would be implemented to minimize the introduction and spread of noxious weeds.

CHU RV8 is located greater than 1.4 miles from proposed pipe storage yards in Jackson County (see figure 3.7.3-1). The Pipeline Project is not expected to directly or indirectly affect this CHU.

Applying the conservation measures identified below, the use/alteration/restoration of pipe storage yards should not result in modifications in the timing, duration, magnitude, or quality of hydrological connections to an off-site vernal pool and/or large-flowered woolly meadowfoam. Additionally, measures taken to minimize the introduction and spread of noxious weeds outlined in the IPM (Appendix N to the POD [appendix B to this BA]) would reduce the risk of spreading or establishing new nonnative weed species.

3.7.3.4 Conservation Measures

Pacific Connector has eliminated from further consideration the following previously proposed pipe storage yards to avoid potential effects to high-quality vernal pool habitat: Avenue C and 7th Street-Elite Cabinet & Door, Medford Industrial Park, and a portion of the previously delineated Burrill Lumber yard that included high quality vernal pool habitat east of the currently proposed yard. To avoid impacts to potential vernal pool habitat, as well as potential large-flowered woolly meadowfoam plants that may occur, although unlikely, along the northern and western edge of the Avenue F & 11th Street pipe yard, Pacific Connector would avoid using portions of this pipe storage yard within 250 feet of potential vernal pool habitat (boundary of indirect effects) or no longer pursue use of the pipe storage yard.

Pacific Connector would install sedimentation control barriers, as recommended in the Recovery Plan (FWS 2012j) to minimize the potential for offsite mobilization of surface flows or sediment. As described in section 3.6.1.4 for vernal pool fairy shrimp, a silt fence would be erected on the west side of the right-of-way within 250 feet of vernal pools located between MPs 145.27 and 145.44. Additional potential mitigation measures considered for large-flowered woolly meadowfoam, if identified in the area, would include implementation of stormwater measures outlined in the ECRP (see appendix F) to reduce the potential for increased sediment mobilization as well as erosion and dust control measures listed in the ECRP to minimize fugitive dust along the construction right-of-way or within pipe storage yards, and BMPs in the IPM (Appendix N to the POD [appendix B to this BA]) to control existing noxious weeds and prevent new infestations within and adjacent to occupied and potential habitats.

3.7.3.5 Determination of Effects

Species

The Project **may affect** large-flowered woolly meadowfoam because:

- the Pipeline Project occurs in the vicinity of occupied, large-flowered woolly meadowfoam habitat.

The Project is **not likely to adversely affect** large-flowered woolly meadowfoam because:

- surveys of potentially suitable habitat at proposed pipe storage yards in Jackson County and along the proposed Pipeline did not document large-flowered woolly meadowfoam plants;
- the 0.46-acre of unsurveyed potential habitat within the Avenue F & 11th Street pipe storage consists of low-quality vernal pool habitat within active industrial sites or previously disturbed industrial areas and is unlikely to contain large-flowered woolly meadowfoam plants;

- Pacific Connector would avoid using portions of proposed pipe storage yards within 250 feet (indirect effect) of large-flowered woolly meadowfoam plants or potentially suitable vernal pool habitat;
- effects on suitable habitat by the Pipeline Project are likely to be insignificant to the point where no meaningful measurement, detection, or evaluation of impact would be possible (i.e., effects would not reach a level where individual plants would be lost);
- sedimentation barriers would be used, as appropriate, to prevent run-off and changes in hydrology;
- conservation measures have been developed to avoid or minimize impacts to future plants identified during surveys prior to construction; and
- construction of the Pipeline Project is not expected to adversely modify hydrology in nearby suitable habitat areas within 250 feet of proposed pipe storage yards.

Critical Habitat

The Project **may affect** designated critical habitat for large-flowered woolly meadowfoam because:

- the Project occurs adjacent and near to large-flowered woolly meadowfoam designated critical habitat.

The Project is **not likely to adversely affect** large-flowered woolly meadowfoam critical habitat because:

- construction of the Pipeline Project is not expected to adversely modify designated critical habitat areas within 250 feet of components of the Pipeline Project (i.e., subunit RV6C); existing features (i.e., paved Agate Road) and proposed conservation measures would provide sufficient protection from adjacent development and invasive plants and noxious weed sources;
- the Burrill Lumber pipe storage yard is hydrologically disconnected from subunit RV6B and RV6D due to topography and distance (greater than 590 feet), and is hydrologically isolated from subunit RV6C by the raised Agate Road;
- no dust-related impacts from use of the Burrill Lumber pipe storage yard would be expected because Pacific Connector would implement measures in the *Air*, *Noise and Fugitive Dust Control Plan* (see Appendix B of the POD [appendix B to this BA]) to minimize potential impacts from fugitive dust; and
- implementation of measures outlined in the IPM (Appendix N to the POD [appendix B to this BA]) would reduce the risk of spread and introduction of invasive plants and noxious weed species.

3.7.4 Cook's Lomatium

Cook's lomatium (*Lomatium cookii*) is a perennial plant of the parsley (Apiaceae) family. It occurs 1) in shallow Agate-Winlo complex soils in sparse prairie vegetation, usually along vernal pools, in the Agate Desert area of the Rogue River Valley in Jackson County, Oregon, and 2) in seasonally wet serpentine-derived grassland meadows, sloped mixed-conifer forest openings, and along roadsides edges in shrub dominated plant communities or adjacent to meadows within the Illinois River Valley area near Cave Junction in Josephine County, Oregon (FWS 2012j). The

Josephine County populations occur on seasonally wet soils in the Illinois Valley. The Pipeline Project is not located in Josephine County, and this population and habitats are not discussed further.

3.7.4.1 Species Account and Critical Habitat

Status

Cook's lomatium was listed as endangered on November 7, 2002 (FWS 2002b). In 2010, the FWS designated critical habitat for Cook's lomatium (and concurrently for large-flowered woolly meadowfoam; FWS 2010c).

Threats

A major factor in the FWS 2002 listing of Cook's lomatium was the present or threatened destruction, modification, or curtailment of its habitat (vernal pools) and range. The primary threats to habitat and range are industrial, commercial, and residential development and their associated road and utility construction and maintenance, and livestock grazing. The FWS also found that competition from introduced grass species and grazing can reduce or eliminate populations (FWS 2002b). In addition, vandalism, in the form of intentional disregard or dismantling of signage or fencing intended to protect certain wetland areas from unauthorized OHV use, and subsequent damage resulting from that use, has resulted in negative effects to habitat. Lastly, although disease (e.g., fungal infections) and herbivory have been identified as potential threats, no data other than casual observations exist to suggest that these factors pose a current substantial threat to the species (FWS 2012j).

Species Recovery

In November 2012, the FWS finalized the *Recovery Plan for Rogue and Illinois Valley Vernal Pool and Wet Meadow Ecosystems* (FWS 2012j). The plan identifies 16 core areas, three in the Rogue Valley and 13 in the Illinois Valley, for protection of Cook's lomatium.

The recovery objectives outlined in the recovery plan include:

- stabilize and protect populations in core areas so further decline in the species' status and range are prevented;
- minimize or eliminate the threats that caused the species to be listed, and any other newly identified threats, in order to be able to delist the species;
- conduct research necessary to refine downlisting and recovery criteria;
- promote natural ecosystem processes and functions by protecting and conserving, in identified core areas, intact vernal pool-mounded prairie complexes and seasonally wet serpentine-derived grassland meadows, sloped mixed-conifer forest openings, and shrub dominated plant communities.

Delisting criteria specific to Cook's lomatium include:

- At least 34 of 36 occurrences for Cook's lomatium (approximately 95 percent of documented/extant occurrences) should be protected from development in conservation-oriented ownership (e.g., conservation easement, formal agreement, conservation bank). For occurrences that have become extirpated, reintroduced or introduced populations may be substituted. Introduced or newly discovered populations outside of currently known core areas may be substituted if the FWS deems them equivalent in their contribution to recovery.

- At least 95 percent of suitable vernal pool habitat acreage within each Priority 1 core areas and at least 90 percent of suitable vernal pool habitat acreage within the five Priority 2 core areas for the species has been protected from development. All suitable habitat must include soils and hydrology that support the plant species.
- Conservation oriented management plans, to guide protection and conservation, for each protected core area are developed following establishment of protected status (such as a conservation easement or transfer of ownership to land trusts or government entities).
- Additional species occurrences identified through future site assessments, GIS, other analyses, or status surveys, and that are determined essential to recovery, are protected.
- Status surveys, status reviews, and population monitoring show achievement of self-sustaining population, s as confirmed through species monitoring and status surveys in each protected occurrence. Population trends must be shown to be stable, increasing, or exhibiting only slight declines from high population levels during a 10-year period prior to consideration for delisting following downlisting, and implementation of management plans is effectively managing or eliminating threats.

Seeds from each core area should be collected and stored as insurance against the risk of extirpations and to ensure that genetic lines are preserved. Seed banking is also necessary to complete the reintroductions or introductions that can contribute to meeting recovery criteria.

Life History, Habitat Requirements, and Distribution

The Jackson County populations occur along the margins and bottoms of vernal pool habitats within the 20,510-acre Agate Desert. Located on the floor of the Rogue River basin north of Medford, the Agate Desert is characterized by shallow, Agate-Winlo complex soils, a relative lack of trees, sparse prairie vegetation, and agates commonly found on the soil surface. Fire may maintain suitable habitat because shrubs compete for sun and space, and a historical fire regime is thought to have prevented such shrubs from encroaching on Cook's lomatium habitat (FWS 2006f). Cook's lomatium plants in the Agate Desert are found on the margins and bottoms of vernal pools with standing water from December to April or May. The plant flowers from late March to May and is pollinated entirely by insects. Each flowering stalk produces either primarily male or female flower clusters (FWS 2006f). In the Rogue River Valley, Cook's lomatium is found in the same vernal pool habitats as the large-flowered woolly meadowfoam and the vernal pool fairy shrimp.

Population Status

Cook's lomatium occupies 146.5 acres in the Rogue Valley's Agate Desert; an estimated 4,086 acres of potential Cook's lomatium habitat is present within the area (FWS 2012j). In the Rogue Valley, Cook's lomatium is known from 13 occurrences, of which six are extant, six are unknown in status, and one is extirpated (FWS 2012j). In 2006, the total population of Cook's lomatium was estimated at 34,000 plants (FWS 2006f).

Critical Habitat

Critical habitat for Cook's lomatium was designated on July 21, 2010. Sixteen CHUs have been designated for the Cook's lomatium; including three CHUs in Jackson County, totaling 924 hectares (2,282 acres) (FWS 2010c). Two of the CHUs in Jackson County, White City and Whetstone Creek, are shared by the designated critical habitat for large-flowered woolly meadowfoam (FWS 2010c). The areas designated as critical habitat for Cook's lomatium in Jackson County include CHUs RV6A, F, G, and H; RV8; and RV9A-E. As the Pipeline Project occurs within and adjacent to the Agate Desert complex, this analysis focuses on the Agate Desert geographic area and does not discuss CHUs in the Illinois River Valley.

The PCEs for Cook's lomatium critical habitat in the Rogue River Valley include (FWS 2010c):

1. vernal pools and ephemeral wetlands and the adjacent upland margins of these depressions that hold water for a sufficient length of time to sustain Cook's lomatium germination, growth, and reproduction, between elevations of 1,220 and 1,350 feet, a minimum of 20 acres, and associated with specific dominant native plants;
2. the hydrologically and ecologically functional system of interconnected pools or ephemeral wetlands or depressions within a matrix of surrounding uplands that form vernal pool complexes; associated features may include the pool basin and ephemeral wetlands, an intact hardpan subsoil, and surrounding uplands including mound topography and other geographic and edaphic features that support systems of hydrologically interconnected pools and other ephemeral wetlands;
3. silt, loam, and clay soils that are of ultramafic and nonultramafic alluvial origin, with a 0 to 3 percent slope, classified as Agate-Winlo or Provig-Agate soils; and
4. no or negligible presence of competitive, nonnative, invasive plant species.

3.7.4.2 Environmental Baseline

Analysis Area

For most listed plant species, the botanical analysis area extends to 30 meters (98 feet) each side of the Pipeline Project (construction right-of-way, TEWAs, UCSAs, rock source and disposal sites, and proposed storage yards) on lands that have potential habitat for listed plant species. This area generally corresponds to the extent of the area surveyed for sensitive and listed plant species during surveys conducted between 2007 and 2018 (at least 100 feet from habitat removal on federal lands and at least 50 feet from habitat removal on non-federal, private lands), and correlates to a distance that indirect effects to plants would be expected. However, for the Cook's lomatium, the analysis area was extended 250 feet from the perimeter of four proposed pipe storage yards that are located within the Vernal Pool Complex – Agate Desert, in Jackson County, Oregon and shown in figure 3.7.4-1, as well as 250 feet from the Pipeline Project right-of-way in the vicinity of Agate-Winlo complex soils. This is a distance within which indirect effects from the proposed action could occur to vernal pools supporting this species (FWS 2011f).

Species Presence

Within the vicinity of the Pipeline Project, Cook's lomatium is known to occur within the Agate Desert, and is associated with Agate-Winlo and Provig-Agate and Coker clay soils in Jackson County (FWS 2010 c). Multiple locations of Cook's lomatium have been documented in the Agate Desert, in and around White City in Jackson County; these locations are in proximity to proposed pipe storage yard locations. One population is located 10.3 miles west of the Pipeline route near MP 145.7 (ORBIC 2017c), and several occurrences of Cook's lomatium have been documented 0.5 mile south of the proposed Avenue F & 11th Street, and WC Short pipe storage yards in the Ken

Denman State Game Management Reserve (Hall Tract Unit; Friedman 2006; ORBIC 2017c; see figure 3.7.4-1). Lands between the proposed pipe storage yards and the Cook's lomatium occurrences are developed with multiple industrial sites on both sides of Antelope Road. No populations of Cook's lomatium were identified by Pacific Connector at any of its proposed facilities; however, some suitable habitat exists near proposed pipe storage yards, as discussed below.

Four pipe storage yards (i.e., Burrill Lumber, WC Short, Avenue F & 11th Street, and Rogue Aggregates) have been proposed within the Agate Desert near White City in proximity to known occupied vernal pools and designated Cook's lomatium critical habitat (figure 3.7.4-1). With the exception of Rogue Aggregates, all four proposed pipe yards occur on Agate-Winlo complex soils. Where survey access was permitted, habitat within the pipe storage yards was evaluated to identify suitable vernal pool habitat for Cook's lomatium.

Surveys for the Cook's lomatium, as well as large-flowered woolly meadowfoam (see section 3.7.3), occurred in the proposed Burrill Lumber and Rogue Aggregates pipe storage yards in 2007. During these surveys, the area evaluated for the Burrill Lumber pipe storage yard was much larger than the currently proposed configuration. Approximately 4.4 acres of high-quality suitable vernal pool habitat was observed about 850 to 1,165 feet east of the currently proposed Burrill Lumber pipe storage yard. No vernal pools or Cook's lomatium plants were identified in the Rogue Aggregates pipe storage yard or the area currently proposed for the Burrill Lumber pipe storage yard.

In 2018, habitat north of Burrill Lumber pipe storage yard was assessed off-site to determine if possible vernal pools were present within 250 feet of the yard. Based on observations from Agate Road and review of aerial photography, no potential vernal pools are located within 250 feet of the Burrill Lumber pipe storage yard. Although the Rogue Aggregates pipe storage yard has been reconfigured since surveys in 2007, portions not included in previous survey efforts are not expected to provide suitable habitat for Cook's lomatium because they do not contain suitable soil types.

No surveys within Avenue F & 11th Street and WC Short pipe storage yards have been permitted. Based on aerial photography and off-site observation in April 2018, the Avenue F & 11th Street and WC Short pipe storage yards do not contain vernal pools. The Avenue F & 11th Street pipe storage yard is highly disturbed and graded, with railroad and docking facilities located on the southern edge of the yard, and WC short pipe storage yard is an existing train yard that would assist moving and off-loading pipe.

Additionally, in vernal pools (totaling approximately 0.2 acre) within and adjacent to the Pipeline right-of-way on private lands (between MPs 145.3 and 145.40) that occur on Agate-Winlo soils were surveyed in 2007. No Cook's lomatium plants were documented (SBS 2008a).

Approximately 190.29 acres within 250 feet of proposed pipe storage yards, including the Avenue F & 11th Street and WC Short pipe storage yards in Jackson County, have not been evaluated on site for Cook's lomatium or suitable vernal pool habitat. Off-site observations; determined that of this 190.29 acres, approximately 174.26 acres did not contain suitable vernal pool habitat; approximately 0.46 acre consists of highly modified, low-quality potential vernal pool habitat, and 15.55 acres consists of upland habitat within 100 feet of potential vernal pool habitat (i.e., "vernal pool complex”; see table 3.6.1-1). This 0.46 acre of low-quality potential vernal pool habitat is associated with active industrial sites or previously disturbed industrial areas but could provide low quality habitat for Cook’s lomatium.

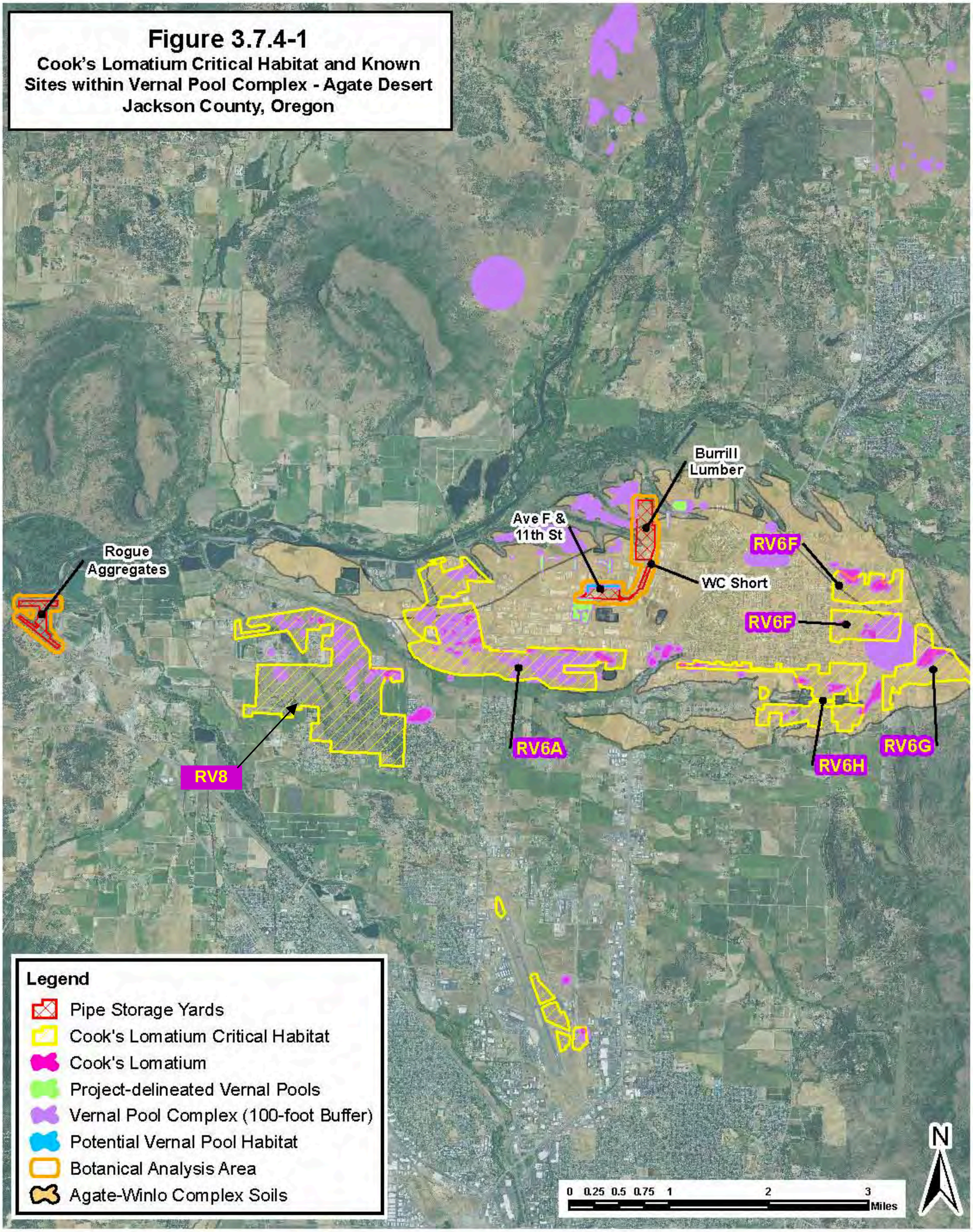


Figure 3.7.4-1
Cook's Lomatium Critical Habitat and Known Sites within Vernal Pool Complex - Agate Desert
Jackson County, Oregon
Burrill Lumber
Ave F & 11th St
Rogue Aggregates
WC Short
RV6F
RV6F
RV8
RV6A
RV6H
RV6G
Legend
Pipe Storage Yards
Cook's Lomatium Critical Habitat
Cook's Lomatium
Project-delineated Vernal Pools
Vernal Pool Complex (100-foot Buffer)
Potential Vernal Pool Habitat
Botanical Analysis Area
Agate-Winlo Complex Soils
0 0.25 0.5 0.75 1 2 3
Miles
N

Critical Habitat

Within the vicinity of White City, Oregon, where four proposed pipe storage yards for the Pipeline Project are located, CHUs RV6 and RV8 have been designated (figure 3.7.4-1). One of the three designated CHUs for Cook's lomatium in Jackson County (RV6) has two subunits located approximately 0.5 mile south (RV6A) and 0.8 mile southeast (RV6H) of the proposed Avenue F & 11th Street and WC Short pipe storage yards. Another CHU (RV8) is located approximately 1.8 miles east of Rogue Aggregates pipe storage yard.

3.7.4.3 Effects of the Proposed Action

Direct and Indirect Effects

Possible direct effects to Cook's lomatium include disturbance to vernal pool or wetland habitat from driving through or storing equipment or pipes near or on vernal pools or wetlands associated with this species. Direct effects to Cook's lomatium and its habitat could be expected in vernal pools and upland habitat within 100 feet from delineated vernal pool habitat (FWS 2011f). Because no vernal pool habitat has been documented during onsite surveys of the proposed Burrill Lumber and Rogue Aggregates pipe storage yards, pipe storage yards in Jackson County have been removed and/or reconfigured to avoid potentially suitable vernal pool habitats, and because Pacific Connector has committed to avoiding vernal pool habitats in pipe storage yards by at least 250 feet or would remove a pipe yard from further consideration if vernal pool habitat is documented during future surveys (see section 3.7.4.4, Conservation Measures), no direct impacts to Cook's lomatium or its habitat is anticipated. Surveys conducted in suitable vernal pool habitat along the construction right-of-way between MPs 145.3 and 145.4 did not locate Cook's lomatium plants; therefore, no direct effects to Cook's lomatium along the pipeline right-of-way are expected.

Indirect effects to Cook's lomatium plants and their habitat could occur with increased road use to access the pipe storage yards, as well as pipe storage yard activities, that are adjacent or near suitable or potentially suitable habitat. Although increased road use on paved Agate Road is not expected to increase fugitive dust, pipe storage yard activities and the associated dust created might impact vernal pool habitat located within 250 feet of activities as dust settles, affecting vegetation and vernal pool physical or chemical properties (e.g., pH, water quality, turbidity, sedimentation, temperature). Use of pipe storage yards adjacent to, or in the vicinity of suitable or potentially suitable habitat, may indirectly affect hydrology (i.e., potential soil compaction by heavy equipment use) upon which vernal pools and associated vegetation are dependent, although this potential effect is highly unlikely. Indirect effects to hydrology could occur if such disturbances to ground and/or soils occurred within 250 feet of suitable or potentially suitable vernal pool habitat (FWS 2011f). Such effects could include altering hydrologic processes, such as runoff patterns as a result of soil compaction, as well as introduction of non-native invasive plant species (PCEs 1 and 4).

No other direct or indirect effects to potential vernal pools are expected from use of unsurveyed pipe storage yards in Jackson County, including the 0.46 acre of potential vernal pool wetlands (and 15.55 acres of vernal pool complex) identified from off-site observations within or adjacent to the Avenue F & 11th Street and WC Short pipe storage yards. Implementation of conservation measures included in section 3.7.4.4 would minimize impact to potential suitable vernal pool habitat and Cook's lomatium plants, if present.

Critical Habitat

Given the distance separating the pipe storage yards and RV6A, RV6H, and RV8, no direct or indirect impacts from the Pipeline Project are anticipated because equipment and pipe storage would not occur within 250 feet of vernal pools or wetlands located in the critical habitat subunit, nor would traffic to and from the pipe storage yards drive within 250 feet of vernal pools within the CHU.

3.7.4.4 Conservation Measures

If Cook's lomatium is observed within proximity to the pipe storage yards or the construction corridor, Pacific Connector would install sedimentation control barriers as recommended in the Recovery Plan (FWS 2012j) to minimize potential impacts to identified Cook's lomatium plants and suitable habitat from erosion or sedimentation. As described in section 3.6.1.4 for vernal pool fairy shrimp, a silt fence would be erected on the west side of the right-of-way within 250 feet of vernal pools located between MPs 145.27 and 145.44. Additional mitigation measures considered for Cook's lomatium, if identified in the area during surveys, would include implementation of additional stormwater BMPs outlined in the ECRP (appendix F) to reduce and mitigate the potential for increased sediment mobilization as well as erosion and dust control measures listed in the ECRP.

3.7.4.5 Determination of Effects

Species

The Project **may affect** Cook's lomatium because:

- suitable, occupied habitat occurs within the vicinity of the Pipeline Project.

The Project is **not likely to adversely affect** Cook's lomatium because:

- surveys of suitable habitat within proposed pipe storage yards in Jackson County and along the proposed Pipeline did not document Cook's lomatium;
- Pacific Connector would avoid using portions of proposed pipe storage yards within 250 feet (indirect effect) of areas with potential vernal pool habitat;
- effects on suitable habitat are likely to be insignificant to the point where no meaningful measurement, detection, or evaluation of effect would be possible (i.e., effect would not reach a level where individual plants would be affected);
- sedimentation barriers would be used, as appropriate, to prevent run-off and changes in hydrology;
- conservation measures have been developed to avoid or minimize effects on any plants identified during surveys prior to construction;
- known occurrences within the vicinity of the Project are farther than 0.5 mile from proposed pipe storage yards; and
- unsurveyed habitat is low quality vernal pool habitat located over 0.25 mile from known sites with no apparent hydrologic connectivity.

Critical Habitat

The Project **may affect** designated critical habitat for Cook's lomatium because:

- the Project occurs in the vicinity of Cook's lomatium critical habitat.

The Project is **not likely to adversely affect** designated critical habitat for Cook's lomatium because:

- the Pipeline Project is over 0.5 mile from the nearest critical habitat subunit (RV6A); and
- the Pipeline Project is not expected to adversely modify habitat areas that provide buffer protection from adjacent development and weed sources, continuous non-fragmented habitat, and intact hydrology (PCEs 1 and 4).

3.7.5 Kincaid's Lupine

Kincaid's lupine (*Lupinus oreganus* ssp. *kincaidii*) is a perennial plant species in the pea (Fabaceae) family. It is known to occur in grassland habitats, mainly in the Willamette Valley and nearby hills, in Oregon, although in Douglas County it occupies sites that are more shaded with tree and shrub canopy (FWS 2006g).

3.7.5.1 Species Account and Critical Habitat

Status

Kincaid's lupine was listed as threatened on January 25, 2000 (FWS 2000c). Approximately 585 acres of critical habitat was designated for this species in 2006 within Oregon and Washington (FWS 2006h).

Threats

The three major threats to Kincaid's lupine populations are habitat loss, competition from non-native plants, and elimination of historical disturbance regimes, such as fire (Wilson et al. 2003 as cited in FWS 2010d). Other threats include herbicide use; disease and predation; inbreeding as a result of isolated and fragmented populations; and habitat vandalism (which is an uncommon occurrence but could further reduce habitat function and destroy individual plants; FWS 2010d). Human alteration of native prairie in Oregon's Willamette Valley has destroyed over 99 percent of Kincaid's lupine habitat (FWS 2000c). Remaining prairie habitat is rapidly disappearing because of agricultural practices, development activities, forestry practices, grazing, roadside maintenance, and commercial Christmas tree farming (FWS 2000c). The remaining Kincaid's lupine populations in prairie habitat are relegated to small, isolated patches of habitat.

Species Recovery

A final recovery plan for the prairie species of western Oregon, including Kincaid's lupine, was published on May 20, 2010, and includes recovery objectives to delist Kincaid's lupine (FWS 2010d). Eight recovery zones were established for Kincaid's lupine, of which Douglas County is considered its own recovery zone. Since the clonal or clumping growth pattern of Kincaid's lupine creates a challenge for estimating and monitoring the number of plants, the recovery plan provides population targets in terms of foliar cover (i.e., the measure of the area occupied by the plants).

The Douglas County Recovery Zone, which the Pipeline Project would pass through, has a recovery goal of a minimum of two populations covering at least 5,000 square meters (1.25 acres), which are not separated by more than 2.0 miles (FWS 2010d). In 2010, populations in Douglas County were estimated to cover approximately 1.2 acres (FWS 2010e). Additionally, monitoring of these populations should show evidence of reproduction by flowering, seed set, or presence of seedlings, and remain stable or increase in size for a period of at least 15 years. Habitat for Kincaid's lupine populations should be managed to provide high-quality habitat that is protected on lands managed by a government agency or private conservation agreement and is monitored and controlled from threats to the species (FWS 2010d). Recovery actions for Kincaid's lupine include:

- evaluate the status of extant populations;
- secure conservation management agreements for populations that are not yet protected;
- develop site-specific management plans;
- manage population sites to minimize woody plant succession and reduce the threat of competition from nonnative plants, including mowing in late summer (August or September) after the plants have become dormant, and elimination of invasive species with careful and appropriate application of herbicides or mechanical control methods;
- restore connectivity among populations, establishing subpopulations within 2 miles of each other;
- augment or reintroduce populations and restore habitat to achieve population targets;
- monitor populations and trends;
- monitor prairie quality at all population sites;
- collect and bank seeds; and
- conduct further research regarding conservation needs and actions.

Life History, Habitat Requirements, and Distribution

Kincaid's lupine is a long-lived perennial herb, primarily inhabiting native prairies and foothills (FWS 2000c). Prior to Euro-American settlement, Kincaid's lupine was likely well-distributed throughout the prairies of western Oregon and southwestern Washington from Lewis County, Washington, in the north, to Douglas County, Oregon, in the south (FWS 2010d). Today, fragmentation, degradation, and elimination of natural prairie habitat has resulted in existing populations that are widely separated by expanses of unsuitable habitat (FWS 2010d).

In Douglas County, Kincaid's lupine has been found in open woodlands and meadows, often near roads, and associated with Pacific madrone, incense cedar (*Calocedrus decurrens*), and Douglas-fir trees with relatively open canopies (BLM et al. 2008). Those populations appear to tolerate more shade (canopy cover of 50 to 80 percent) than populations in the Willamette Valley (BLM et al. 2008). However, shade does appear to be a limiting factor at many of the Kincaid's lupine sites in Douglas County, where plants may only be found on road cut banks, old logging roads, or previously burned areas (BLM et al. 2008). Additionally, canopy openness and vigor of Kincaid's lupine populations appear to be correlated and it is likely that production of viable seeds decreases as forest canopy increases (Menke and Kaye 2006; BLM et al. 2008). Kincaid's lupine habitat in forested sites is subject to similar alterations from natural succession; fire suppression activities result in increased canopy closure and cover of woody species that contribute to the decline in Kincaid's lupine forested habitat (FWS 2006g).

Kincaid's lupine reproduces sexually and asexually with production of rhizomes (horizontal stems) that can produce clumps of cloned plants. Individual clones can be several centuries old (FWS 2006h; Kaye 2008) and can become quite large with age, producing many flowering stems. Excavations and morphological patterns suggest that plants 33 feet or more apart can be interconnected by below-ground stems, and such clones can exceed 66 feet across. Because of vegetative (clonal) growth pattern, it is difficult to distinguish individuals (Wilson et al. 2003); counting individual "plants" and monitoring the size of populations is challenging. Instead, monitoring agencies have used a grid pattern and counted stems or leaves to assess density rather than attempt to count "individuals."

Flowering typically begins in April and continues through June (FWS 2010d). Pollinators include small native bumblebees, solitary bees, and occasionally European honey bees and insect pollination appears to be critical for successful seed production (FWS 2010d). Seeds are dispersed from fruits that open explosively upon drying (FWS 2006g). Seeds of the *Lupinus* genus can remain dormant for many years because of their relative impermeability and may remain viable in the ground for up to 60 years (Grigore and Tramer 1996; CPOP 2014). Lupine seeds germinate under increasing humidity or when the seed coat is cracked by pressure or temperature fluctuations (Grigore and Tramer 1996). Kincaid's lupine is also a primary larval host plant for the endangered Fender's blue butterfly (FWS 2010h) and fire is necessary to maintain and sustain habitat for the Fender's blue butterfly (FWS 2003d). Also, fire clears shading vegetation, especially of invasive species, and converts soil phosphorous into a form more usable by plants. Kincaid's lupine may respond positively to fire (Wilson and Clark 1997) and fire may lead to increased numbers of pollinators which have a positive effect (FWS 2003d).

Population Status

Most of the known extant populations of Kincaid's lupine are found in Oregon's Willamette Valley. At the time of listing, at least 49 of 54 sites were on private lands and therefore were considered to be at a higher risk of extirpation (FWS 2000c). As of the 2010 five-year review, Kincaid's lupine is known to occur within about 154 extant sites, comprising about 393 acres; (FWS 2010e). Another five-year review was initiated in February 2016 that will provide additional information on population status (FWS 2016f).

Critical Habitat

Approximately 585 acres of critical habitat were designated on November 30, 2006, in Benton, Lane, Polk, and Yamhill Counties, Oregon, and Lewis County, Washington (FWS 2006h). The designation did not include Douglas County where conservation agreements were established to formally document the intent to protect, conserve, and contribute to the recovery by implementing recovery actions for Kincaid's lupine and its habitat (see further discussion below).

Other Conservation Agreements and Plans. In 2006, the BLM Roseburg District, Umpqua National Forest, and FWS completed a programmatic conservation agreement for Kincaid's lupine in Douglas County, which specifies the following goals (BLM et al. 2006):

- Maintain stable populations by protecting and restoring habitat.
- Reduce threats to the species on BLM and NFS lands.
- Promote larger functioning meta-populations, with increased population size and genetic diversity.

- Meet the recovery criteria in the Recovery Outline for the species (FWS 2006g).

Also in 2006, three private timber companies in Douglas County (Lone Rock Timber Management Company, Roseburg Forest Products, and Seneca Jones Timber Company) signed a voluntary conservation agreement. This *Voluntary Agreement for Kincaid's Lupine (Lupinus sulphureus* spp. *kincaidii) in Douglas County* (Lone Rock Timber Management Company et al. 2006) includes reporting guidelines and an agreement for road maintenance and minimizing disturbance along roads, controlling noxious weeds, and training staff on identification of Kincaid's lupine plants. The objective of the Voluntary Agreement is "to promote functioning meta-populations," including coordinating propagation activities for establishing new sites and extending known populations.

In March 2008, a management plan for Kincaid's lupine in Douglas County was developed between the BLM's Roseburg District, the Umpqua National Forest, and the FWS addressing the populations and habitat of Kincaid's lupine on BLM and NFS lands in Douglas County (BLM et al. 2008). Kincaid's lupine occurs on 14 sites within Douglas County, of which 9 are on federally managed lands (eight on BLM land [Roseburg District] and one on the Umpqua National Forest; BLM et al. 2008).

3.7.5.2 Environmental Baseline

Analysis Area

The botanical analysis area extends to 30 meters (98 feet) each side of the Pipeline Project (construction right-of-way, TEWAs, UCSAs, rock source and disposal sites, and proposed storage yards) on lands that have potential habitat for listed plant species. This area generally corresponds to the extent of the area surveyed for sensitive and listed plant species during surveys conducted between 2007 and 2018 (at least 100 feet from habitat removal on federal lands and at least 50 feet from habitat removal on non-federal, private lands and along access roads where road improvements are proposed), and correlates to a distance that indirect effects to plants would be expected. Portions of the botanical analysis area that coincide with Kincaid's lupine populations are included in figures 3.7.5-1, 3.7.5-2, and 3.7.5-3.

Species Presence

The Pipeline Project is located within known or historic Kincaid's lupine range between MPs 46.8 and 99.3. Records obtained from ORBIC (2017c) indicate that Kincaid's lupine had been previously located at 11 sites within 2.5 miles of the Pipeline. The closest sites are: 1) 10 clumps located 1.5 miles north of MP 56.0 in 1999 within a 200 square-foot area; 2) 100 to 1,000 plants located 1.5 miles southeast of MP 59.6 in 2005; 3) 100 to 1,000 plants located 2.0 miles northeast of MP 86 in 1990; 4) 400 to 4,000 plants within four sites occupying approximately 3 acres located 2.2 miles southwest of MP 96.0 in 2003; and 5) about 100 to 200 plants in one acre located in 1992 approximately 1.5 miles east of MP 98.9. Herbarium records indicate that one extinct population (1979) occurred approximately 1.7 miles east of MP 98.9. Botanical surveys conducted by Pacific Connector in 2007 and 2008 located three new populations of Kincaid's lupine along the pipeline route, as discussed below.

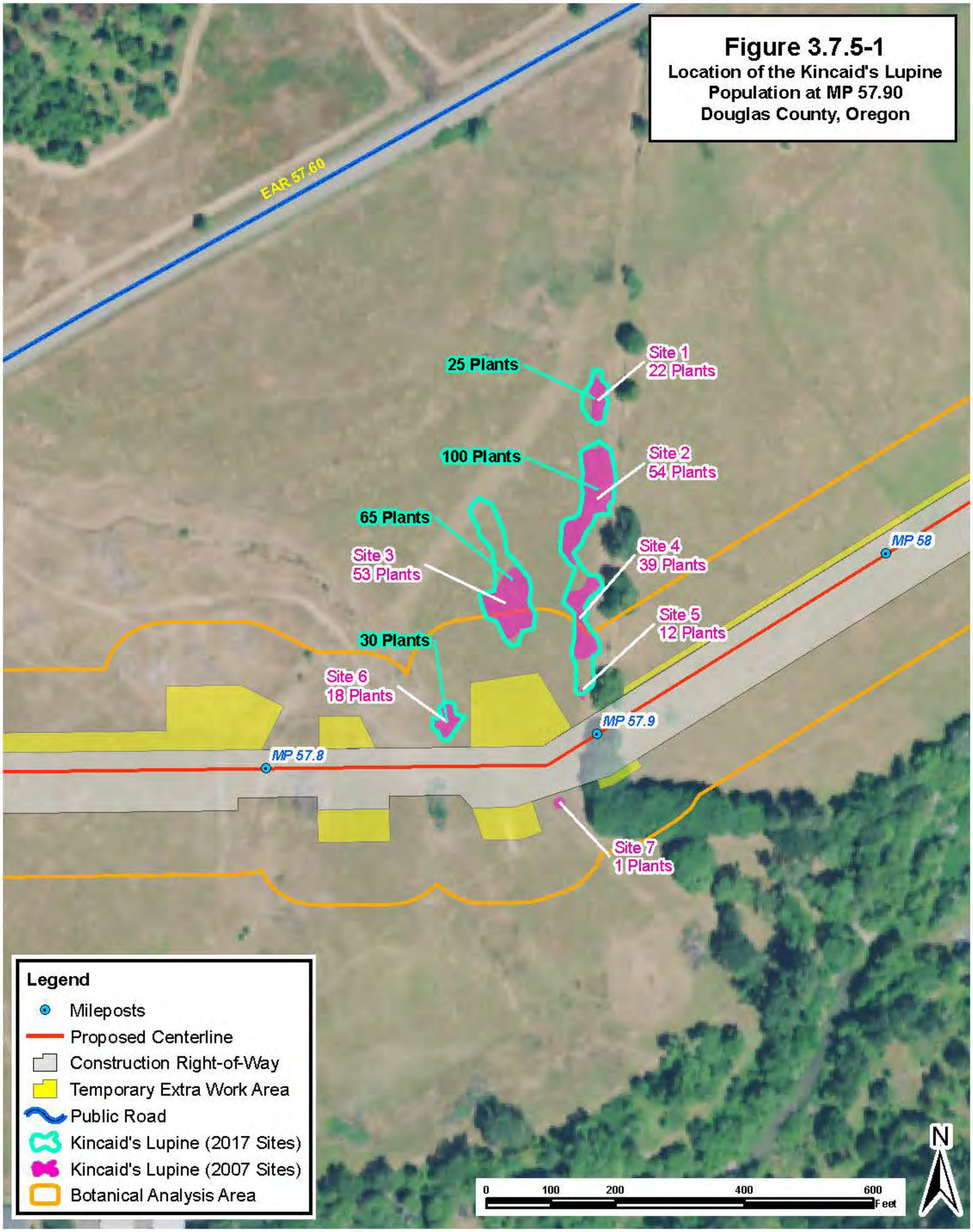


Figure 3.7.5-1
Location of the Kincaid's Lupine Population at MP 57.90
Douglas County, Oregon
EAR 57.60
25 Plants
Site 1
22 Plants
100 Plants
Site 2
54 Plants
65 Plants
Site 3
53 Plants
Site 4
39 Plants
Site 5
12 Plants
30 Plants
Site 6
18 Plants
MP 58
MP 57.9
MP 57.8
Site 7
1 Plants
Legend
Mileposts
Proposed Centerline
Construction Right-of-Way
Temporary Extra Work Area
Public Road
Kincaid's Lupine (2017 Sites)
Kincaid's Lupine (2007 Sites)
Botanical Analysis Area
0
100
200
400
600
Feet
N

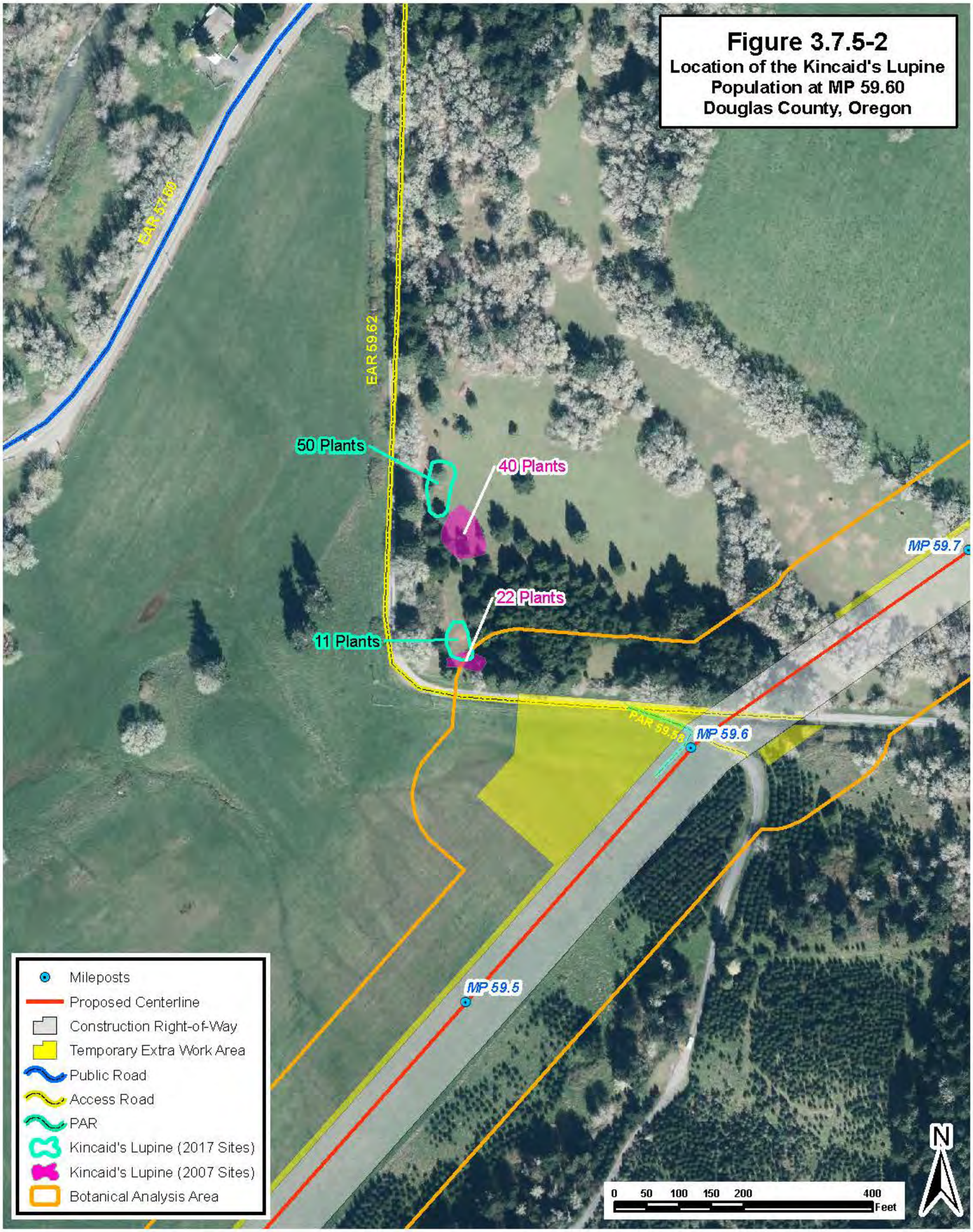


Figure 3.7.5-2
Location of the Kincaid's Lupine
Population at MP 59.60
Douglas County, Oregon
EAR 57.60
EAR 59.62
50 Plants
40 Plants
22 Plants
11 Plants
PAR 59.58
MP 59.6
MP 59.7
MP 59.5
Mileposts
Proposed Centerline
Construction Right-of-Way
Temporary Extra Work Area
Public Road
Access Road
PAR
Kincaid's Lupine (2017 Sites)
Kincaid's Lupine (2007 Sites)
Botanical Analysis Area
0 50 100 150 200 400
Feet
N

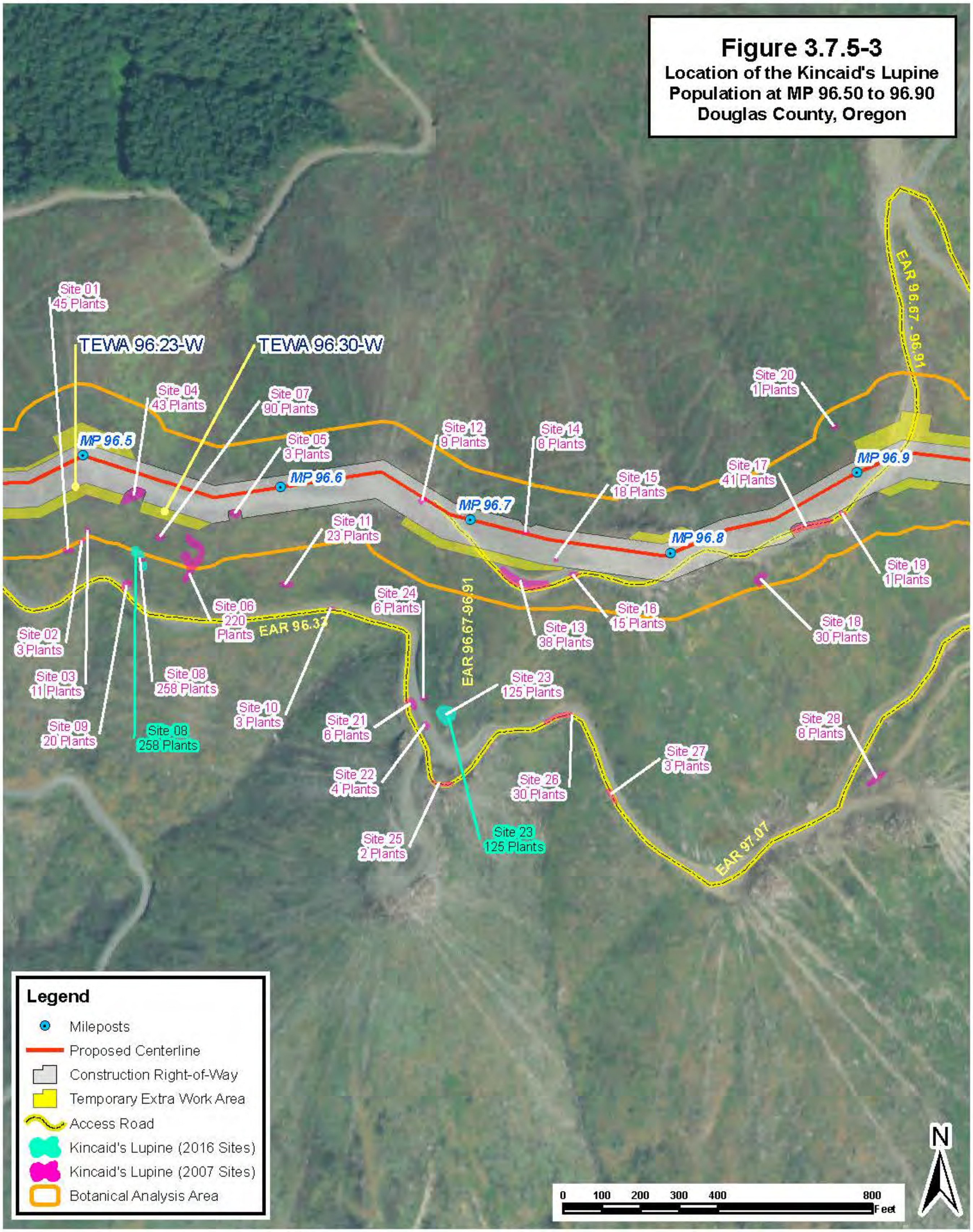


Figure 3.7.5-3
Location of the Kincaid's Lupine Population at MP 96.50 to 96.90 Douglas County, Oregon
Site 01 45 Plants
TEWA 96.23-W
TEWA 96.30-W
Site 04 43 Plants
Site 07 90 Plants
Site 05 3 Plants
Site 12 9 Plants
Site 14 8 Plants
Site 20 1 Plants
Site 15 18 Plants
Site 17 41 Plants
MP 96.5
MP 96.6
MP 96.7
MP 96.8
MP 96.9
EAR 96.67 - 96.91
Site 11 23 Plants
Site 19 1 Plants
Site 24 6 Plants
Site 06 220 Plants
EAR 96.33
Site 16 15 Plants
Site 13 38 Plants
Site 18 30 Plants
Site 02 3 Plants
Site 03 11 Plants
Site 08 258 Plants
EAR 96.67-96.91
Site 23 125 Plants
Site 09 20 Plants
Site 08 258 Plants
Site 10 3 Plants
Site 21 6 Plants
Site 28 8 Plants
Site 27 3 Plants
Site 22 4 Plants
Site 26 30 Plants
Site 25 2 Plants
Site 23 125 Plants
EAR 97.07
Legend
Mileposts
Proposed Centerline
Construction Right-of-Way
Temporary Extra Work Area
Access Road
Kincaid's Lupine (2016 Sites)
Kincaid's Lupine (2007 Sites)
Botanical Analysis Area
0 100 200 300 400 800
Feet
N

Prior to beginning field surveys in 2007, botanists with SBS conducted a habitat review to identify potential habitat and delineate survey areas for Kincaid's lupine within the botanical analysis area and along existing roads identified for access to the construction right-of-way between MPs 46.8 to 99.3.

Surveys were conducted within the botanical analysis area for this species where survey permission was granted. Most surveys were conducted in 2007 and 2008, but additional surveys have been conducted since 2008 in areas of reroutes, minor route adjustments, and areas where survey permission has been granted. Areas where Kincaid's lupine plants were documented during previous survey efforts were also resurveyed in 2016 and/or 2017. Surveys continued in 2018, and the data are currently under review.

Within the 30-meter botanical analysis area, approximately 2,674.24 acres, generally between MPs 46.8 and 99.3, have been identified as potential suitable habitat (see table 3.7.5-1). The potential suitable habitat includes both meadow (typically non-native pasture) and forested upland Kincaid's lupine habitats. Of this habitat, access was granted to 1,682.61 acres (842.86 acres within the Pipeline Project), including potential habitat within 50 feet of access roads where road improvements have been proposed. Table 3.7.5-1 provides a summary of potential suitable Kincaid's lupine habitat within the botanical analysis area.

TABLE 3.7.5-1

Summary of Potential Suitable Kincaid's Lupine Habitat within the Botanical Analysis Area

		Acres Surveyed			**Acres Not Surveyed c/**		
General Landowner	**Suitable Habitat Status**	**Project a/**	**Buffer a/**	**Total**	**Project a/**	**Buffer b/**	**Total**
MPs 46.8 – 99.3 (2,916 acres within botanical analysis area)							
Federal	Suitable Habitat	174.98	162.00	336.98	31.75	42.80	74.55
	Not Habitat	84.17	130.77	214.94	N/A	N/A	N/A
	Unknown	N/A	N/A	N/A	0.02	0.14	0.16
	Total	*259.15*	*292.77*	*551.92*	*31.77*	*42.94*	*74.71*
Non-Federal	Suitable Habitat	486.58	450.20	936.78	184.32	211.96	396.28
	Not Habitat	97.13	96.78	193.91	N/A	N/A	N/A
	Unknown	N/A	N/A	N/A	232.59	288.05	520.64
	Total	*583.71*	*546.98*	*1,130.69*	*416.91*	*500.01*	*916.92*
Total	Suitable Habitat	661.56	612.20	1,273.76	216.07	254.76	470.83
	Not Habitat	181.30	227.55	408.85	N/A	N/A	N/A
	Unknown	N/A	N/A	N/A	232.61	288.19	520.80
	Total	**842.86**	**839.75**	**1,682.61**	**448.68**	**542.95**	**991.63**

a/ Project includes: right-of-way, temporary extra work area, uncleared storage area, rock storage, pipe storage yards, aboveground facilities.

b/ Buffer (botanical analysis area) includes area within 30 meters (98 feet) or 50 feet of habitat removal on federal land and non-federal land, respectively, and within 50 feet either side of existing access roads identified with possible road improvements.

c/ Areas not surveyed are either: 1) denied access; 2) were not surveyed because of recent modification to the proposed route that occurred after the flowering season; or 3)portions of the 30-meter analysis outside of the targeted 50-foot survey area on non-federal lands. "Not Habitat" was determined from adjacent survey parcel information, aerial photography, or "drive-by;" no surveys would be necessary and acres are not included.

Of the 1,682.61 acres of potential habitat with survey access, 1,273.76 acres (661.56 acres within the Pipeline Project) were considered suitable habitat for Kincaid's lupine. Habitat suitability was qualitatively assessed based on Kincaid's lupine habitat analysis conducted in Oregon by SBS in 2001.

Approximately 991.63 acres (448.68 acres within the Pipeline Project) of potentially suitable habitat for this species within the botanical analysis area was denied access by the landowner or occurs within recent modifications of the Pipeline Project (the majority of this habitat occurs on private lands; see table 3.7.5-1). Pacific Connector would continue to survey habitat where permission is granted. Where survey access is denied, Pacific Connector would conduct one year of surveys in suitable habitat within the Pipeline Project footprint prior to construction. For purposes of analysis, until surveys are conducted, a conservative assumption can be made that a similar percent of the unsurveyed area could contain suitable habitat, compared to the areas where surveys have been completed. Based on this assumption, approximately 730 acres of unsurveyed habitat within the botanical analysis area (73.6 percent of 992 acres, or 330 acres within the Pipeline Project right-of-way) could contain suitable habitat for Kincaid's lupine.

Surveys conducted in 2007 for the Pipeline Project located three populations of Kincaid's lupine containing approximately 1,330 plants (see table 3.7.5-2): two in western and one in eastern Douglas County (figures 3.7.5-1, 3.7.5-2, and 3.7.5-3). Two of the sites (MPs 57.84 through 57.92 and MP 59.60) are unique in Douglas County in that they occupy pasture / meadow habitat rather than forested habitats and may preserve high value genetic information and diversity.

TABLE 3.7.5-2

Summary of Kincaid's Lupine Locations

Milepost	Year Located	Number of Subpopulations	Number of Plants Observed by Survey Date	Site Description
57.84-57.92	2007	7	2007: 199 2017: 220	Along centerline near MP 57.9; in the right-of-way and continuing south of the right-of-way at MP 57.85 - 57.90
59.6	2007	2	2007: 66 2017: 61	Outside of the construction zone and 30 meter analysis area.
96.48-96.9 [1]	2007	28	2007: 1,064 2016: 64 (or 383)	In the right-of-way and in access roads south of the right-of-way

a/ This site was burned during the Stouts Creek fire in 2015; only two subpopulations contained plants when the site was revisited in 2016.

Population at MPs 57.84-57.92: This site was located on private land along the right-of-way (as proposed in 2007) between MPs 57.84 and 57.92 (figure 3.7.5-1). This site was approximately 2.1 miles from a known site 1.5 miles northeast of MP 56.0, and approximately 1.6 miles southwest of a second site located during surveys in 2007 near MP 59.60. Approximately 199 plants were found at this site within seven subpopulations covering approximately 0.6 acre within an approximately 4-acre pasture. Subpopulations or patches (clonal groups) ranged in size from 1 to 54 plants and were anywhere from 20 feet to 177 feet from each other (SBS 2008a). Plant counts were made by considering all stems in close proximity as one plant. Six of the seven patches were within 33 feet of each other and were assumed to be interconnected by below-ground stems; subpopulation 7 was 150 to 190 feet from the other documented patches and was assumed to not be interconnected. Subpopulations were located approximately 2 feet south of the right-of-way (subpopulation 7) and 3 to 438 feet north of the right-of-way (subpopulations 1 through 6; figure 3.7.5-1). This site was revisited in 2017 and the site appears to be stable or slightly increasing despite the removal of oaks along the fence line and continued grazing. One plant south of the right-of-way (subpopulation 7) was not relocated in 2017 (SBS 2017).

Population at MP 59.6. A second site was located on private land approximately 300 feet north of MP 59.60 and approximately 67 feet and 222 feet to the north and west of TEWA 59.30-N, respectively (figure 3.7.5-2). McNabb Creek Road, an existing access road (EAR 59.62), is approximately 40 and 85 feet to the south and west of this occurrence. Approximately 66 plants within two patches or subpopulations (clonal groups) were documented covering approximately 0.5 acre scattered in a two-acre area on a flat grazed pasture (SBS 2008b). This site was also revisited in 2017. The two patches of plants have migrated slightly farther from the Pipeline Project, possibly as a response to grazing, but appear to be stable or slightly increasing in size (SBS 2017).

Population at MPs 96.48-96.9. A third Kincaid's lupine site was found between MPs 96.5 and 96.9 and on proposed access roads south of MPs 96.7 to 96.9 during 2007 survey efforts (figure 3.7.5-3). Approximately 1,064 plants were located within 28 subpopulations or patches scattered within a 20-acre area. Plants covered an approximately 0.6-acre area (with approximately 29 percent cover). The 28 patches ranged in size from one plant to 258 plants and were documented within and adjacent to the Pipeline right-of-way and proposed access roads (see figure 3.7.5-3).

The population was documented on private timberland two miles south of the South Umpqua River on a ridgeline east of Stouts Creek and was considered an important element in the recognized Stouts Creek-Callahan Ridge meta-population because it occurs in a central location between these populations thus forming an important genetic link. The plants were all located on loam soils in a young mid-seral mixed conifer and hardwood forest. Plants were documented within canopy gaps and, less regularly, under closed canopy (mostly under ponderosa pine trees) and in openings along four-wheel drive roads.

In late July 2015, the Stouts Creek fire burned through this population with a high intensity (all trees were killed and the ground scorched). The area burned in 2015 was subsequently logged using ground-based equipment; roads were widened, new roads were built, and large piles of slash from logging activities were left on site (SBS 2016). SBS revisited the site in June 2016 to determine the impact of the fire on the Kincaid's lupine population in this area. All 28 subpopulations documented in 2007 were relocated and examined for re-sprouting lupine. Kincaid's lupine plants (383 plants total) were observed in only two of the original 28 sites (subpopulations 8 and 23); subpopulation 8 is located 55 to 70 feet from proposed access road EAR 96.33 and 95 feet south of TEWA 96.25, and subpopulation 23 is located 20 feet from proposed access road EAR 96.33 and 395 feet south of TEWA 96.66-W. Proposed access road EAR 96.33 has been significantly widened since the Stouts Creek fire. Many of the sites visited in 2016 suffered physical disturbance from heavy equipment, and several of the sites were under large slash piles. All sites that had been in or adjacent to proposed access roads were obliterated by the significantly widened roads. Eleven of the sites were relatively undisturbed, but no plants were present.

Although fire is a recommended method to manage habitat for Kincaid's lupine in prairie habitat, wildfires have also been identified as a threat to Kincaid's lupine, especially if the fire destroys lupine plants before they set seed for the next growing season and senesce (FWS 2006g). FWS (2010d) recommends prescribed burning in the late summer and early fall (September or October), after plants have set seed and senesced. Because the fire in 2015 occurred in late July/early August, it is possible plants in this population could have set seed. Lupine seedlings have the potential to return to this area, especially because legume seeds are known to be long-lived, and Kincaid's lupine has evolved in a landscape with periodic wildfire, such that increased temperatures from the fire could have cracked the seed coat germinating previously dormant seeds (Grigore and Tramer 1996; CPOP 2014). Pacific Connector will continue to monitor previous plant locations, as well as conduct pre-construction surveys in the Pipeline Project area between MPs 96.48 and 96.9.

Critical Habitat

Critical habitat has not been designated for Kincaid's lupine in Douglas County.

3.7.5.3 Effects of the Proposed Action

Direct and Indirect Effects

A report published on the biology of Kincaid's lupine (Wilson et al. 2003) indicates that Kincaid's lupine spreads extensively by physiologically-interdependent clones interspersed across large distances in the population, making it challenging to distinguish genetically distinct individual plants. Any estimates of number of individuals impacted by the proposed action are subject to broad margins of error. Because even broadly separated clones share resources through caudices, removal of stems from the occurrence may impact other connected clones, potentially increasing the number of plants affected. There are no data to date regarding the short- or long-term survivability of individuals when separated from the remainder of clone. Therefore, removing any individuals from small populations like those documented during survey efforts could decrease their potential survival and ability to colonize available habitats.

An important related concern is that these populations may consist of substantially fewer genetically distinct plants than estimated due to clonal growth. Kincaid's lupine depends on sexual reproduction to replace individual plants that may succumb to numerous threats, to augment populations, and to spread into suitable habitat. Such out-crossing plants require a large number of genetically distinct individuals as well as adequate pollinators to maintain genetic diversity and avoid negative effects of inbreeding depression, which may already be impacting these small remnant populations.

The three new populations of Kincaid's lupine identified during surveys in 2007 on private lands at MPs 57.84 through 57.92, 59.60, and 96.48 through 96.9 are too small to meet the minimum viable population size specified in the FWS recovery plan (either by estimated number of plants or by density within a coverage area). The newly found populations, however, may be contributing to other known meta-populations and recovery plan objectives, and removal of these plants may contribute negatively toward recovery of the species.

The population at MP 57.9 totals 0.6 acre within a four-acre area (15 percent cover) and the population at MP 59.6 is approximately 0.5 acre within a two-acre area (25 percent cover). Total cover at these population locations is high due to the vigor and age of the plants. These sites are approximately 2.1 to 2.7 miles from an extant site with plants of low vigor near Ten Mile, but far from other known sites, so are unlikely to be part of an eventual meta-population for meeting Recovery Plan goals (FWS 2010d). They do, however, contribute significantly to the "additional" population goals. Additionally, these sites are unique for Douglas County in that they occupy valley-floor pasture/meadow habitats similar to Willamette Valley populations. As a result, plants identified during survey efforts may be preserving high value genetic information and diversity.

Prior to the 2015 Stouts Creek fire, the population near MP 96.5 was considered an important element in the recognized Stouts Creek-Callahan Ridge meta-population. It is approximately 2.5 miles east/northeast of a large known population cluster on BLM and Roseburg Timber lands at Stouts Creek, approximately 2.7 miles west/northwest from a population on Forest Service and private land at Callahan Ridge, and approximately 3.7 miles from a population at Callahan Meadows. It occurs in a central location between these populations thus forming an important genetic link and increases the possibility of developing a successful "South Umpqua meta-population" to further achieve recovery goals. When surveyed in 2007, the population consisted of 28 patches within an area of 20 acres, occurring in transitory and natural openings in 45-year-old forest. The total cumulative area of the patches documented is approximately 0.6 acre (29 percent total cover), with the largest patch covering about 0.1 acre. However, the combination of the high intensity Stouts Creek fire followed by physical disturbance to soils may preclude re-establishment of Kincaid's lupine at these sites.

Direct Impacts

Subpopulation 7 (one plant, near MP 57.84) which is located south of the proposed Pipeline route is likely not a part or clone of the other plants and should not be affected by dissecting below-ground stems. Additionally, surveys in 2017 did not relocate this plant. Therefore, no direct impacts to the subpopulations that are or were located at this site are expected.

No direct effects are expected at the second population near MP 59.60 documented north of TEWA 59.30-N, because the site is at least 67 feet from the Pipeline Project. Furthermore, direct impacts from use of the existing access road are also not expected (figure 3.7.5-2 and figure K-2 in appendix V.2).

The third population between MPs 96.5 and 96.9 had an estimated 1,064 plants located within 28 subpopulations when surveyed in 2007. When this population was revisited in 2016 after the Stouts Creek fire and subsequent salvage logging and road widening, no viable plants were located in the Pipeline Project right-of-way or within proposed access roads. Although no plants were relocated along the construction right-of-way in 2016, it is possible that construction of the Pipeline Project and use of access roads could affect this population if plants resprout in this area. Because legume seeds are known to be long-lived, the lupine plants previously documented may have set seeds prior to the late July 2015 fire, and plants can be interconnected by underground stems up to 33 feet apart (FWS 2006g). Additional surveys would be conducted within this area prior to construction to determine the presence or absence of Kincaid's lupine plants. If plants or seedlings are located within the construction right-of-way, measures would be taken to avoid the plants to minimize impacts (see the *Kincaid's Lupine Mitigation Plan* [Attachment 1 to the *Federally-listed Plant Conservation Plan*] in appendix V.2).

Not all suitable habitat has been surveyed to date; therefore, additional Kincaid's lupine plants may be located within areas where direct impacts could occur. However, to minimize impacts, Pacific Connector would implement mitigation measures, as described below (see section 3.7.5.4, Conservation Measures) and in the *Kincaid's Lupine Mitigation Plan* (appendix V.2), to any identified populations that might be impacted by the Pipeline Project.

Indirect Impacts

Indirect impacts include habitat alteration of 2,003.77 acres of known or estimated suitable Kincaid's lupine habitat that occur within the botanical analysis area (1,237.77 known acres plus an additional 730 acres of estimated suitable habitat based on assumptions discussed above). Indirect impacts are likely to include: 1) changes in hydrology and soil characteristics, 2) an increase in invasive weeds, and 3) alterations of vegetation cover and species composition. Changes in the natural hydrology of a site, such as by ditching or draining a wet prairie, can alter the annual duration of soil saturation, which in turn affects the species composition of the site. The potential for soil compaction along the construction right-of-way could occur from heavy equipment use and repeated vehicle traffic. Soil compaction can alter soil hydrologic conductivities, decreasing soil infiltration rates and available water contents, and increase runoff rates, or concentrate surface waters (such as along a settled trenchline). Pacific Connector's ECRP (see appendix F) describes the mitigation measures that would be implemented during restoration to alleviate potential soil compaction along the right-of-way to assist revegetation success and to minimize any potential effects to Kincaid's lupine. Construction of the Pipeline Project in Kincaid's lupine meadow habitats could cause an increase in weedy grasses and forbs. In Kincaid's lupine forested habitat, a decrease in overstory canopy cover and subsequent shift to early seral vegetation associated with logging is expected with construction of the Pipeline Project. A reduction in canopy cover alone (i.e., without the ground disturbance associated with logging activities) could result in an improvement to forested Kincaid's lupine habitat. Kincaid's lupine is very sensitive to habitat loss, competition from nonnative plants, and elimination of historical disturbance regimes (and resulting competition from increased vegetation cover), all of which have contributed to the decline of Kincaid's lupine populations (FWS 2006g). Indirect impacts to documented patches of lupine are also possible from heavy dust created during construction activities and use of existing access roads and subsurface disturbance to underground stems.

Pacific Connector would implement the procedures outlined in their IPM (see Appendix N to Pacific Connector's POD [appendix B to this BA]) to minimize introduction and spread of invasive species. Additionally, application of dust abatement measures included in Pacific Connector's *Air, Noise and Fugitive Dust Control Plan* (see Appendix B to Pacific Connector's POD [appendix B to this BA]) would minimize the potential for fugitive dust impacts to Kincaid's lupine plants and its habitat during construction.

Critical Habitat

Critical habitat has not been designated for Kincaid's lupine within the Project area.

3.7.5.4 Conservation Measures

Avoidance, Minimization, and Rehabilitation / Restoration

As described above for the Applegate's milk-vetch (see section 3.7.1.4), Pacific Connector has developed a *Federally-listed Plant Conservation Plan* to address how avoidance, minimization, propagation, restoration, and other conservation measures would be applied to protect listed plant species, as well as how potential impacts on unsurveyed lands would be addressed. This plan also contains a *Kincaid's Lupine Mitigation Plan* that specifically addresses how mitigation would be implemented for the Kincaid's lupine (see Attachment 1 within the *Federally-listed Plant Conservation Plan*, appendix V.2).

Because the removal of any Kincaid's lupine plants may hinder the recovery and eventual downlisting of the species, Pacific Connector has avoided or minimized impacts to the populations of Kincaid's lupine that were located during survey efforts near MPs 57.84 to 57.92, 59.60, and 96.5 to 96.9, as described in the Kincaid's mitigation plan (appendix V.2). These measures included altering the proposed route, removing or minimizing proposed TEWAs, and/or minimizing the construction right-of-way (see figures K-1, K-2, and K-3 in appendix V.2). Pacific Connector would conduct additional surveys within the Stouts Creek fire area (MP 96.5 to 96.9) to determine the presence or absence of Kincaid's lupine plants prior to ground-disturbing activities. If subsequent surveys continue to document the absence of these plants within the Pipeline right-of-way, Pacific Connector would revert back to the previous disturbance footprint (i.e., remove neck-downs within the construction right-of-way and TEWAs that are called out in figure K-3 in appendix V.2). If plants are located within the construction right-of-way, measures similar to those previously incorporated into the Pipeline Project (see figure K-3 in appendix V.2), would be implemented, where necessary, to minimize or avoid effects to observed plants.

Persisting subpopulations between MPs 96.5 to 96.9 identified along the existing access roads would be flagged by a qualified botanist prior to Pipeline project activities in the area and Pacific Connector's EIs would clearly fence the road edges adjacent to these subpopulations to minimize potential disturbance from road use and possible maintenance activities.

When access to the construction right-of-way is granted, surveys would be conducted in potential habitat (previously surveyed or unsurveyed) and the FWS would be notified of survey results. If plants are present, the avoidance/conservation measures included in the Kincaid's lupine mitigation plan would be implemented, where feasible. Measures of avoidance may include minor alignment reroutes, necking down the construction right-of-way, excluding a portion of an identified TEWA or pipe storage yard, or erecting a protective fence to avoid impacts to plants from construction debris.

If any Kincaid's lupine plants are observed within the construction area, seed collection would be completed in the year prior to construction, after the plants have flowered and the seeds have developed and matured. The collected seed would either be provided to a certified repository (i.e., The Berry Botanic Garden) or would be replanted within or adjacent to the construction right-of-way during restoration efforts on suitable BLM lands where future protection can be managed or on private lands where a conservation easement has been acquired. If planting is to occur on the construction right-of-way, it would occur outside the 30-foot maintained easement.

Additional mitigation measures for impacts to individual Kincaid's lupine plants would include application of measures included in the IPM (Appendix N to the POD [appendix B to this BA]) to control existing noxious weeds and prevent new infestations within and adjacent to occupied and potential habitats. Competition with invasive plant species have been the biggest threat to maintaining or reestablishing Kincaid's lupine in some locations (Thorpe and Massatti 2008; Thorpe et al. 2009); therefore, control of these invasive species could have a beneficial impact on Kincaid's lupine. Other measures could include planting native forbs and shrubs adjacent to Kincaid's lupine populations to encourage a variety of pollinating insects. Controlling canopy cover in occupied or potential wood habitats could also stimulate growth of existing clones if shading is judged to be a limiting factor. Pacific Connector would not plant trees within the construction right-of-way and TEWA areas between MPs 96.5 and 96.9, if approved by the landowner, to enhance habitat conditions for adjacent Kincaid's lupine populations.

It is possible that clones of Kincaid's lupine could become established within the construction right-of-way where rerouted near MPs 57.84 to 57.92, or could resprout within the Stouts Creek fire area near MPs 96.5 to 96.9. Pacific Connector has agreed to monitor revegetation success in the areas of the restored Kincaid's lupine populations (between MPs 57.84 to 57.92 and MPs 96.5 to 96.9) annually for five years after completion of construction. Monitoring would include inspection between those mileposts for any new growths of Kincaid's lupine. If any are found, only mowing to comply with USDOT requirements would be conducted. The five-year monitoring period is longer than FERC's three-year monitoring period requirement for sensitive areas such as wetlands (see section VI.D.3. of FERC's *Procedures*).

Mitigation

The Forest Service has proposed a suite of mitigation projects to address the effects of the Pacific Connector Pipeline Project on various resources on NFS lands and to ensure that construction and operation of the pipeline would be consistent with the objectives of the respective Forest Service LRMPs (appendix O.4). These mitigation actions would be a condition of the Forest Service letter of concurrence and would be included in the Right-of-Way Grant, if one were issued for this Project. Implementation and funding of these actions would be carried out through negotiated agreements between the Forest Service and Pacific Connector.

Several projects proposed for land on the Umpqua National Forest (i.e., the Elk Creek and Upper Cow Creek Lupine Meadow Restoration projects, the Elk Creek Roadside Noxious Weed Project, and the Upper Cow Creek and Elk Creek Pump Chance projects) have the potential to result in short-term impacts to Kincaid's lupine, such as temporary disturbance to habitat. However, these projects would result in beneficial effects in the long term by improving habitat for Kincaid's lupine through actions such as removal of encroaching conifers, noxious weed control, and fire suppression within lupine habitat. Currently, these projects lack the site-specific details needed for implementation; however, the Forest Service is seeking consultation at a programmatic level for these and other proposed Forest Service actions described in this BA. It is anticipated that these projects would require a secondary site-specific project-level ESA consultation prior to implementation.

3.7.5.5 Determination of Effects

Species

The Project **may affect** Kincaid's lupine because:

- suitable habitat is present within the analysis area; and
- individual plants have been located within the analysis area during survey efforts.

The Project is l**ikely to adversely affect** Kincaid's lupine because:

- approximately 991.6 acres of potential suitable habitat that has not been surveyed occurs within the botanical analysis area, which includes 448.7 acres within the pipeline right-of-way; therefore, it is possible that unidentified plants occur within the construction right-of-way and workspace;
- surface disturbance and excavation would occur within potentially suitable habitats, which may contain unidentified plants (including in areas where surveys have not been completed);

- indirect effects, including potential changes in hydrology and soil characteristics, introduction and spread of invasive plants and noxious seeds, alterations to vegetation cover and species composition of associated habitat, and effects from fugitive dust, could impact documented or suspected plants and habitat outside the right-of-way, but within 30 meters (98 feet) of the Pipeline Project and along access roads; and
- trenching activities associated with the Pipeline Project could impact below-ground stems and the expected impact to extant plants is unknown'

Critical Habitat

A **no effect** determination is warranted for Kincaid's lupine's critical habitat because:

- the Project does not occur within designated Kincaid's lupine critical habitat.

3.7.6 Western Lily

The western lily (*Lilium occidentale*) is a perennial member of the lily (Liliaceae) family. It is found in forest openings along the Coast Range, within four miles from the ocean, from Humboldt County, California, to Coos County, Oregon.

3.7.6.1 Species Account and Critical Habitat

Status

The western lily was listed as endangered on August 17, 1994 (FWS 1994c), and a final recovery plan (FWS 1998c) was released four years later.

Threats

In the species recovery plan, the FWS identified human modification or destruction of habitat, competitive exclusion from natural succession, grazing by deer, livestock, elk, and small mammals as the primary threats to the western lily (FWS 1998c). Human depredation, insect herbivory, fungal, viral, or bacterial infection, and random loss of genetic variability in small populations were listed as secondary threats.

In the five-year review of western lily, the FWS identified continued development, including creation of new cranberry bogs, residential development, utility and road construction and maintenance, land clearing and drainage for livestock grazing, agricultural plowing, and logging as principal threats to this species (FWS 2009f). Additionally, the FWS considers competitive exclusion by shrubs and trees to be the most significant long-term threat to the western lily (FWS 1998c, 2009f).

Species Recovery

The recovery plan for western lily identifies six recovery zones (FWS 1998c). These recovery areas are not defined geographically, but are positioned between known extant sites or historical sites. The proposed pipeline and LNG terminal occur within Recovery Zone 1, within which three extant populations of western lily occur (FWS 2009f).

The recovery plan states that the western lily can be downlisted to threatened when at least 20 viable populations (a viable population consists of a stable or growing population of at least 1,000 flowering plants) distributed among the six recovery zones are protected and managed.

The objective of the recovery plan is to stabilize and protect existing occupied sites as viable populations so that the species can be downlisted or delisted in the future. To achieve the objective, the following steps are recommended (FWS 1998c):

- on-site conservation that manages the habitat to maintain the appropriate seral stages (i.e., prevents or reverses encroachment by trees and shrubs);
- off-site conservation through collection and maintenance of a seed bank and reintroduction or augmentation of populations from seeds; and
- conducting and encouraging public outreach.

As noted in the 5-year review (FWS 2009f), the number of extant populations of western lily and the distribution of these populations among recovery zones currently meets the recovery criteria. However, many of the 23 known populations are unlikely to ever meet the minimum population criteria due to the limited area of available habitat (FWS 2009f).

Life History, Habitat Requirements, and Distribution

Western lily inhabits sphagnum bogs, freshwater fens, coastal scrub and prairie, the transition zones between these vegetation types, and other poorly drained soils along the coast of southern Oregon and northern California (FWS 1998c, 2009f). Habitats with which this species is associated include coastal bluff scrub, coastal prairie, and openings in coastal coniferous forest dominated by Sitka spruce, including freshwater marshes and swamps (CNDDB 2005). The western lily has an extremely restricted distribution within four miles of the coast from north of Coos Bay, Oregon to Humboldt Bay in California (FWS 2009f).

The species grows in soils that are described as both well-drained or poorly drained and have a significant layer of organic topsoil; with the two types of soils on which it occurs consisting of decomposed peat or muck substrate, or soils that are poorly drained due to a shallow iron pan, or clay layer (FWS 2009f). Occurrences within the Coos Bay area are reported to occur in Blacklock soils; however, it also grows in soils that are well drained that have a substantial layer of organic soil (SHN 2013b). Species typically associated with western lily include Sitka spruce (*Picea sitchensis*), salal (*Gaultheria shallon*), Douglas' spiraea, western wax myrtle, willows (*Salix* spp.), Oregon crabapple (*Malus fusca*), evergreen huckleberry (*Vaccinium ovatum*), Pacific reed grass (*Calamagrostis nutkaensis*), slough sedge (*Carex obnupta*), and false lily-of-the-valley (*Maianthemum dilatatum*; Imper 2003, FWS 2009f). In Oregon, western lily emerges in late March or early April and flowers in late June or July (Imper 2003).

Population Status

At the time of listing, the western lily was known from 31 small, isolated populations spread over seven widely separated regions (FWS 1994c). At the time of the species recovery plan (1998), western lily had been extirpated from 18 of an estimated 55 sites. Since publication of the recovery plan in 1998, six new sites were discovered; however, many known occurrences have been extirpated and many previously documented occurrences could not be relocated (FWS 2009f). The 5-year review for the western lily grouped all known occurrences into "principle populations" to "eliminate confusion in identifying discrete occurrences, and make the accounting of populations more accurate and meaningful" (FWS 2009f). The 23 extant principle populations, identified in the 5-year review, ranged in size from less than 0.1 acre to more than 6 acres, totaling about 40 acres of occupied habitat (FWS 2009f).

Estimating population size for this species is difficult, thus, comparison of current total population estimates with estimates at the time of listing is not particularly useful; however, overall, there has been a downward trend in spatial distribution and occupied habitat since the time of listing (FWS 2009f). In 2013, a new population of western lily was discovered near Charleston, Oregon on lands now owned by the South Slough National Estuarine Research Reserve (Burns 2018). This new population is believed to be one of the largest populations now existing in Oregon.

Critical Habitat

Critical habitat has not been designated for western lily.

3.7.6.2 Environmental Baseline

Analysis Area

The botanical analysis area extends to 30 meters (98 feet) each side of the Pipeline Project (construction right-of-way, TEWAs, UCSAs, rock source and disposal sites, and proposed storage yards) on lands that have potential habitat for listed plant species. This area generally corresponds to the extent of the area surveyed for sensitive and listed plant species during surveys conducted between 2007 and 2017 (i.e., at least 100 feet from habitat removal on federal lands and at least 50 feet from habitat removal on non-federal, private lands and along access roads where road improvements are proposed). For the LNG Terminal, the analysis area includes the terminal footprint and potential habitat for western lily extending north to the Trans-Pacific Parkway, as well as within 30 meters (98 feet) of the associated temporary construction work areas and mitigation sites (e.g., Port laydown site, Kentuck project site) shown in figure 2.1-3.

Species Presence

The botanical analysis area crosses the plant's range including the LNG terminal and the Pipeline route from approximately MPs 0 to MP 12 (i.e., within the coast and coastal forest ecoregion; SBS 2008b, 2008c), although the species is more typically found within four miles of the coast. The closest known occurrences of western lily are approximately 1 mile south of the Myrtlewood Off-site Park & Ride, 5 miles northeast of the LNG terminal, and 5.5 miles north of the pipeline at Hauser Bog (ORBIC 2012). This occurrence at Hauser Bog is on blacklock soils, which are found on marine deposits, are deep, poorly drained, and have a high organic content. At the time of listing in 1994, there were 43 plants reported flowering (although this is based on an incomplete survey information; FWS 2009f). In 2003, approximately 609 lilies were observed at Hauser Bog, including 63 flowering plants and in 2009, 494 plants observed although the population was rated as poor estimated viability (FWS 2009f; ORBIC 2012). Western lilies at the Hauser Bog site sustain inundation because they grow on mounds that allow bulbs to remain above high water (FWS 2009f); high groundwater has been implicated in mortality of western lilies at other sites (FWS 2009f).

Other extant populations of western lily are present about 8 miles south of the LNG terminal at Bastendorff Bog Preserve, Sunset Bay State Park and South Slough National Estuarine Research Reserve (approximately 9 miles), and several sites within Shore Acres State Park (approximately 10 miles; FWS 1998c). Western lilies in those populations have been rated with excellent or good estimated viabilities except for the population at Sunset Bay State Park, which was last observed in 2004 and ranked with poor viability (ORBIC 2012). The western lily has not been documented within the Project botanical analysis area (ORBIC 2012).

Botanical surveys in the vicinity of the LNG terminal were conducted in 2005, 2006, 2012, and 2013. Based on soil types present and the species' moisture requirements, suitable habitat within the survey area was found to be limited to freshwater wetlands on site that have a significant organic layer within the soil profile (SHN 2013b). Focused surveys for western lily were conducted at 11 sites adjacent to or coinciding with the terminal footprint, including the South Dunes site, on July 8, 9, 10, and 11, 2013 (SHN 2013c). No western lilies were observed during surveys conducted for the LNG Terminal (SHN 2013b).

Surveys for the western lily were not conducted within all areas currently proposed for the LNG Project. Areas where surveys have not been conducted include the Boxcar Hill and Port Laydown sites, Myrtlewood Off-site Park & Ride, and the Kentuck, Panhandle, Lagoon, and North Bank mitigation sites. Although surveys for western lily were not conducted in the Myrtlewood Off-site Park & Ride (the closest Project facility to a known occurrence of western lily), the Park & Ride is located completely in a paved parking lot and does not contain suitable habitat for the western lily. The other areas contain freshwater wetlands that may contain potential habitat for the western lily.

A habitat review was conducted prior to the beginning of field surveys in 2007 to identify potential habitat and delineate survey areas for western lily within the botanical analysis area and along existing roads identified for access to the construction right-of-way.

Overall, 37.6 acres have been identified as potential suitable habitat requiring surveys within the botanical analysis area. Of that potential habitat, access was granted by the landowners to 36.1 acres (including 13.7 acres within the Pipeline right-of-way). An additional 9.3 acres of potential suitable habitat was surveyed adjacent to the Noah Butte access road, but no suitable habitat was located. All potential suitable habitats are located between MP 4.15 and MP 11.42 in Coos County.

Of the 36.1 acres of potential habitat that was surveyed, only one area near MP 8.2 (6.7 miles from the coast) was considered potentially suitable habitat for western lily. Surveys conducted at this site in 2014 identified only a narrow band of marginal habitat that had adequate moisture and seasonally boggy areas, but it had undergone much disturbance during recent agriculture development. No plants were documented.

Access to approximately 1.5 acres (0.2 acre within the Pipeline right-of-way) of potentially suitable habitat for this species was denied by the landowner. This area would need to be surveyed prior to construction in order to establish a complete survey of this area. However, given the unsuitable habitat conditions surveyed in adjacent areas, the 1.5 acres remaining to be surveyed are not expected to provide suitable habitat for western lily. No western lilies have been observed during surveys conducted on accessible potential habitat and the chance that western lilies occur on the unsurveyed 1.5 acres (0.2 acre within the Pipeline right-of-way) is unlikely, but still possible.

Critical Habitat

No critical habitat has been designated for western lily.

3.7.6.3 Effects of the Proposed Action

Direct and Indirect Effects

Given that no plants were located in areas surveyed and only limited, marginally suitable habitat was observed, it is unlikely that western lily would be documented in unsurveyed areas of the LNG terminal and associated facilities. Additionally, review of NRCS soil survey data indicates that the unsurveyed area of potentially suitable habitat along the pipeline route does not have the combination of the soil characteristics (i.e., deep, poorly drained marine deposits with high organic content) that support known western lily populations. Therefore, direct and indirect impacts to this species from the Project are unlikely to occur.

3.7.6.4 Conservation Measures

If plants are documented during pre-construction surveys, mitigation measures included in the *Federally-Listed Plant Conservation Plan* (appendix V.2) would be implemented. Consultation with the FWS would also be reinitiated if this species is found to be present in the Project area and effects cannot be avoided.

3.7.6.5 Determination of Effects

Species

The Project **may affect** the western lily because:

- known populations occur within 1 mile of the botanical analysis area; and
- potential suitable habitat is available within the analysis area.

The Project is **not likely to adversely affect** the western lily because:

- surveys of potential western lily habitat at the Jordan Cove site and associated facilities and along the pipeline route did not document western lily and potential suitable habitat within the botanical analysis area is limited;
- surveys in potentially suitable habitat would occur prior to ground-disturbing activities; if plants are identified, conservation measures developed to avoid or minimize impacts to future plants would be implemented; and
- consultation with the FWS would be reinitiated if this species is found to be present in the area and impacts cannot be avoided.

Critical Habitat

Critical habitat has not been designated for the western lily.

3.7.7 Rough Popcornflower

The rough popcornflower (*Plagiobothrys hirtus*) is an annual herb in the borage (Boraginaecae) family. It is found in seasonal wetlands in the Umpqua River valley in Douglas County, Oregon (FWS 2000d).

3.7.7.1 Species Account and Critical Habitat

Status

The rough popcornflower was listed as endangered on January 25, 2000 (FWS 2000d). There has been no critical habitat designated for this species.

Threats

The FWS listed the rough popcornflower as threatened based on the destruction, modification, or curtailment of its wetland habitat and range. At the time of listing, the species was limited to 17 small isolated habitat patches (FWS 2000d). Areas supporting the rough popcornflower are threatened by hydrological alterations (including ditching and wetland fill), livestock grazing, agricultural land conversion, competition with non-native vegetation, forest succession and canopy cover, roadside mowing, as well as residential and commercial development.

Other threats include herbicide and pesticide use, chemical spills and runoff from roads, roadside maintenance, habitat vandalism, and grazing. When flowers and seed heads are grazed, the reproductive output for the year is destroyed; however, FWS noted in its listing decision that grazing in the fall, during the plant's dormant stage, can be a benefit to the species by reducing the growth of weedy competitors (FWS 2000d). The small, isolated populations also make the species vulnerable to disease outbreaks, weak genetic viability, adverse pollinator activity, and random environmental events.

Species Recovery

A recovery plan was developed in 2003 (FWS 2003e), which created three recovery units, corresponding to drainage basins within the North Umpqua system, to ensure that the rough popcornflower was conserved throughout its range. The recovery plan identified that nine reserves, each containing a minimum of 5,000 plants, should be distributed across the three recovery units of Calapooya Creek, Sutherlin Creek, and Yoncalla Creek (FWS 2003e). Additionally, a minimum of 1,000 square meters (10,764 square feet) should be occupied by rough popcornflower within each reserve and that patches of occupied habitat within reserves are within 1 km (0.6 mile) of one another. The objective of the recovery plan is to reduce threats and increase population viability until the rough popcornflower can be downlisted. The recommended steps are as follows:

- Conserve and manage existing patches and develop new protected populations within a minimum of nine reserves in three recovery units.
- Implement long-term ex-situ conservation of rough popcornflower seeds.
- Research factors that threaten the recovery of the species.
- Provide outreach services for owners of reserve populations and the general public.

All the recovery units identified in the recovery plan occur more than 17.5 miles north of the Project right-of-way and more than 4 miles north of the nearest proposed pipe storage yard.

Life History, Habitat Requirements, and Distribution

The rough popcornflower is currently found in seasonal wet meadows or wet prairies in poorly drained clay or silty clay loam soils at elevations ranging from 100 to 900 feet (FWS 2003e, 2014f). Deep, poorly drained soils provide a high-to-surface-level water table from November to May.

Rough popcornflowers' seedlings germinate with the initiation of fall rains and overwinter as submerged rosettes. The rough popcornflower is often observed in the deeper sections of shallow meadow pools that lack significant shade and is associated with typical marshland sedge and grasses (FWS 2003e).

Rough popcornflower generally blooms from June through July. Rough popcornflower grows in scattered groups and reproduces largely by insect-aided cross-pollination and partially by self-pollination (FWS 2014f). The herbaceous plant occurs near the towns of Sutherlin and Yoncalla, mostly on private lands in the Umpqua River drainage (FWS 2003e).

Population Status

At the time of listing, there were 17 known extant populations of rough popcornflower. As of 2010, there were 17 extant occurrences of rough popcornflower, distributed from Yoncalla Creek near Rice Hill, south to Sutherlin Creek near Wilbur, of which five populations have been introduced (FWS 2010f). Populations range from 75 plants to more than 30,000 plants (FWS 2010f). Six populations are considered protected and have a documented occupancy of at least 5,000 plants (FWS 2010f).

Critical Habitat

Critical habitat has not been designated for the rough popcornflower.

3.7.7.2 Environmental Baseline

Analysis Area

The botanical analysis area extends to 30 meters (98 feet) each side of the Pipeline Project (construction right-of-way, TEWAs, UCSAs, rock source and disposal sites, and proposed pipe storage yards) on lands that have potential habitat for listed plant species. This area generally corresponds to the extent of the area surveyed for sensitive and listed plant species during surveys conducted between 2007 and 2018 (i.e., at least 100 feet from habitat removal on federal lands and at least 50 feet from habitat removal on non-federal, private lands and along access roads where improvements are proposed), and correlates to a distance that indirect effects to plants would be expected.

Species Presence

This species has only been documented in northern Douglas County. The nearest occupied habitat to the Pipeline Project is along Sutherlin Creek. Rough popcornflower occurs within multiple subpopulations approximately 1.7 miles north of the proposed Winchester pipe storage yard where 62,765 plants were documented in 2016 (ORBIC 2017b). The closest rough popcornflower occurrence to the pipeline right-of-way is approximately 17.5 miles north of MP 68 (ORBIC 2017c).

A habitat review was conducted prior to the beginning of field surveys in 2007 to identify potential habitat and delineate survey areas for rough popcornflower within the botanical analysis area and along existing roads identified for access to the construction right-of-way between MPs 51.7 through 67. Aerial photographs and knowledge of regional landscape and biological and physical features (soils, geology, topography, elevation, target species habitat, and plant community habitat) were used to determine potential habitat for rough popcornflower.

Within the 30-meter botanical analysis area of the Project, where survey permission was granted, approximately 2.80 acres (1.07 acres within the project right-of-way) were identified as suitable habitat and 6.43 acres were determined not to be suitable habitat for the rough popcornflower (see table 3.7.7-1). No rough popcornflower individuals were located during surveys conducted during Pipeline Project survey efforts. Table 3.7.7-1 provides a summary of potential suitable rough popcornflower habitat and survey status within the botanical analysis area.

TABLE 3.7.7-1

Summary of Potential Suitable Rough Popcornflower within the Botanical Analysis Area

General Landowner	Suitable Habitat Status	Acres Surveyed			Acres Not Surveyed c/		
		Project a/	Buffer b/	Total	Project a/	Buffer b/	Total
MPs 51.7 – 67.0 (109 acres within botanical analysis area)							
Federal	Suitable Habitat	0.00	0.00	0.00	0.00	0.00	0.00
	Not Habitat	0.00	0.00	0.00	N/A	N/A	0.00
	Unknown	0.00	0.00	0.00	0.00	0.00	0.00
	Total	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Non-Federal	Suitable Habitat	1.07	1.73	2.80	0.00	0.01	0.01
	Not Habitat	2.00	4.43	6.43	N/A	N/A	N/A
	Unknown	0	0	0	82.63	17.18	99.81
	Total	*3.07*	*6.16*	*9.23*	*82.63*	*17.19*	*99.82*
Total	Suitable Habitat	1.07	1.73	2.80	0	0.01	0.01
	Not Habitat	2.00	4.43	6.43	N/A	N/A	N/A
	Unknown	0	0	0	82.63	17.18	99.81
	Total	**3.07**	**6.16**	**9.23**	**82.63**	**17.19**	**99.82**

a/ Project includes: right-of-way, temporary extra work area, uncleared storage area, rock storage, pipe yards, aboveground facilities.

b/ Buffer (botanical analysis area) includes area within 30 meters (98 feet) or 50 feet of habitat removal on federal land and non-federal land, respectively and within 50 feet either side of existing access roads identified with possible road improvements.

c/ Areas not surveyed were either:1) denied access; 2) surveyed because of recent modification in the pipeline route that occurred after the flowering season; or 3), portions of the 30-meter (98-foot) botanical analysis area outside of the targeted 50-foot survey area on non-federal lands. "Not Habitat" was determined from adjacent survey parcel information, aerial photography, or "drive-by;" no surveys would be necessary and acres are not included.

Access to approximately 99.82 acres (82.63 acres within the Project right-of-way) of potentially suitable habitat for this species has not been granted within the botanical analysis area. The majority of these acres (93.16 acres) are associated with the proposed Winchester pipe storage yard and buffer. Pacific Connector would continue to survey habitat where permission is granted. Where survey access has been denied, Pacific Connector would conduct surveys in suitable habitat within the Pipeline Project prior to construction.

Critical Habitat

Critical habitat has not been designated for this species.

3.7.7.3 Effects of the Proposed Action

Direct and Indirect Effects

Given that the nearest known occurrence of rough popcornflower is over 17 miles north of the pipeline route, it is unlikely that rough popcornflower plants would be documented along the right-of-way. Potential wetland habitat for the species may be present at the proposed Winchester pipe storage yard, which is located 1.7 miles south of documented occurrences. If Pacific Connector determines that it would use this pipe storage yard during construction, surveys for rough popcorn flower would be conducted. If plants are documented, Pacific Connector would either not use the pipe storage yard or, if the yard is necessary, not use that portion of the yard where plants are documented. However, due to the current use of this pipe storage yard and adjacent highway, any plants found adjacent to these areas would likely already experience indirect effects.

Based on the information presented above, direct impacts to this species are unlikely to occur. Indirect impacts could; however, occur if this plant is located within or adjacent to Winchester pipe storage yard or the unsurveyed portion of the Project through dust generated via use of the area, changes in runoff and hydrology, or through the spread/establishment of nonnative plants.

3.7.7.4 Conservation Measures

If documented, mitigation measures included in the *Federally-Listed Plant Conservation Plan* (appendix V.2) would reduce impacts to rough popcornflower plants if documented during preconstruction surveys.

Mitigation

The Forest Service has proposed a suite of mitigation projects to address the effects of the Pipeline Project on various resources on NFS lands and to ensure that construction and operation of the pipeline would be consistent with the objectives of the respective Forest Service LRMPs (appendix O.4). These mitigation actions would be a condition of the Forest Service letter of concurrence and would be included in the Right-of-Way Grant, if one were issued for this Project. Implementation and funding of these actions would be carried out through negotiated agreements between the Forest Service and Pacific Connector.

Although rough popcornflower is not known to occur on NFS lands crossed by the Project, the species is suspected to occur on the Umpqua National Forest (Forest Service 2019). As a result, three projects proposed for land on the Umpqua National Forest have the potential to result in short-term impacts to rough popcornflower, such as temporary disturbance to habitat, if the species were to occur in these areas. Projects include a noxious weed treatment, and two water source improvements to improve fire suppression (i.e., the Elk Creek Roadside Noxious Weed Project, and the Upper Cow Creek and Elk Creek Pump Chance projects; see table 2.8-1). These projects may result in beneficial effects in the long term by improving potential habitat for rough popcornflower, especially considering competition with non-native vegetation has been identified as a threat to this species. Currently, these projects lack the site-specific details needed for implementation; however, the Forest Service is seeking consultation at a programmatic level for these and other proposed Forest Service actions described in this BA. It is anticipated that these projects would require a secondary site-specific project-level ESA consultation prior to implementation.

3.7.7.5 Determination of Effects

Species

The Project **may affect** rough popcornflower because:

- populations occur near a pipe storage yard; and
- potential suitable habitat might be present within the 30-meter (98-foot) botanical analysis area.

The Project is **not likely to adversely affect** rough popcornflower because:

- where access has been granted, surveys for the Pipeline Project have not documented individuals of rough popcornflower;
- surveys in potentially suitable habitat identified within Winchester pipe storage yard and within potential habitat along the right-of-way would occur prior to ground-disturbing activities; if plants are identified, conservation measures developed to avoid or minimize effects on documented plants would be implemented; and
- consultation with the FWS would be reinitiated if this species is found to be present in the area and impacts cannot be avoided.

Critical Habitat

Critical habitat has not been designated for rough popcornflower.

3.8 CUMULATIVE EFFECTS

FWS and NMFS describe cumulative effects (50 CFR 402.02) as the result of future actions by state or private entities, not involving federal actions, but reasonably certain to occur in the action area considered in this BA. Future federal actions that are unrelated to the proposed action are not considered because they require separate consultation pursuant to Section 7 of the ESA. A standard of "reasonably certain to occur" is clarified as "those actions that are likely to occur, bearing in mind the economic, administrative, or legal hurdles which remain to be cleared". Further, NMFS provides that "speculative actions that are factored into the cumulative effects analysis add needless complexity into the consultation process…" (51 *Federal Register* 19933). No specific state or private actions have been identified within the action area that meet the standard for evaluation of cumulative effects under ESA. Therefore, no cumulative effects to the species addressed in this BA are anticipated as a result of the proposed action.

4.0 ESSENTIAL FISH HABITAT

The Sustainable Fisheries Act of 1996 amended the MSA and requires federal agencies, in part, to consult with NMFS about activities that may adversely affect EFH (NMFS 1997a). The MSA established guidelines for Regional Fishery Management Councils to identify and describe EFH in Fishery Management Plans (FMP) to responsibly manage exploited fish and invertebrate species in federal waters. The PFMC has developed four FMPs that address EFH for managed species in the Project area (PFMC 2004, 1998, and 1999).

The MSA describes EFH as those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity (NMFS 1997a). The MSA provides these additional definitions:

- "Waters" include aquatic areas and their associated physical, chemical, and biological properties that are used by fish, and may include areas historically used by fish where appropriate;
- "Substrate" includes sediment, hard bottom, structures underlying the waters, and associated biological communities;
- "Necessary" means the habitat required to support a sustainable fishery and the managed species contribution to a healthy ecosystem; and
- "Spawning, breeding, feeding, or growth to maturity" covers the full life cycle of a species.

One purpose of this EFH assessment is to determine whether, and to what degree, Project actions would adversely affect any of the EFH within the analysis areas. NMFS (2015d) defines a project action that will adversely affect EFH as:

> *any impact that reduces quality and/or quantity of EFH. This includes direct or indirect physical, chemical, or biological alterations of the waters or substrate and loss of, or injury to species and their habitat, and other ecosystem components, or reduction of the quality and/or quantity of EFH. Adverse effects may result from actions occurring within EFH or outside of EFH.*

There are three general analysis areas in which Project effects to EFH are assessed:

- marine: the marine waters extending from the mainland marine coastline (excluding Coos Bay), out to 12 nmi that may be affected by LNG carriers or other Project actions;
- estuarine: the waters of Coos Bay; and
- riverine: freshwater areas that may be affected by Project actions in fifth-field watersheds currently containing EFH species.

The PFMC has developed four FMPs that address EFH for managed species in the Project action area. There are four federal FMPs and associated EFH that coincide with these analysis areas. They include highly migratory species, coastal pelagic species, groundfish, and Pacific Coast salmon. Within these analysis areas, EFH has been designated for two salmonid species, five pelagic species, 70 groundfish species, and over a dozen highly migratory species as described below.

EFH has been defined by the PFMC out to the limits of the U.S. EEZ. Marine traffic associated with construction and operation of the LNG Project may affect EFH beyond the marine analysis area (that is, beyond the limits of the OCS out to the limits of the EEZ). For example, vessel traffic would generate localized noise, and impacts on water quality may occur due to discharge of ballast water, intake and discharge of cooling water, or accidental spills of pollutants at sea. However, Coos Bay and the waters offshore out to the limits of the EEZ currently provide deepwater access for maritime commerce, and support high levels of deep draft vessel traffic. Any impacts due to the incremental increase in marine vessel traffic during construction and operation of the Project would not have a significant adverse effect on EFH outside of the marine analysis area of the Project action area. As a result, the analysis of potential adverse effects to EFH coincides with the Project action area under the ESA, and the EFH Assessment has been incorporated into the BA, including the required contents as listed in 50 CFR § 600.920(e)(3).

See section 2 of this BA for a description of the Project. Section 3.5 analyzes the effects of the Project on ESA listed fish species and supplies most of the analysis provided in this EFH as it addresses effects to fish species and their habitat in all three analysis areas defined above.

The following discussion focuses on the potential effects to habitats for groups of species, not individual species. Table 4-1 provides a summary of the EFH habitat description, Project actions that may contribute to adverse effects to EFH, and overall determination of adverse effects for each EFH group.

TABLE 4-1

Potential Impacts to EFH due to Construction and Operation of the Project

EFH	Description of EFH a/	Potential Impacts	Determination of Effects
Highly Migratory Species	EFH is defined by temperature ranges, salinity, oxygen levels, currents, shelf edges, and sea mounts. Based on species characteristics, the closest EFH would be beyond the 40-fathom depth off of Coos Bay. b/	• Accidental spills of hazardous substances	Minimal adverse effects or negligible effects to highly migratory species EFH
Coastal Pelagic Species	All marine and estuarine waters from the coast to the limits of the EEZ and above the thermocline where sea surface temperatures range between 50°F and 79°F	• Accidental spills of hazardous substances • Dredging of 62.7 acres of estuarine habitat in Coos Bay • Installation of two HDDs across Coos Bay • Potential impingement or entrainment of small fish, food and larval organisms from dredging and LNG carrier cooling water intake	Habitat effects minimal; significant adverse effects to coastal pelagic species (northern anchovy, Pacific sardine) EFH unlikely
Groundfish	All waters from the extent of the high tide line (and parts of estuaries) to offshore to the 3,500-meter (1,914-fathom) depth.	• Accidental spills of hazardous substances • Dredging of 62.7 acres of estuarine habitat in Coos Bay • Short-term water quality degradation should a low-probability inadvertent return occur during installation of two HDDs across Coos Bay • Potential impingement or entrainment of small fish, food, and larval organisms	Habitat effects minimal; significant adverse effects to multiple groundfish species (e.g., rockfish, English sole, starry flounder) EFH unlikely

TABLE 4-1 (continued)

Potential Impacts to EFH due to Construction and Operation of the Project

EFH	**Description of EFH a/**	**Potential Impacts**	**Determination of Effects**
Pacific Coast Salmon	All streams, lakes, ponds, wetlands, and other waterbodies currently and historically accessible to salmon. Estuaries and marine areas extending to the EEZ and beyond.	• Accidental spills of hazardous substances • Dredging of 62.7 acres of estuarine habitat in Coos Bay • Installation of two HDDs across Coos Bay • Periodic channel dredging and disposal • Short-term increase in noise associated with land based pile driving at the MOF and in-water pile driving at various temporary construction activities • Potential impingement or entrainment of small fish, food and larval organisms • Fish salvage during stream crossings • Short-term loss of nearshore cover, prey species, and long-term loss of sources of large wood recruitment from riparian vegetation removal • Elevated suspended sediment at pipeline stream crossings • Diverted open-cut across South Umpqua River, installation of HDD across Coos River and Rogue River	Isolated and localized adverse effects to Pacific coastal salmon species (coho and Chinook salmon) EFH

a/ PFMC (2006; updated version July 24, 2006)
b/ PFMC (2007)

4.1 ESSENTIAL FISH HABITAT DEFINITION

As noted, there are four FMP fish habitat groups. The characteristics of each of the habitats and associated species relative to Project analysis areas are summarized below.

4.1.1 Highly Migratory Species

Highly migratory species only occur within the marine analysis area because they migrate considerable distances across oceans to feed and reproduce. Highly migratory species defined by the PFMC include tunas (five species), sharks (five species), billfish/swordfish (two species), and the dorado (also called dolphinfish or mahi-mahi). However, highly migratory species and their various life stages are not uniformly distributed within the marine analysis area. Species' life cycles included in table 4.1.1-1 have been separated by their distributions in the EEZ north of 37°N latitude (north of Monterey Bay, California). The earliest life stages for most highly migratory species on the U.S. West Coast occur south of Monterey Bay, outside the marine analysis area. Based on their distribution in mostly warmer waters and usually well outside the coastal area habitat that is typical of the marine area near Coos Bay, none of these fish are likely to be present in the immediate marine waters near the entrance to Coos Bay.

TABLE 4.1.1-1

Highly Migratory Fish Species Managed by the Pacific Fishery Management Council for which Essential Fish Habitat Has Been Identified and May Occur Within the Proposed Action Marine Analysis Area

		Distribution within the EEZ Analysis Area North of 37°N Latitude				
Common Name/ ***Scientific Name***	**Life Cycle and Habitat Associations a/**	**Eggs**	**Larvae**	**Neonate-Early Juvenile b/**	**Late Juvenile - Sub-adults b/**	**Adult**
Common thresher shark *Alopias vulpinus*	Epipelagic, neritic, and oceanic waters off beaches, in shallow bays, open coast bays and offshore, in near surface waters. Feeds primarily on northern anchovy, Pacific hake, Pacific mackerel, and sardine.					X
Bigeye thresher shark *Alopias superciliosus*	Coastal and oceanic waters in epi- and mesopelagic zones. Little known of diet; presumably feeds on pelagic fish and squids.					X
Blue shark *Prionace glauca*	Epipelagic and oceanic waters. Feeds on northern anchovy, Pacific hake, squid, spiny dogfish, herring, and flatfish.			X	X	X
Shortfin mako shark *Isurus oxyrinchus*	Oceanic and epipelagic waters. Reportedly feed on mackerel, sardine, bonito, anchovy, tuna, other sharks, swordfish, and squid.			X	X	X
Albacore *Thunnus alalunga*	Oceanic, epipelagic waters. Feed opportunistically. Younger fish may aggregate in vicinity of upwelling fronts to feed.			X		X
Northern bluefin tuna *Thunnus thynnus*	Juvenile-oceanic, epipelagic waters. Major part of diet is northern anchovy.			X		
Skipjack tuna *Katsuwonus pelamis*	Adult-oceanic, epipelagic waters. Major part of diet are pelagic red crab and northern anchovy.					X
Broadbill swordfish *Xiphias gladius*	Oceanic, epipelagic, and mesopelagic waters. Food species not documented.			X		X

a/ PFMC 2007.
b/ All juvenile life stages are combined for species other than sharks.

4.1.2 Coastal Pelagic Species

Coastal pelagic species include four fin fish—northern anchovy, Pacific sardine, Pacific (chub) mackerel, and jack mackerel—and the invertebrate market squid. Coastal pelagic species occur from the ocean surface to depths of 1,000 meters (547 fathoms within the marine analysis area, but the distributions of several species tend to be in relatively shallow water closer to shore, including the estuarine analysis area). These species are not associated with the seafloor or bottom substrates. EFH for coastal pelagic species also includes portions of the water column where sea surface temperatures range between 50°F (near the United States/Mexico maritime boundary) and 79°F (seasonally and annually variable) (PFMC 2006).

All life stages for each of the coastal pelagic species are expected to occur within the marine analysis area, and the adults of most species are expected within the estuarine analysis area (table 4.1.2-1). Northern anchovies are the only coastal pelagic species for which all life stages are likely to utilize the estuarine analysis area (table 4.1.2-1), although some life stages of Pacific sardine and Pacific mackerel may be present. In Coos Bay, these are not resident species, but are primarily present in the summer months. During the summer, the estuary may be utilized as a forage area for juveniles and adults, and as a nursery area for larvae and juveniles for some of the species.

TABLE 4.1.2-1

Coastal Pelagic Fish Species Managed by the Pacific Fishery Management Council for which Essential Fish Habitat Has Been Identified and May Occur within the Proposed Action Estuarine Analysis Area and Marine Analysis Area

		Distribution within Estuarine Analysis Area				Distribution within Marine Analysis Area			
Common Name ***Scientific Name***	**Life Cycle and Habitat Associations a/**	**Eggs**	**Larvae**	**Juvenile**	**Adult**	**Eggs**	**Larvae**	**Juvenile**	**Adult**
Pacific sardine *Sardinops sagax*	Pelagic commercially harvested schooling fish that inhabits coastal subtropical and temperate waters. Occurs in estuaries, but more commonly near shore and offshore. Highly mobile, moving seasonally along the coast. More abundant in Oregon during the summer and warm water years. Spawning occurs year-round (spatially and seasonally dependent on temperature) in loosely aggregated schools in the upper 50 yards of the water column, generally 30-90 miles offshore. Major prey species for commercially valuable and endangered fish species.			?	X	X	X	X	X
Northern anchovy *Engraulis mordax*	Often in schools near the surface. Spawning occurs every month, especially in late winter and early spring (February–April). Overwinter in mixed layer temperatures. Nearshore habitats support most of the juvenile population. Eat phytoplankton or zooplankton by either filter-feeding or biting. Considered a valuable source of food for endangered fish and bird species.	X	X	X	X	X	X	X	X
Pacific (chub) mackerel *Scomber japonicus*	Pelagic for all life stages. Adults commonly found in shallow banks with increased abundance from July to November. Spawning peaks April through July in California.			?	?	X	X	X	X
Jack mackerel *Trachurus symmetricus*	Pelagic schooling fish that range widely. Diet on large zooplankton, juvenile squid, and anchovy. They are more available on offshore banks in late spring, summer and early fall than during the remainder of the year. Much of their range lies outside the 200 mile EEZ.				X	X	X	X	X
Market squid *Loligo opalescens*	Prefer oceanic salinities and rarely found in bays, estuaries, or near river mouths. Spawning occurs year-round. They are important as forage foods for many species.		X	X	X	X	X	X	X

a/ PFMC 2007

Within the Coos Bay estuary, northern anchovies are expected to be transient users of eelgrass (Phillips 1984). Eelgrass provides indirect benefits to these species by contributing to productivity in the estuary, and eelgrass drift may provide cover for coastal pelagic species (Nightingale and Simenstad 2001).

4.1.3 Groundfish Species

There are over 80 species of groundfish, most of which live at or near the ocean bottom, that are managed under the Pacific Coast Groundfish FMP (PFMC 2008). Many groundfish species occur within the marine and estuarine analysis areas. This FMP includes EFH within the waters and substrates at "depths less than or equal to 3,500 meters (1,914 fathoms) to mean higher high water level (MHHW) or the upriver extent of saltwater intrusion, defined as upstream and landward to where ocean-derived salts measure less than 0.5 ppt during the period of average annual low flow" (PFMC 2005). Species and their likely life stage distributions in the Project analysis areas are summarized in table 4.1.3-1 (at the end of this section). This distribution is based on mapped habitat suitability probabilities for spatial occurrences by different life stages (Appendix B-4 in PFMC 2006). Although many groundfish species have the potential to be in the estuary based on the PFMC habitat maps, only 19 species are considered to be more than "unlikely" in the estuarine analysis area. Based on sampling within Coos Bay estuary, at least 16 groundfish species are known to be present (Wagoner et al. 1990).

Most groundfish species are not residents of Coos Bay but utilize the bay primarily in the spring and summer months. During spring and summer, the estuary may be utilized as a forage area for juveniles and adults, and as a nursery area for larvae and juveniles. For example, starry flounder spawn near river mouths and sloughs. Juvenile starry flounder are found exclusively in estuaries. Sampling in upper Coos Bay from 1979 to 1990 showed that young-of-the-year flounder are present at least in the spring and summer months (Wagoner et al. 1990). Flounder and sole are found in sandy or muddy substrate, and juveniles are found in shallow water near rivers and in estuaries in eelgrass beds. Adults generally are found in deeper waters in the winter and migrate to shallower water in the spring. Juvenile English sole depend heavily on intertidal areas, estuaries, and shallow nearshore waters for food and shelter.

The black rockfish is the only member of the rockfish family that is consistently caught in the Coos Bay recreational fishery. Other species caught include copper, blue, grass, and canary rockfish, as well as bocaccio (Wagoner et al. 1990). Rockfish occur in the lower areas of Coos Bay, mainly during the late spring and summer months (Wagoner et al. 1990). Black rockfish are not known to spawn in estuaries. Rockfish recruit to seagrass beds in shallow, soft bottom embayments (Love et al. 1991). Johnson et al. (2003) reported that juveniles of many commercially important species utilize eelgrass habitat in Southeastern Alaska. Rockfish juveniles settle into shallow vegetated habitats for rearing. Vegetated habitats (e.g., eelgrass and kelp) provide refuge from predators and access to prey. Juvenile rockfish may also be closely associated with seagrass drift for both feeding and refugia while they move between pelagic and near shore habitat (Nightingale and Simenstad 2001).

Rockfish have not been observed by ODFW while seining in or near the immediate Project slip area, indicating that this area is not likely utilized by rockfish (ODFW 2006a). Black rockfish and cabezon, however, were the most abundant juvenile rockfish species captured elsewhere within Coos Bay (near the entrance), between June 2003 and December 2005 (Schlosser and Bloeser 2006). Trap sites were located in eelgrass beds, along dock pilings, and in sandy bottom habitat near the entrance to Coos Bay. Juvenile chillipepper, copper, grass, yellowtail, and kelp greenling were also captured near the Coos Bay entrance.

Lingcod begin life in near-surface marine waters and estuarine areas. Juvenile lingcod primarily use estuaries, entering to feed, while adults are usually found in marine waters that are 100 to 150 meters deep. Lingcod lay eggs in rocky, marine subtidal areas. Larvae are found in the near-surface marine waters and estuarine areas. In this life stage, lingcod feed primarily on copepods, eggs, and other crustaceans. As lingcod mature, they are commonly found in shallow, inter-tidal areas of bays near algae and seagrass beds.

TABLE 4.1.3-1

Groundfish Species Managed by the Pacific Fishery Management Council for which Essential Fish Habitat Has Been Identified and May Occur Within the Proposed Action Estuarine Analysis Area and Marine Analysis Area

Common Name Scientific Name	Life Cycle and Habitat Associations a/	Distribution within Estuarine Analysis Area b/				Distribution within EEZ Analysis Area b/			
		Eggs c/	Larvae c/	Juvenile c/	Adult c/	Eggs c/	Larvae c/	Juvenile c/	Adult c/
Soupfin shark *Galeorhinus galeus*	Coastal-pelagic species associated with the bottom, inhabiting bays, muddy shallows and offshore up to 225 fathoms (fm). Adult males occur in deeper waters and females usually at less than 30 fm. From dense shoals, migrating north in the summer and south in the winter. Mating occurs in the spring.			L	M			H	H
Spiny dogfish *Squalus acanthias*	An inner shelf-mesobenthal species with a depth range of 0 to 677 fm. Common in inland seas and shallow bays. Seasonal migrations occur within preferred temperature range.			L	H			H	H
Leopard shark *Triakis semifasciata*	Inhabits enclosed muddy bays, flat sandy areas, mud flats, sandy and muddy bottoms strewn with rock near reefs and kelp beds. Common in littoral waters and around jetties and piers. Pupping and feeding/rearing grounds in estuaries and shallow coast waters. Found at depths up to 50 fm, common at 0 to 2 fm.			H	H			H	H
Big skate *Raja binoculata*	Inhabits inner and outer shelf areas, particularly on soft bottom sediments. Either associated with silty sediment, or with sediment consisting of a mixture of mud, sand, gravel, and cobble. Found at depths up to 55 fm.	U		U	U	H		H	H
California skate *Raja inornata*	Usually occur in habitats with muddy bottoms. Juveniles are associated with soft bottom sediments. Common in inshore waters and shallow bays; sometimes in deep water.	H		U	H	H		H	H
Longnose skate *Raja rhina*	Occurs on the bottom inner and outer shelf areas, usually less than about 175 fathoms deep. Juveniles and adults are associated with soft bottom sediments with combinations of mud and cobble near high relief structures.	L		U	U	H		H	H
Pacific cod *Gadus macrocephalus*	Adults and juveniles prefer mud, sand, and clay. Usually found near bottom, with a wide depth range of 7 to 300 fm. Spawning occurs from the late fall to early spring. Larvae and small juveniles are pelagic, large juveniles and adults are parademersal.	L	U	U	U	H	H	M	L
Pacific grenadier (rattail) *Coryphaenoides acrolepis*	Commercial species that inhabits the continental slope. Highest densities occur on the sandy bottoms of abyssal plains. Migrations have not been documented, but larger fish are found in deeper water. Larvae are pelagic.	H	H	U	U	H	H	L	H
Pacific whiting (hake) *Merluccius productus*	Inhabits euhaline waters of the continental shelf. Juveniles reside in shallow coastal waters, bays, and inland seas and move deeper as they get older. Highly migratory. Spawns from December through March, perhaps more than once per season.	U		U	L	H		U	H
Spotted ratfish *Hydrolagus colliei*	Found near the bottom, from close inshore to about 500 fm. Abundant in cold waters at moderate depths. Feed on mollusks, crustaceans and fish; also echinoderms and worms. Fishers are reputed to fear the jaws of the ratfish more than they do the dorsal spine.	U		U	U	H		H	H

TABLE 4.1.3-1

Groundfish Species Managed by the Pacific Fishery Management Council for which Essential Fish Habitat Has Been Identified and May Occur Within the Proposed Action Estuarine Analysis Area and Marine Analysis Area

Common Name Scientific Name	Life Cycle and Habitat Associations a/	Distribution within Estuarine Analysis Area b/				Distribution within EEZ Analysis Area b/			
		Eggs c/	Larvae c/	Juvenile c/	Adult c/	Eggs c/	Larvae c/	Juvenile c/	Adult c/
Rougheye rockfish *Sebastes aleutianus*	Usually found on the bottom in deep, offshore waters with soft substrata, frequenting boulders and at slopes greater than 20 degrees. Depths range from 14 to 478 fm.			U	U			H	L
Pacific Ocean Perch *Sebastes alutus*	This commercially important schooling fish is abundant offshore, often found along submarine canyons, depressions, pinnacles, and seamounts. Depth ranges from surface to 451 fm (most occur in 80 to 200 fm).		U	U	U		H	H	M
Kelp rockfish *Sebastes atrovirens*	Inhabiting shallow waters, adults are primarily residential in kelp forests and on the bottom near rocky areas and are considered parademersal. Common at depths of 5 to 7 fm, but found up to 25 fm with a distribution mostly off the coast of California.				U				H
Aurora rockfish *Sebastes aurora*	Adults and juveniles are found in soft- and hard- bottom habitats on the continental slope/basin. Distribution ranges from Vancouver Island, British Columbia to Cedros Island, Baja California. Depth ranges from 68 to 420 fm.		U	U	U		H	H	H
Redbanded rockfish *Sebastes babcocki*	Thought to associate with both soft substrata and hard-bottom substrata, and in crevices between boulders. This deepwater species has been caught in the 50 to 342 fm range and is found from Amchitka Island, Alaska to San Diego, California.				U				H
Silvergray rockfish *Sebastes brevispinis*	Inhabits the outer shelf-mesobenthal zone on a variety of rocky-bottom habitats. Found at the surface to 205 fm, from the Bering Sea to Baja California.				U				L
Shortraker rockfish *Sebastes borealiz*	Deepwater species inhabiting the middle shelf to the mesobenthal slope and common on the bottom from 100 to 478 fm. Distribution from the Aleutian Islands and down to Point Conception, California				U				H
Gopher rockfish *Sebastes carnatus*	These are shallow-water benthic fish that inhabit rocky reefs, kelp beds, and sandy areas near reefs. Common depth from surface to 9 fm and mostly limited to the California coast.		U	U	U		H	H	H
Copper rockfish *Sebastes caurinus*	Occur in nearshore waters, from the surface to 100 fm. Found on or near natural rocky reefs, boulder fields, artificial reefs, oil platforms and rockpiles; usually directly on the bottom with reefs or kelp bed areas. May move inshore to release their young.				U				H
Greenspotted rockfish *Sebastes chlorostictus*	Associated with soft-bottom habitats and also with rock outcrops, reefs, caves, and crevices. Range is from Washington to Baja California with depths 27-150 fm			U	U			H	L
Black and yellow rockfish *Sebastes chrysomelas*	Inhabits holes and crevices in rocky areas. Found in intertidal areas and depths to 20 fm.		U	U	U		H	M	M
Starry rockfish *Sebastes constellatus*	Usually found on reefs. Viviparous, with planktonic larvae and pelagic juveniles. Limited distribution along the California coast from north of San Francisco to Baja. Depth ranges from 13 – 150 fm.			U	U			U	M
Darkblotched rockfish *Sebastes crameri*	Adults are associated with muddy areas near cobble or boulders. Found at depths of 14 to 328 fm from the Bering Sea to Catalina Island, California.		U	U	U		H	H	H

TABLE 4.1.3-1

Groundfish Species Managed by the Pacific Fishery Management Council for which Essential Fish Habitat Has Been Identified and May Occur Within the Proposed Action Estuarine Analysis Area and Marine Analysis Area

		Distribution within Estuarine Analysis Area b/				Distribution within EEZ Analysis Area b/			
Common Name **Scientific Name**	**Life Cycle and Habitat Associations a/**	**Eggs c/**	**Larvae c/**	**Juvenile c/**	**Adult c/**	**Eggs c/**	**Larvae c/**	**Juvenile c/**	**Adult c/**
Splitnose rockfish *Sebastes diploproa*	Associated with offshore mud habitats near isolated rock cobble and boulder fields. Most common at 50 to 250 fm. Young occur in shallow water, often at the surface under drifting kelp, algae, and seagrass. Emigration from surface waters occurs primarily in May and June.		H	U	U		H	H	H
Greenstriped rockfish *Sebastes elongatus*	Prefers a mixture of mud and rock bottom and found at depths of 14 to 232 fm. Distribution from Alaska to Baja California.			U	U			H	H
Widow rockfish *Sebastes entomelas*	All life stages are pelagic, but older juveniles and adults are associated with hard bottoms among rocks. This important commercial fish ranges from near Kodiak Island, Alaska to Todos Santos Bay in Baja California; from surface to 300 fm.			U	U			H	M
Pink rockfish *Sebastes eos*	Demersal, inhabiting rocky bottoms in isolated areas from Southern Oregon to Central Baja California. Depth range from 40 to 200 fm.				U				H
Yellowtail rockfish *Sebastes flavidus*	They are considered a middle shelf-mesobenthal species most common near the bottom. This schooling rockfish has a range from Unalaska Island, Alaska to San Diego, California and is found from the surface down to 300 fm.			U	U			H	H
Chilipepper rockfish *Sebastes goodei*	Most commonly associated with deep, high-relief rocky areas and along cliffs. A commercially important species in California found at the surface to 232 fm.			U	U			H	H
Rosethorn rockfish *Sebastes helvomaculatus*	Adults are mostly found in muddy areas adjacent to boulders, cobble, or rock. Depth range from 40 to 300 fm. Limited distribution from Alaska to Baja California.				U				L
Squarespot *rockfish* *Sebastes hopkinsi*	They are reef-associated, in areas with cobble and have a depth range of 2 to 120 fm.			U	U			H	H
Shortbelly rockfish *Sebastes jordani*	Can be found in large schools, offshore and off smooth bottom areas near the shelf break and sharp drop-offs. Depths of 0 to 191 fm.				U				H
Cowcod *Sebastes levi*	Adults are primarily found over high-relief rocky areas. Juveniles prefer soft bottom habitats and those consisting of low-relief rocks. Mostly found off California at depths of 11 to 200 fm.			U	U			H	L-M
Quillback rockfish *Sebastes maliger*	A common, shallow-water benthic species, from subtidal depths to 150 fm. Young occur along shores and adults usually in deeper waters.			U				H	
Black rockfish *Sebastes melanops*	Adults inhabit midwater and surface areas over-high relief rocky reefs, in and around kelp beds, boulder fields, pinnacles, and artificial reefs. Larvae and young juveniles are pelagic.			M	U			H	H
Blackgill rockfish *Sebastes melanostomus*	An aggregate species, usually inhabiting deep rocky-or hard-bottom habitats along steep drop-offs. Larvae inhabit the upper mixed layer of water, juveniles are pelagic (associated with flat bottoms) and migrate shoreward. Spawn from January to June.		U	U	U		H	H	H

TABLE 4.1.3-1

Groundfish Species Managed by the Pacific Fishery Management Council for which Essential Fish Habitat Has Been Identified and May Occur Within the Proposed Action Estuarine Analysis Area and Marine Analysis Area

		Distribution within Estuarine Analysis Area b/				Distribution within EEZ Analysis Area b/			
Common Name **Scientific Name**	**Life Cycle and Habitat Associations a/**	**Eggs c/**	**Larvae c/**	**Juvenile c/**	**Adult c/**	**Eggs c/**	**Larvae c/**	**Juvenile c/**	**Adult c/**
Vermilion rockfish *Sebastes miniatus*	Found over rocks, along drop-offs, and over hard bottom. Adults inhabit rocky reefs at depths of 8 to 150 fm. Larvae are pelagic and found near the surface for three to four months, and are frequently associated with algae.				U				H
Blue rockfish *Sebastes mystinus*	Strong affinity for kelp forests. Adults inhabit midwater and surface areas around high relief rocky areas, within and round the kelp colony, and around artificial reefs. Common depth range of 33 to 167 fm. Larvae and early stage juveniles are pelagic, and older individuals are semi-demersal or demersal.		L	U	U		H	H	H
China rockfish *Sebastes nebulosus*	Occur both inshore and along the open coast from 1 to 75 fm. Most Juveniles are pelagic, but adults are sedentary, associated with rocky reefs or cobble. They are residential and associated the bottom, crevices, and kelp beds.			U	U			H	H
Tiger rockfish *Sebastes nigrocinctus*	Found at depths of 5 to 150 fm. Juveniles are pelagic, common near water surface with algae mats and plants. Adults are semi-demersal. Often found in caves, off cliffs, and on floors. Solitary, may be territorial.				U				H
Speckled rockfish *Sebastes ovalis*	They occur in midwater over rocks and are also found near the bottom on reefs and among boulders. Depths range from 17 to 200 fm.			U	U			H	H
Bocaccio *Sebastes paucispinis*	Benthic juveniles and adults are found around vertical relief; over sand-mud bottoms with little relief; and in areas with mixtures of rocks and boulders, rock ridges, and rocks and boulders among mud. Most common at depths of 40 to 175 fm. Larvae and small juveniles are pelagic; large juveniles and adults are semi-demersal.		L	U	U		H	H	M
Canary rockfish *Sebastes pinniger*	Most abundant above hard bottoms, usually 50 to 110 fm. In its southern range, it is a reef associated species. Larvae and juveniles are pelagic. Young of the year can be found in tide pools, and can be associated with artificial reefs and interfaces between mud and rock. Juveniles descend deeper as they mature. Capable of large latitudinal movements.			U	U			H	H
Redstripe rockfish *Sebastes prorigger*	Generally found off the bottom over both high- and low-relief rocky areas. Depths range from 7 to 232 fm (most common at 70 to 150 fm).				U				H
Grass rockfish *Sebastes rastrelliger*	Common in nearshore rocky areas, along jetties, and in kelp and eelgrass. Residential species at shallow depths.			U	U			H	H
Yellowmouth rockfish *Sebastes reedi*	Found over rough bottoms from the Northern Gulf of Alaska to the south of Crescent City, California, with a depth range from 75 to 200 fm. More common at 100 to 200 fm.			U	U			H	M
Rosy rockfish *Sebastes rosaceus*	These fish are solitary bottom-dwellers found over hard, high-relief areas and at low-relief spots among rocks and sand. Depths range from 27 to 150 fm.			U	U			H	H
Yelloweye rockfish *Sebastes ruberrimus*	Inhabits rocky reefs and boulder fields from Prince William Sound, Alaska to Ensenada, Baja California. An important commercial species ranging from 8 to 300 fm.			U	U			H	H

TABLE 4.1.3-1

Groundfish Species Managed by the Pacific Fishery Management Council for which Essential Fish Habitat Has Been Identified and May Occur Within the Proposed Action Estuarine Analysis Area and Marine Analysis Area

		Distribution within Estuarine Analysis Area b/				Distribution within EEZ Analysis Area b/			
Common Name **Scientific Name**	**Life Cycle and Habitat Associations a/**	**Eggs c/**	**Larvae c/**	**Juvenile c/**	**Adult c/**	**Eggs c/**	**Larvae c/**	**Juvenile c/**	**Adult c/**
Flag rockfish *Sebastes rubrivinctus*	These demersal fish inhabit rocky areas and have a depth range of 0 to 302 meters.			U	U			M	H
Bank rockfish *Sebastes rufus*	Juveniles are parademersal and prefer mixed mud and rock habitats. Adults can be found on rocky reefs, among boulder fields, cobble, and mixed mud-rock bottoms. Depths range from 17 to 135 fm.			U	U			H	L
Stripetail rockfish *Sebastes saxicola*	A dominant soft-bottom fish. Pelagic juveniles, with a narrow depth range of 27 to 30 fm, are associated with sandy bottoms. Adult depth ranges from 5 to 299 fm (most common 80-150 fm).			U	U			H	H
Sharpchin rockfish *Sebastes zacentrus*	An outer shelf-mesobenthal species preferring mud and cobble and mud and boulder substrata. Found at depths from 14 to 260 fm.		U	U	U		H	H	M
Shortspine thornyhead *Sebastolobus alascanus*	Juveniles occupy shallower waters than adults, usually over muddy bottoms near rocks. Adults are found on muddy bottoms and bottoms with mud and cobble/boulder mixes. A deepwater species, found at 10 to 833 fm.			U	U			H	H
Longspine thornyhead *Sebastolobus altivelis*	Juvenile and adults are demersal and occupy the sediment surface, preferably sand or mud. A deepwater species, found often at 110 to 960 fm.			U	U			H	H
Cabezon *Scorpaenichthys marmoratus*	Most abundant in estuaries where all life stages may be present. Found intertidally or in shallow subtidal areas in a variety of habitats, often in the vicinity of kelp beds, jetties, oil platforms, isolated rocky reefs or pinnacles, and shallow tide pools. Mostly utilize rocky bottoms and cobble substrata.				U				H
Sablefish *Anoplopoma fimbria*	Inner shelf-bathybenthal commercial species. Eggs, larvae, and young juveniles are pelagic. Older-juveniles and adults are benthopelagic on soft bottoms, commonly with mud and sea urchins. Often migratory, wide-ranging depths from 170 fm to 1,000 fm. Spawning occurs in the late fall and early winter in waters at depths >167 fm.	L	U	U	U	H	H	H	H
Lingcod *Ophiodon elongatus*	Occupy the estuarine-mesobenthic zone, from intertidal areas to 266 fm. Mostly inhabit slopes of submerged banks with seaweed, kelp and eelgrass beds. Spawning occurs from December through April, 2-5 fm below mean lower low water over rocky reefs in areas with a swift current.	H	U	U	U	H	H	H	H
Finescale codling (mora) *Antimora microlepis*	Inhabits the lower regions of the continental slope between 437 fm and 980 fm. Whether or not the species migrates extensively or uses the North American west coast slopes only as feeding areas is not known.				U				H
Kelp greenling *Hexagrammos decagrammus*	High affinity for rocky banks near dense algae or kelp beds, or in kelp beds. Larvae and small juveniles are pelagic, adults are demersal (but not usually below 11 fm). Juveniles associated with rocky reefs and microalgae. Newly hatched larvae move out of estuaries or shallow nearshore areas into open water. Spawning occurs in the fall.		M		U		H		M

TABLE 4.1.3-1

Groundfish Species Managed by the Pacific Fishery Management Council for which Essential Fish Habitat Has Been Identified and May Occur Within the Proposed Action Estuarine Analysis Area and Marine Analysis Area

Common Name Scientific Name	Life Cycle and Habitat Associations a/	Distribution within Estuarine Analysis Area b/				Distribution within EEZ Analysis Area b/			
		Eggs c/	Larvae c/	Juvenile c/	Adult c/	Eggs c/	Larvae c/	Juvenile c/	Adult c/
Pacific sanddab *Citharichthys sordidus*	Inhabit s inner continental shelf along the West Coast. Most abundant in 20 to 50 fm. Small juveniles prefer silty sand substrata and adults prefer sand and coarser sediments and low-relief rock bottoms. Spawning occurs late winter through summer.				U				H
Arrowtooth flounder *Atheresthes stomias*	Eggs and larvae are pelagic and juveniles and adults are demersal. Juveniles and adults are usually found on sand or sandy gravelly substrata, but occasionally over rock-relief sponge bottoms. Migrate from shallow-water summer feeding grounds on the continental shelf to deep-water spawning grounds over the continental shelf. Spawning occurs in the winter.	H	H	U	U	H	H	H	H
Petrale Sole *Eopsetta jordani*	Juveniles and adults are demersal. Adults migrate seasonally between deep-water winter spawning areas to shallower, spring feeding grounds. Found on sand and mud bottoms from 10 to 300 fm. Most abundant at 30 to 70 fm from April through October and at 150 to 250 fm during winter.			U	U			H	H
Rex sole *Glyptocephalus zachirus*	Abundant on sandy, muddy, and gravely bottoms. Also in complexes of mud and boulders. Cold temperate, upper-slope, outer-shelf flatfish with pelagic eggs and larvae. Move inshore in summer and offshore for spawning in winter and early spring.			U	U			H	H
Flathead sole *Hippoglossoides elassodon*	These sole inhabit soft, silty or muddy bottoms from 0 to 575 fm (common 55 to 135 fm). They can also be associated with mud mixed with gravel or sand.			U	U			L	L
Dover sole *Microstomus pacificus*	Innershelf-mesobenthal commercially caught species, mostly in waters <273 fm. Adults and juveniles have high affinity for soft bottoms of fine mud and sand. Commonly associated with mud and sea urchins. Eggs are epipelagic, larvae are epi-mesopelagic, and juveniles and adults are demersal. Spawning occurs in the spring near the bottom of the water. Females and juveniles migrate offshore to deeper waters in the fall.			U	U			H	H
English sole *Parophrys vetulus*	Shallow-water, soft-bottom, marine and estuarine environments. Spawning occurs in winter to early spring over soft-bottom mud strata, depths of 27-38 fm. Eggs and larvae are pelagic and adults are demersal		M	L	L		H	H	H
Starry flounder *Platichthys stellatus*	Occur in the inner continental shelf and shallow sublittoral communities. Older individuals occur from 75 miles upstream to the outer continental shelf. Juveniles prefer sandy to muddy substrata. Spawning occurs in late winter-early spring in estuaries or sheltered inshore bays with less than 25 fm.	L		U	L	H		H	H
Rock sole *Pleuronectes bilineatus*	Juveniles and adults are demersal and found primarily in shallow water bays and over the continental shelf on rocky, pebbly, or sandy bottoms form 0 to 200 fm. Most are caught in 20 to 40 fm.				U				H
Curlfin sole *Pleuronichthys decurrens*	Curlfin are found on soft bottoms from 4 to 291 fm, but usually are found in shallower waters.				U				H

TABLE 4.1.3-1

Groundfish Species Managed by the Pacific Fishery Management Council for which Essential Fish Habitat Has Been Identified and May Occur Within the Proposed Action Estuarine Analysis Area and Marine Analysis Area

		Distribution within Estuarine Analysis Area b/				Distribution within EEZ Analysis Area b/			
Common Name Scientific Name	**Life Cycle and Habitat Associations a/**	**Eggs c/**	**Larvae c/**	**Juvenile c/**	**Adult c/**	**Eggs c/**	**Larvae c/**	**Juvenile c/**	**Adult c/**
Sand sole *Psettichthys melanostictus*	High affinity to shallow waters with sandy/muddy substrate. Spawning occurs in winter and spring near shore. Larvae and small juveniles are pelagic and transported to estuaries by tidal current.		M	U	U		H	H	H

a/ Life Cycle and Habitat Association: Froese and Pauly 2008; ODFW 2008; NMFS 2005d; PFMC 2005; PFMC 2004; Orr et al. 1998; PFMC 1998; Kostow 1995.
b/ Life Stages Distribution: Ground Fish Species' Distribution based on Habitat Suitability Probability Maps, Appendix B-4 (PFMC 2005); McCain et al. 2005.
c/ "U" indicates unlikely occurrence; "L" –Low probability; "M"—Moderate probability; "H"—High probability; " " indicates no PFMC distribution data available.
d/ X=collected in samples or assumed to be present based on known habitat use (Source: Hinton and Emmett 1994)

EEZ = Economic Exclusion Zone; fm = fathom

4.1.4 Pacific Salmon Species

EFH for Pacific salmon species includes nearshore marine water and waters extending out 200 nmi to the EEZ boundary off the coasts of Washington, Oregon, and in California north of Point Conception. It also includes inland estuaries and freshwater streams, lakes, ponds, and other waterbodies that were historically accessible to salmon. EFH excludes habitats upstream from longstanding impassible barriers (e.g., waterfalls) and upstream from impassible barriers (e.g., dams) identified by PFMC (1999). Pacific salmon species with EFH in the marine, estuarine, and riverine Project analysis areas include Chinook and coho salmon. This includes two ESA-listed coho salmon ESUs in portions of the analysis area as described below.

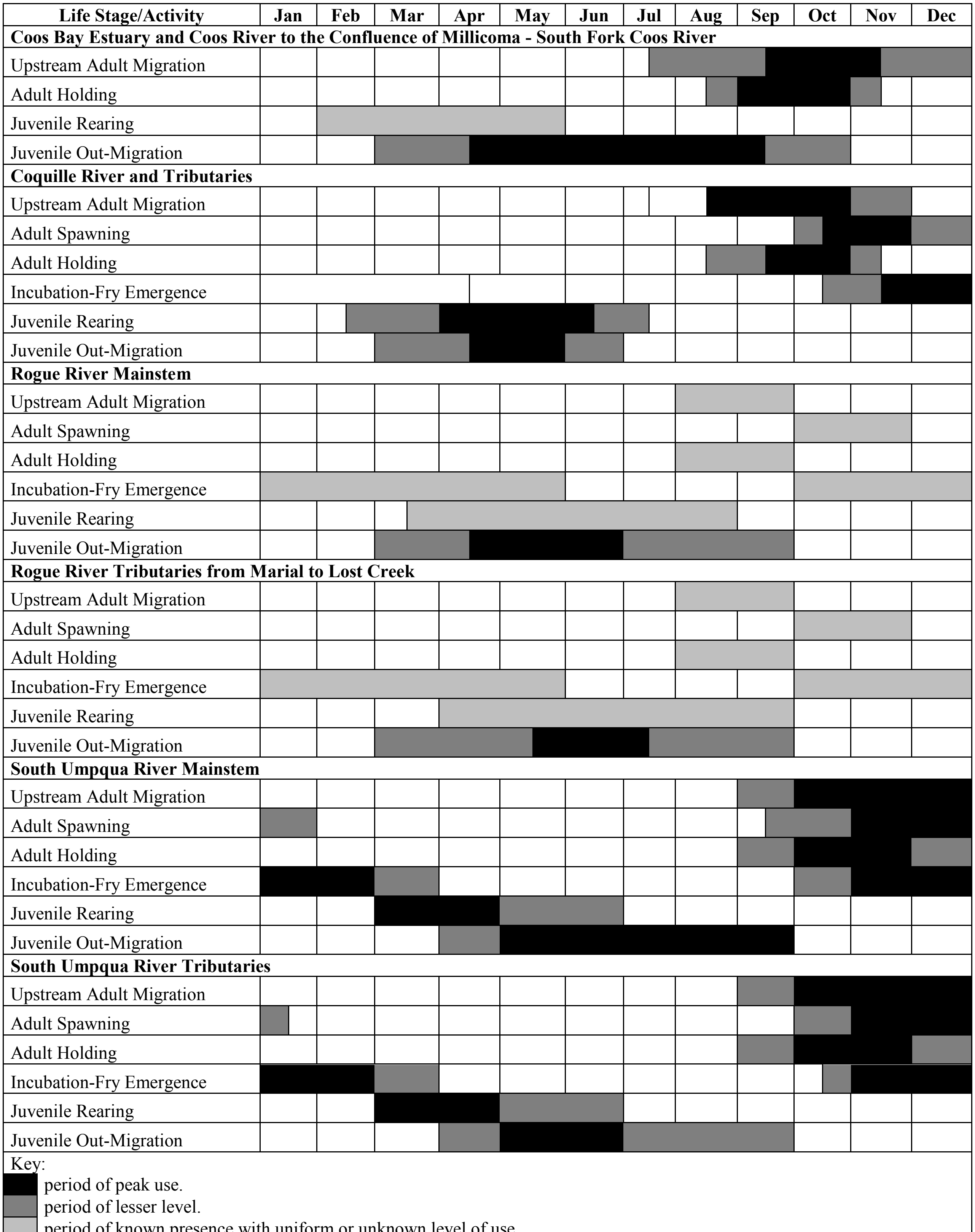
EFH for Chinook and coho salmon has been designated within the following watersheds that coincide with the Project riverine analysis areas: South Umpqua River (HUC 17100302), Coos River (HUC 17100304), Coquille River (HUC 17100305), and Upper Rogue River (HUC 17100307). EFH for Chinook salmon and coho salmon is also present in the Upper Klamath River (HUC 18010206) in California and Oregon, but construction of multiple dams on the mainstem Klamath River has made upstream areas impassible to anadromous fish (Hamilton et al. 2005). Habitats within the Project area upstream from the Iron Gate Dam are not currently accessible to coho or Chinook salmon, but the Oregon Fish and Game Commission in July 2008 authorized the study of reintroduction of anadromous fish into the Klamath River system in Oregon. As of 2014, no action has been taken to actually remove these dams or transport fish upstream past the dams, so no further assessment of potential EFH effects in the Upper Klamath River watershed is provided in this BA.

Coho salmon within the riverine analysis area of the Upper Rogue River (HUC 17100307) watershed are within the SONCC coho salmon ESU, and their threatened status, environmental baseline, Project effects, and determination of effects under the ESA (species effects and effects to designated critical habitat) were addressed earlier in this BA in section 3.5.3. Likewise, section 3.5.4 evaluates coho salmon within the South Umpqua River (HUC 17100302), Coos River (HUC 17100304), and Coquille River (HUC 17100305) watersheds that are within the Oregon Coast ESU, which are listed as threatened and with designated critical habitat under the ESA.

EFH for coho salmon of both listed ESUs is present within the riverine and marine analysis areas. The listed Oregon Coast coho salmon ESU is also present in the estuarine analysis area of Coos Bay.

Figure 4.1.4-1 shows the specific timing of life history phases for fall-run Chinook salmon within the estuarine and riverine analysis areas. Spawning does not occur within the Coos Bay estuary or the analysis area included for the Coos River. Spawning does occur within the Coquille River and tributaries, in the Rogue River mainstem and tributaries, and in the South Umpqua River mainstem and tributaries.

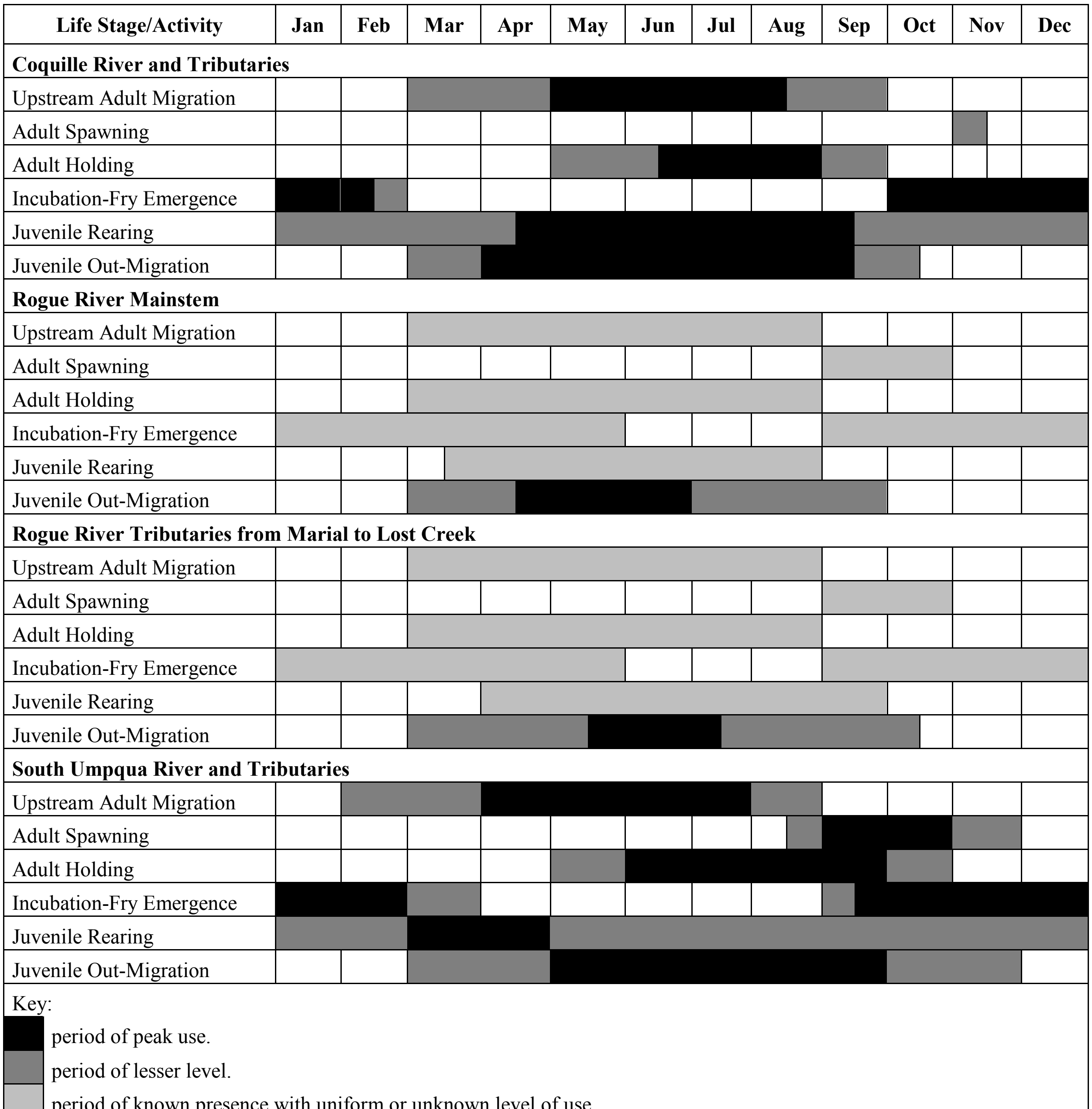
Specific timing and life history phases of the ESA-listed coho salmon are presented the main BA sections 3.5.3 (SONCC coho) and 3.5.4 (Oregon Coast coho) shown in (figures 3.5.3-1 and 3.5.4-1). Whereas adult coho in the SONCC ESU and Oregon Coast ESU begin upstream migrations in September, fall Chinook salmon in some watersheds begin as early as mid-July (Coos River and Coquille River) or early August. Similar to coho, fall Chinook salmon in the South Umpqua River begin upstream migrations in early September. Spawning in the South Umpqua mainstem begins as early as mid-September, but begins in October within tributaries to the South Umpqua. Fall Chinook salmon spawning in the Rogue River mainstem and tributaries also begins in October (see figure 4.1.4-1).



Source: ODFW 2008.

Figure 4.1.4-1 Approximate Timing of Fall Chinook Salmon Use of Streams and Estuaries in the Pipeline Project Area

Figure 4.1.4-2 shows the specific timing of life history phases for spring-run Chinook salmon within the riverine analysis areas. No life-phase timing of spring Chinook salmon is reported for the Coos Bay estuary or Coos River. Spawning does occur in the Coquille River and tributaries from September through mid-November. Spawning also occurs within the Rogue River mainstem and tributaries in October and November, as well as in the South Umpqua River mainstem from mid-September through January and in its tributaries from October through mid-January (see figure 4.1.4-2).



Source: ODFW 2008.

Figure 4.1.4-2 Approximate Timing of Spring Chinook Salmon Use of Streams in the Pipeline Project Area

4.2 ANALYSIS OF EFFECTS

Most of the Project effects to fish and their habitats are described in detail in the BA's effects discussions for the ESA listed fish species including green sturgeon (section 3.5.1.3), eulachon (section 3.5.2.3), SONCC coho salmon (section 3.5.3.3), and Oregon Coast coho salmon (section 3.5.4.3). While effects analyzed were specific to these species, the details of the type of effects are mostly comparable to other fish habitat groups in the same environment.

Because the four EFH fish management groups would have effects that are similar or the same across the three analysis areas (marine, estuarine, and riverine) in type and magnitude, the discussion below will focus on the level of specific effects within each analysis area. Where effects would be unique to each management group, these effects are called out.

4.2.1 Marine Analysis Area

The marine analysis area includes EFH for all four FMP fish groups and is the only analysis area where highly migratory species may be present. With the possible exception of adult common thresher shark, highly migratory species are likely to be absent from the marine environment near the entrance to Coos Bay. Project actions in this area that have the potential to affect these FMP groups are associated with underwater noise and potential fuel, gas, or oil spills from LNG carriers in transit to and from the LNG Project. A more detailed discussion of direct, indirect, and cumulative effects of the Project on fish and their associated habitat requirements in the marine analysis area is included in section 3.5.

4.2.1.1 Acoustic Effects

Underwater noise produced by LNG carriers transiting the marine analysis area may affect fish of all four FMP groups. Some of the LNG carriers that would call on the LNG Project generate more noise than the LNG carriers built in 2003 with 138,028 m^3 capacity that produced sound levels (with one standard error) of 182 ± 2 dB re: 1 µPa @ 1 meter as reported by Hatch et al. (2008). Hatch noted that LNG carriers produced nearly the highest noise level of any type of major vessel monitored.

State agencies in Washington, Oregon, and California along with federal agencies have developed interim noise exposure threshold criteria for pile-driving effects on fish (WSDOT 2019; Fisheries Hydroacoustic Working Group 2008; Popper et al. 2006). These threshold criteria are considered levels below which injury effects would not occur to fish from in water noise. These thresholds should thus be suitable for all forms of in-water noise. Interim noise exposure threshold criteria for pile driving effects on fish include: 1) a cumulative sound exposure level (SEL_{cum}) of 187 dB re 1 μPa^2 s for fishes weighing more than two grams, 2) a SEL_{cum} of 183 dB re 1 μPa^2 s for fishes less than two grams, and 3) a single-strike peak level (SPL_{peak}) of 206 dB re 1 µPa for all sizes of fishes (WSDOT 2019). As described by Hatch et al. (2008), LNG carriers built in 2003 produced sound levels (with one standard error) of 182 ± 2 dB re: 1 µPa @ 1 meter that attenuated to 160 dB at 35 ± 11 meters and to 120 dB at 16,185 ± 5,359 meters.

In-water noise values generated by LNG carriers transiting the marine analysis area for the Project would attenuate to levels below the effect thresholds noted above a few meters from a vessel's hull and, therefore, would not cause direct harm to fish. Very small fish within one meter (three feet) of an LNG carrier hull that are exposed to LNG carrier noise for extended periods, however, could be adversely affected. Because most fish can easily avoid LNG carriers in transit, noise exposure typically would be very brief, further reducing the potential for adverse effects. Therefore, underwater noise generated by LNG carriers transiting the marine analysis area is not expected to adversely affect EFH of the four FMP groups.

4.2.1.2 Fuel or Oil Spills at Sea

The LNG carriers use either a steam or duel fuel diesel electric propulsion system that is primarily fueled by natural boil-off gas. Fuel (e.g., diesel) used for back-up generation for LNG carrier propulsion and oil or hydraulic fluids used for mechanical equipment could possibly leak or be spilled while the carriers are in transit. A maximum of 120 LNG carriers per year would traverse the marine analysis area to call at the LNG Project (resulting in 240 round trips). The low volumes of petroleum oils and fuel on LNG carriers greatly reduces the risk of impacts on the marine environment from petroleum spills. The Federal Water Pollution Control Act, as amended by the CWA (33 U.S.C. 1251–1387), prohibits the discharge of oil upon the navigable waters of the United States. Also, LNG carriers calling on the LNG Project would be required by the Coast Guard to have a vessel response plan in order to be adequately prepared for accidental spills. As reported by Pacific States/British Columbia annual reports (2002), the number of oil spills reported from fishing, recreational and other harbor marine vessels in Oregon ranged from about 9 to 65 per year, which is fairly infrequent considering that thousands of marine vessels, both recreational and commercial utilize Oregon coastal marine waters. As a result, accidental spills or release of fuel, lubricants, or hydraulic fluids within the marine analysis area are not expected to adversely affect any EFH of the four FMP groups.

4.2.2 Estuarine Analysis Area

The estuarine analysis area of Coos Bay includes habitat and fish from the coastal pelagic, groundfish, and Pacific salmon FMP groups. Effects to EFH in this area would be associated with LNG carrier transit into and out of the bay; slip, access channel, marine waterway modifications, and associated upland facility construction and operation; HDD installation under the Coos Bay estuary; and LNG carrier water intake and discharge while at the loading dock. A summary of marine and estuarine habitat areas temporarily and permanently affected by construction and operation of the LNG Project is presented in table 3.5.1-4 in section 3.5.1.3. Additional detailed discussion of direct, indirect, and cumulative effects of the Project on fish and associated habitats in the estuarine analysis area is included in section 3.5 of this BA.

4.2.2.1 Turbidity Effects from Capital Dredging and Maintenance Dredging in Coos Bay

Resuspension of sediments and temporary increases in turbidity above Coos Bay background levels would occur while installing and removing the temporary earthen berm at the LNG terminal slip and while dredging the access channel and developing the marine waterway modifications, and developing the Eelgrass Mitigation site.

Turbidity increases would be limited to the time required to complete each of the respective Project components within the ODFW in-water work window (October 1 to February 15) and would be subject to water quality compliance standards.

Construction of the LNG terminal slip would require excavation and dredging of Coos Bay's shoreline west of Jordan Cove. Excavation of the slip would be primarily conducted in isolation from the waters of Coos Bay by leaving a temporary earthen berm in place at the mouth of the slip during excavation. Release of turbid waters into the bay would be essentially prevented during excavation of the slip, except during a short period when the earthen berm is removed to connect the slip to the access channel and Federal Navigation Channel. Details on dredging quantities and methods, sedimentation and turbidity levels, and other Project-related effects on fish habitat are described in section 3.5.1.3 of this BA and in our EIS (FERC 2019).

The effects of temporary siltation and sedimentation on EFH from removing the earthen berm at the mouth of the Terminal slip and while dredging the access channel would be similar to those that would result from maintenance dredging of the Coos Bay Federal Navigation Channel by the COE. The quantity of dredge material from the maintenance of the Federal Navigation Channel averages about 900,000 cubic yards (cy) per year. In comparison, Jordan Cove would dredge a total of about 1.8 million cy (mcy): 0.5 mcy when removing the earthen berm and 1.3 mcy when dredging the access channel to a design depth of minus 45 feet (NAVD88) plus 1.7 feet for advanced maintenance dredging and 2 feet for allowable overdepth. Dredging methods would include cutterhead suction dredge, clam shell dredge, and/or mechanical excavation with backhoe.

Turbidity was modeled for the new construction and maintenance dredging operations based on the anticipated geotechnical and environmental conditions for this Project using the COE's DREDGE model and two dimensional numerical model Mike21 (see discussion in section 3.5.1.3, green sturgeon). Increases in turbidity in the bay due to construction-related dredging would be for a short period of time (4-6 months) affecting a restricted area. Therefore, short-term increases in turbidity above background levels would occur primarily in the vicinity of dredging activity. When dredging the access channel, the turbidity plume would be primarily elongated in an upstream or downstream direction, depending on the tidal cycle. To a more limited extent, the plume also would extend laterally from dredging sites. As dredging operations approach the Federal Navigation Channel (where water velocities are greater), the turbidity plume would extend farther downstream (during an outgoing tide) or upstream (during an incoming tide) than it would near the mouth of the terminal slip where water currents are lower.

Modeling at the access channel has demonstrated the maximum turbidity plume extent, defined by the simulated 20 mg/l (about 10 NTU above background levels. The maximum TSS at a specific dredge site using a clamshell dredge was estimated to be about 6,000 mg/l decreasing substantially away from the dredge location. Moffatt & Nichol (2006) also estimated that average turbidity levels during dredging operations (covering changing tidal directions) would not exceed background levels (about 10 to 30 mg/l) for the mechanical dredge at the slip. These levels would be even less for the hydraulic dredge beyond the actual dredge location, while elevated levels would occur outside of the actual dredge area for periods not exceeding 2 hours in duration depending on tidal direction. At lower tidal velocities, values would not exceed 30 mg/l outside of 200 meters, and at high tidal velocity less than 50 mg/l in 200 meters. The concentrations and distribution are partly dependent on the type of dredging method that would be used. Proposed methods for dredging include use of mechanical or hydraulic (suction) dredging equipment. While the hydraulic cutter suction dredge is preferred due to its lower turbidity generation, a type of mechanical dredge may be used, especially in portions of the nearshore area due to buried wood. Model results for the access channel and slip construction indicate that elevated TSS above background would extend about 0.2 to 0.3 mile beyond the dredge sites during a full tidal cycle with any method considered and would exceed about 500 mg/l for about 0.1 mile. Maximum concentrations outside of the specific dredge location would only occur for about 2 hours or less over the tidal cycle with the plume moving upstream or downstream of the dredge site on flood or ebb tide, respectively. Turbidity is expected to dissipate to background levels within a few hours after dredge operations cease (Moffatt & Nichol 2017a).

During construction dredging for the marine waterway modifications, a total of approximately 590,000 cy of dredge material would be removed from four locations (referred to as Dredge Areas 1 through 4) adjacent to the existing Federal Navigation Channel between CM 2 and 7. These areas would be dredged to a controlled depth to match the adjacent Federal Navigation Channel, which is currently -37 feet MLLW. Construction at the four marine waterway modification areas would be done via hydraulic dredging (cutter suction or hopper) or clamshell dredging, or a combination of these. Hydraulic placement of materials at the upland sites (e.g., APCO Sites 1 and 2, and the Kentuck project site) is the proposed method for dredging including material transport with temporary subtidal dredge material transport pipelines (see *Dredged Material Management Plan* [Moffatt & Nichol 2017a]). Dredging is expected to require about 5 months to complete, with an additional 45-day mobilization period, based on an assumed production rate of 7,700 cy per day and could be spread over four in-water work windows. Extending this in-water work over four construction seasons also would improve the logistical feasibility of material placement at APCO Site 2.

Suspended sediment concentrations at the four marine waterway modification sites would reach background level (about 20 mg/l) over a distance of about 1.2 miles[48] with any of the dredging methods. However, hopper style suction dredging would have much higher concentrations during construction with TSS over 500 mg/l extending about 1.0 mile across the dredging site, while the hydraulic cutter suction dredge or mechanical clamshell dredge would produce TSS of 500 mg/l extending about 0.1 mile from the dredge site. The distribution of and concentrations of suspended sediment would be the same for construction or maintenance dredging. See section 3.5.1 for more information on dredging in the marine waterway modifications.

At the Eelgrass Mitigation site, a total of 40,000 cy of dredge material would be removed, most likely with a small hydraulic dredge. Modeled turbidity values were determined to be about 1,700 mg/l (about 270 to 290 NTUs) in the active dredging area with plume over 20mg/l (10 NTU) above background levels, from the excavator dredge area would be generally limited to between 340 and 360 feet in all directions (Moffatt & Nichol 2017b). If a mechanical excavator would be used for the eelgrass site construction, a confined area of elevated TSS would extend less than 0.1 mile from point of dredging (Moffatt & Nichol 2017b). Because the site is a more confined and shallow area with somewhat limited circulation, the turbidity plume would be maintained within the local area of excavation. The duration of suspended sediment settling, therefore, is expected to be very short with turbidity dissipating to background levels within an hour after dredge operations cease, depending on the tidal cycle. Turbidity controls utilized during construction are anticipated to minimize risk of turbidity associated with the Eelgrass Mitigation site. See section 3.5.1 (green sturgeon) for a discussion of these controls as well as more information on dredging in the of the Eelgrass Mitigation site.

Project maintenance dredging would remove about 115,000 cy every three years from the access channel area for the first 10 years, and occur in five-year intervals after 10 years (Moffatt & Nichol

[48] Plume distance noted includes total spread both upstream and downstream of dredge site.

2017a). During the Project maintenance dredging period, the dredged material is expected to be primarily fines (mud, clay, silt). For the access channel, modeling results for maintenance dredging are the same as capital dredging for the access channel as noted above. However, the dredging of the slip would only be exposed to the larger bay during maintenance dredging.

After the first ten years of operation, maintenance dredging is expected to occur every five years, with an estimated total volume per dredging event of 160,000 cy. Future maintenance dredging of the slip and access channel would likely be conducted using a mechanical clamshell dredge, which consists of a close-lipped bucket operated from a floating barge. The close-lipped bucket is specifically designed to reduce sediment resuspension into the overlying water column by forming a seal when the bucket surfaces. The material removed by clamshell dredging would be placed on either a flat-deck barge with watertight sideboards, or a bin-barge with one or multiple cells. The material would be transported to the APCO Sites. Saline decant water that does not evaporate or percolate into the sand below dredge disposal sites would be discharged back into the marine slip or bay at APCO via an outfall pipe. Return water from the decanted dredge material would be required to meet appropriate water quality standards (Moffatt & Nichol 2017a).

On average, the COE removes approximately 550,000 cy from the bar 200,000 cy from CM 2 to 12 and 150,000 cy from CM 12 to 15 each year. The COE claims that its maintenance dredging of the Federal Navigation Channel does not significantly increase turbidity below CM 12 (Roye 1979). To minimize the generation of TSS and turbidity during dredging, operational and environmental controls would be employed to ensure compliance with water quality criteria stipulated in the CWA Section 401 Certification issued by ODEQ. Such controls may include ceasing dredging, decreasing cutterhead speed, increasing the suction flow rate and using different size or type of dredge (e.g., use of a cutter suction dredge or closed clamshell bucket to minimize turbidity generation), lowering the crest elevation, and/or avoiding sediment stockpiling during peak ebb conditions. In addition, containment systems on scows and/or barges used to transport material from the Eelgrass mitigation site, or other dredge locations, would minimize the release of turbid decant water back into the bay. All dredging activities that are not isolated from Coos Bay would be conducted during the in-water work window that will extend from October 1st to February 15th to limit potential impacts to sensitive life stages of fish.

A TMMP will be prepared during final design. The TMMP will be finalized after the means and methods of dredge operations are confirmed by the selected contractor. The primary goal of the TMMP will be to manage proposed dredging operations for the Project consistent with ODEQ water quality standards and permit requirements. Provisions of the ODEQ-approved TMMP will be followed during all dredging activities.

Juvenile life stages of coho and Chinook salmon would be less common in Coos Bay during the fall and winter in-water work window. Exposure to sedimentation and turbidity from dredging, therefore, would be minimal. Adult coho and Chinook salmon, however, migrate into the estuary in the fall and early winter concurrent with in-water construction and maintenance activities (see life history figures 4.1.4-1 and 4.1.4-2 above for Chinook salmon and figure 3.5.3-1 for SONCC coho and figure 3.5.4-1 for Oregon Coast coho salmon). Smaller fish, with a limited swimming ability, would be less able to avoid turbid waters within about 200 feet of dredging operations. Turbidity exposure to adult or juvenile fish would be short-term and localized and may be mitigated to an immeasurable extent as fish avoid underwater noise generated near dredging areas.

Benthic and epibenthic biota would be directly and indirectly affected by dredging, sedimentation, turbidity, and from other in-water construction activities. Construction of the MOF, slip, and access channel would result in the long-term loss of intertidal to shallow subtidal, salt marsh, and eelgrass habitats as described in greater detail in section 3.5.1.3 and table 3.5.1-4. Temporary impacts to deep subtidal habitats would result from dredging the marine waterway modifications.

While both long- and short-term losses of such habitat from dredging would adversely affect EFH for the three FMP groups, such impacts would be minor relative to the overall availability of EFH in Coos Bay. EFH disturbed by dredging the marine waterway modifications sites, access channel and the earth berm at the slip entrance, and periodic maintenance dredging in the Federal Navigational Channel would recover to a limited extent within a month to a year subject to future disturbance (Newell et al. 1998; Swartz et al. 1980, as cited in Wilber and Clarke 2007). Over the long-term, productivity of benthic and epibenthic species and the organisms that feed upon them would be diminished due to periodic maintenance dredging. The Eelgrass Mitigation site, although requiring several years to develop, would eventually improve the ecological function of the existing eelgrass community and contribute to a long-term increase in EFH for all three FMP groups.

Based on the predicted levels of turbidity from dredging in Coos Bay relative to background levels, the short-term, localized, but ongoing exposure of fish to such conditions during the possible four in-water work windows; and the periodic disturbance of benthic communities for about a year after each 3 to 5 year dredge cycle, dredging related impacts may adversely affect EFH for juvenile and adult fish from the three FMP groups.

4.2.2.2 Turbidity Effects from Temporary In-water Construction

In-water construction activities are expected to temporarily increase concentrations of sediment and turbidity. Such increases would be localized and limited to the time required to complete each of the following Project components within the ODFW in-water work window:

- TMBB,
- MOF,
- pile dike rock apron,
- Trans-Pacific Parkway/US-101 intersection widening,
- APCO Site access bridge construction,
- replacement of anchoring systems for existing meteorological ocean data collection buoys as well as addition of anchoring systems for two new buoys, and
- establishment of hydraulic connections to the Kentuck project for estuarine habitat mitigation.

Benthic and epibenthic biota would be directly and indirectly affected by sedimentation, turbidity, excavating the TMBB, fill associated with the MOF, and from other in-water construction activities. Construction of the MOF and Pile Dike Rock Apron would result in the long-term loss of intertidal to shallow subtidal, salt marsh, and eelgrass habitats as described in greater detail in section 3.1.5. Temporary impacts to intertidal and deep subtidal habitats, including eelgrass communities, also would result from in-water construction including the work bridge piling for the APCO Site access bridge, the Eelgrass Mitigation Temporary Dredge Line, the Kentuck Project, and the APCO 2 Temporary Dredge Transfer Line.

While both long- and short-term losses of such habitat would adversely affect EFH for the three FMP groups, such impacts would be minor relative to the overall availability of EFH in Coos Bay. The Eelgrass Mitigation site, although requiring several years to develop, would eventually result in a long-term increase in habitat that would benefit EFH for all three FMP groups.

4.2.2.3 Turbidity Effects – LNG Carriers in the Waterway

Propwash from propellers of LNG carriers and tug boats, as well as ship wakes (waves) breaking on shore, may cause an increase in shoreline erosion and turbidity over existing conditions. Depending on the intensity of such wave energy and bottom scour, eroded materials could be re-suspended within the water column resulting in disturbance, displacement, and injury to nearshore fish and benthic communities. Potential effects to the abundance, diversity, and health of benthic biota could alter food availability and feeding conditions for foraging and migrating fish species. Depending on the magnitude of vessel-generated waves and the location and character of the shoreline they encounter, potential fish stranding also could result from certain vessels in transit in Coos Bay (see section 4.2.2.5).

To address such concerns, potential wake effects of LNG carriers and tugs, with up to 120 inbound and 120 outbound trips per year, were evaluated through model studies by Jordan Cove (see section 3.5.1.3). The model results indicated LNG carrier transit would contribute to existing shoreline erosion caused by wind and existing vessel traffic, however, the magnitude would be small and much less than what naturally occurs from wind-generated waves. The height of waves along the shoreline were predicted to range from 0.6 to 0.8 feet for outbound tugs periodically traveling at high speeds (up to 10 knots) to meet incoming LNG carriers. Wave heights associated with typically slower LNG carrier-tug transits were predicted to be lower at 0.2 to 0.6 feet. Therefore, Project-related wakes and shoreline erosion would likely be within the range of the natural annual variability of wind waves that have heights ranging from 0.5 to 3 feet (Moffatt & Nichol 2017c).

Modeled propeller-generated bottom disturbance from LNG carrier passages indicated some increases in bed disturbance within 0.25 to 0.5 mile of the slip along a narrow band (about 80 feet wide) in the deep mid-channel where coarse sediments occur. This would result in a limited amount of turbidity that would be localized and within the range of seasonal background levels in Coos Bay. Modeled tugboat operations indicated some bottom disturbance also would be likely during docking. The extent of bottom disturbance in the access channel would be limited to a depth of nearly 0.5 feet below the bed surface over a small area of about 100 by 50 feet, but about 12 acres of bottom could be scoured to a depth over 0.2 foot. In most cases, the actual disturbance would likely be much less than this because of the conservative assumptions used in the model, including a lack of slope protection. Slope protection is planned for the north side and sections of the east side of the slip, reducing potential bottom scour. Again, elevated suspended sediment and turbidity levels during LNG carrier docking are expected to be localized in the vicinity of the slip and access channel primarily near the bottom during the period of unberthing and settle once the propellers stopped resulting in short-term effects to benthic communities and fish habitat in the docking area. Overall, while the magnitude, extent, and frequency of propeller scour, suspended sediment, and turbidity resulting from Project-related wave energy and propwash, may be minor, it may adversely affect EFH for the three FMP groups.

4.2.2.4 Turbidity Effects – Pipeline Construction with HDD

Coos Bay would be crossed by two HDDs, one from MP 0.28 to MP 1.00 (West HDD), the other from MP 1.46 to MP 3.02 (East HDD). The Coos River (a tributary to the estuary) would also be crossed using HDD at MP 11.13. At that location, the Coos River is under tidal influence.

Drilling requires use of a drilling mud for lubrication of the bit and removal of cuttings. A non-toxic, biodegradable bentonite clay mixture makes up drilling mud. Because the drilling mud is under pressure during drilling, if the bit encounters substrate fractures or channels, it is possible for bentonite to escape from the hole (termed a "inadvertent return"). Bentonite can escape to the surface through fractures in the drilled substrate. Benthic organisms, which coho salmon would feed on, could also be affected by burial. However, bentonite is more likely to stay in suspension than settle if compared to common bottom sediment; therefore, in flowing water areas, effects to benthic organisms from burial from inadvertent return are likely to be low.

The horizontal crossing length of the West HDD would span 5,192 feet, extending from the North Spit to the southeast, crossing the Coos Bay navigation channel and terminating at North Point in North Bend, Oregon. The HDD profile would pass approximately 158 feet below the railroad trestle bridge and approximately 138 feet below the deepest part of the navigation channel. The depth and the locations of the railroad trestle foundations are unknown at this time (GeoEngineers 2017a). The feasibility analysis for the West HDD anticipates a relatively low risk of hydraulic fracture and drilling fluid surface releases occurring during construction due to geologic conditions along the drill path. However, there is a risk of hydraulic fracture and drilling fluid surface release within about 150 feet of either end of the HDD due to the anticipated loose sand and decreased depth of cover during drilling operations.

The horizontal crossing length of the East HDD would span 8,972 feet extending from North Point in North Bend, Oregon eastward across Coos Bay and ending at the mouth of Kentuck Slough. Surface conditions at North Point at the west end of the HDD consist of a relatively flat ground surface covered with fill stockpiles. The east end of the HDD would be located within a flat grass vegetated area in Kentuck Slough valley. The proposed depth of the pipeline would be 210 feet below ground surface. The risk can be reduced by reaming the hole from both ends of the crossing. Use of large-diameter casings near entry and exit locations would reduce the risk of fracking reaching surface waters. In general, GeoEngineers (2017a) expects the risk of drill hole instability along the HDD drill paths to be relatively low. Minor hole instabilities may be encountered within the very loose to loose soils expected along the upper portions of the HDD profile at the east end near Kentuck Slough, but that condition would not jeopardize the successful installation of the product pipe.

For construction using HDD across the Coos River (GeoEngineers 2017b), the design length of the Coos River HDD crossing would be approximately 1,602 feet. The proposed entry point would be located approximately 500 feet from the north bank of the Coos River and the exit point approximately 630 feet from the south bank. The entry and exit points would allow for adequate depth beneath the Coos River. The preliminary design provides a minimum of 50.3 feet of cover below the Coos River. GeoEngineers' evaluation determined that the construction of the Coos River HDD crossing is likely feasible. GeoEngineers stated that there is a relatively high risk of hydraulic fracture and drilling fluid surface releases along the first 500 feet and last 300 feet of the HDD, respectively; however, this fracturing risk would be mitigated by use of a large-diameter casing. However, the risk of drilling fluid surface release to the Coos River would be relatively low. The locations where any inadvertent return may occur in the Coos River would be affected less because of the dilution factor of the large volume of water from any spill. Pacific Connector's *Drilling Fluid Contingency Plan for Horizontal Directional Drilling Operations* (see appendix D) describes how the drilling operations would be conducted and monitored to minimize the potential for inadvertent drilling mud releases. The HDD Contingency Plan also includes procedures for cleanup of drilling mud releases. If significant concentrations are found during monitoring as a result of a release, possible corrective measures would be taken as described for Oregon Coast Coho in section 3.5.4.3 (Direct and Indirect Effects – Estuarine Analysis Area).

4.2.2.5 Construction Runoff and Stormwater Discharge from LNG Project

The type of effects to EFH from upland facility stormwater discharge during construction and operation are described in detail in sections 3.5.1.3 and 3.5.4.3. During construction, impacts on marine resources could result from the clearing of vegetation at the terminal, erosion and sediment runoff, and potential hazardous substance spills. While no streams are present in the upland portion of the LNG Project, the removal of existing vegetation could modify the character and amount of water runoff into the bay. Jordan Cove would prevent uncontrolled releases of sediment runoff during construction by implementing the erosion control and revegetation measures described in Jordan Cove's ESCP. Additionally, accidental spills of hazardous materials (e.g., equipment fuel, oils, and paints) during construction could have effects on aquatic resources in the bay. Jordan Cove prepared a draft site-specific SPCCP to control accidental releases of hazardous materials and manage potential adverse effects to EFH and fish species in Coos Bay.

Stormwater discharge has the potential to contain chemicals toxic to EFH species present in the Coos Bay estuary and nearshore ocean, excluding highly migratory species. The applicant's NPDES permit, if approved, would require monitoring of discharges to ensure they do not modify state water quality standards of the receiving water. The 1200-C stormwater permit application states, "The permit registrant must not cause a violation of instream water quality standards" (ODEQ 2007).

Because the water quality standards are designed to protect aquatic resources, including EFH species, the applicants are required to ensure the standards are not exceeded, and therefore do not cause adverse harm to aquatic resources. Thus, compliance monitoring to ensure all terms and conditions of the permit issued by the state also would ensure that aquatic resources are protected. However, it is known that stormwater runoff can result in chemical concentrations at the point of discharge that are in excess of EPA water quality criteria (WDOE 2009). The general characteristics of the stormwater management system is described below.

The proposed stormwater management system is designed to direct flows that do not come into contact with any equipment containing potential contaminants (grease or lubrication oil) to designated areas for treatment. Treatment of runoff from areas that have low potential for oil or grease contamination generally consist of on-site infiltration to treat for suspended solids. Cartridge filter vaults may also be used in some locations. Stormwater collected in areas that are potentially contaminated with oil or grease would be pumped or would flow to the oily water system. Primarily, these localized drains are located around equipment to contain grease and/or lubrication oil. Water and oil from the collection sump would overflow to the oily waste separator package equipped with plate type separation devices to remove any oil and grease washed down from the facility equipment. Recovered oil and grease would be held in the sump and periodically pumped directly to storage drums for disposal. The oily water system would flow to the oily water separator package(s) before being treated and discharged to the IWWP and ocean outfall. The facility would be designed to provide drainage of surface water to designated areas for disposal in accordance with 49 CFR § 193.2159. Stormwater collection and treatment facilities would be designed to meet regulatory requirements from NMFS and ODEQ.

The proposed oil and grease treatment system is designed to limit discharges of oil and grease and would ultimately need approval from the State to obtain the NPDES permit. The treatment system function is an additional level of protection for inadvertent spills that come into contact with stormwater. The facility is not designed to intentionally mix oil and grease with stormwater and there are no continuous discharges of oil and grease from the LNG Project. Discharges from the LNG Project that could contain oil and grease would only occur during stormwater events. The following is a description of stormwater management systems for specific Project components.

Stormwater Management at LNG Terminal Site

The *Storm Water Management Plan*[49] has been prepared to address stormwater system design, which would require approval from ODEQ. Impervious surfaces associated with the LNG Terminal site include concrete at operational laydown areas, vehicle offloading areas, secondary containment areas, and working areas for operational maintenance. General surfacing in other areas where operational maintenance access would potentially be required would be dense-graded aggregate. In the areas of the Administration building and the SORSC building, finished surfaces would consist of asphalt for the parking lots and concrete for the helipad. The gas metering station would be surfaced with dense-graded aggregate. Runoff would be separated into either the stormwater system or the oily waste system. Stormwater with a high potential to encounter oil and grease pollution would be contained via curbs or other means and routed to an oil/water separator prior to being conveyed to the IWWP according to the applicable the NPDES permit requirements. For areas of the site where stormwater has a low potential to encounter oil and grease pollution, the first flush of stormwater would be treated onsite by either infiltration facilities, flow-through type cartridge filter devices, or vegetated side slopes. Infiltration facilities would provide treatment for the majority of the stormwater falling on the site. The facilities would be designed to capture and infiltrate all stormwater for 100 percent of the 2-year, 24-hour storm. Overflows from the infiltration facilities would be routed to pipe outfalls in the slip and Coos Bay. For locations that are not feasible to infiltrate, stormwater would be routed to cartridge filter devices, where the treated effluent would be discharged to Coos Bay through an NPDES permitted outfall. Stormwater from access roads to the site would flow through vegetated side slopes or ditches for treatment prior to being discharged to natural grade.

Industrial wastewater would be conveyed to the Port's existing ocean outfall, pursuant to the NPDES permit issued by the ODEQ. Stormwater collection and treatment facilities would be designed in consultation with NMFS and the ODEQ.

[49] The *Storm Water Management Plan* is appended to Jordan Cove's Resource Report 2.

During construction, spills or leaks of hazardous liquids such as fuel or oil associated with construction equipment have the potential to reach surface waters including Coos Bay. Potential adverse effects from a fuel spill would likely be short-term and localized, affecting EFH species within the estuarine analysis area. Petroleum-based contaminants such as fuel, oil, and some hydraulic fluids contain polycyclic aromatic hydrocarbons (PAHs) which can be acutely toxic to the aquatic environment for fishes, and can also cause lethal and sublethal effects to aquatic organisms (Breteler et al. 1985). Potential impacts from such spills would be avoided or greatly reduced by regulating storage and refueling activities, and by immediately implementing cleanup should a spill or leak occur. To avoid and control the potential contamination of surface water, the preliminary SPCCP prepared for the construction phase; describes the measures that would prevent and minimize the potential for accidental releases of hazardous materials and to establish protocols concerning containment, remediation and reporting of any releases that occur. The SPCCP would be included as part of the NPDES permit.

Operation of the LNG Project would not require or produce large quantities of hazardous materials. Solvents and paints would be used during normal maintenance activities and would be stored in specialized containers with secondary containment to prevent spills. Within the LNG Project would be a system of curbs, drains, and basins that contain and collect accidental spills or leaks thus preventing releases into Coos Bay that otherwise could impact water quality and reduce feeding opportunities for aquatic species within the estuarine analysis area. Operations at the LNG Project would comply with the SPCCP to minimize the potential for accidental releases of hazardous materials and to establish proper protocols concerning minimization, containment, remediation, and reporting should releases occur. The SPCCP would meet the requirements of 40 CFR Part 112.

In the event of a spill, any hazardous materials from the concrete containment basins would be collected and trucked offsite to appropriate disposal areas. In the unlikely event of an accidental LNG spill, no effects on EFH are anticipated because LNG is not toxic, is not soluble in water, and, if spilled on water, would vaporize and rise when exposed to the warmer atmosphere.

During operations, LNG carriers calling on the LNG Project could have accidental releases of fuels or other contaminants commonly used on ships. There is no planned bunkering (loading of fuel oils) for the LNG carriers and these products are kept in relatively small quantities on ships. Therefore, such spills would be limited to small inadvertent spills of petroleum-based fuels and lubricants from equipment onboard that would be managed according to the carrier's oil spill response plan. Depending on the timing, weather conditions, and the efficiency of the response and cleanup, localized adverse impacts may still occur depending on the proximity to aquatic habitat.

Stormwater Management at Trans Pacific Parkway/US-101 Intersection Widening

Stormwater generated as a result of new impervious area at the Trans Pacific Parkway/US-101 Intersection Widening would be collected and conveyed to treatment facilities to provide treatment for 100 percent of the 2-year storm event. Drainage curbs would be installed near the edge of pavement along the northwest side of the roadway. These drainage curbs would collect and convey flow from the road crown to water quality treatment facilities. The water quality facilities would provide treatment for the design flow volume and bypass higher flows before discharging the runoff into Coos Bay.

Stormwater Management at Kentuck Project Site

Roadway improvements associated with the Kentuck project, which include elevating and re-paving of East Bay Drive and Golf Course Lane, would result in the addition of new impervious area. The stormwater facilities at the Kentuck project site would be designed to provide treatment for 100 percent of the 2-year storm event wherever feasible.

East Bay Drive would sheet flow stormwater runoff to roadside drainage curbs. Once along the curb, water would flow toward cartridge filters which would treat water before discharging the runoff onto rip-rap road base adjacent to the receiving waters in Kentuck Inlet.

Along most of Golf Course Lane, surface water ditches and flow-through bio-infiltration conveyance systems are proposed. In these areas, collected flow that does not fully infiltrate into the underlying well-draining soils would be conveyed to an outfall into the Kentuck Slough. At the north end of Golf Course Road, runoff would be collected in drainage curbs and conveyed to cartridge filters before discharging to Kentuck Slough.

Stormwater Management at Temporary Construction Facilities

Construction laydown areas would be surfaced to a large extent with larger, open-graded aggregate that would allow infiltration; therefore, stormwater from these areas would be self-contained and would infiltrate without the need for outfalls. Impervious surface would not be added at the Myrtlewood Off-site Park & Ride. Stormwater treatment for temporary facilities is described further in section 3.5.1.3.

Stormwater Management at APCO Sites

APCO Site 1 (East) would be surfaced with dense-graded gravel and would have existing drainage patterns would be preserved to the maximum extent practical. Stormwater would be treated primarily by vegetated swales and filter strips. Fill placed on APCO Site 2 (West) would be surfaced with native vegetation. Additional storm water controls would be added if necessary. The bridge connecting APCO Site 1 and 2 is in preliminary design. All stormwater run-off from the bridge would be treated prior to discharge to Coos Bay.

As a result of the stormwater management system that would be implemented during Project construction and operation, stormwater runoff and discharges may affect EFH or coastal pelagic, groundfish, and Pacific salmon species under the three FMP groups.

4.2.2.6 Stranding from Ship Wakes

Fish stranding can occur when fish, particularly those with a weak swimming ability, become displaced from shallow waters onto shore by waves generated by the wakes of passing vessels. A description of how fish stranding occurs, various causal factors, and locations in Coos Bay identified as having a potential risk of fish stranding are described in sections 3.5.1.3 and 3.5.4.3. Detailed fish stranding studies involving juvenile salmon and other fish species have been conducted in the Lower Columbia River and provide the primary basis for the following analysis.

Fish stranding typically results in mortality unless subsequent waves return the fish to the water after stranding occurs. A series of interlinked factors act together to produce stranding during vessel passages. These factors may include water surface elevations, with low tides more likely to result in strandings than high tides; beach slope, with strandings more likely on low gradients than high; wake characteristics influenced by vessel speed, size, hull geometry, and depth underwater (draft); and biological factors, such as numbers of small fish with weak swimming ability near the shoreline that tend to be more susceptible to stranding (see section 3.5.4.3).

In the Lower Columbia River, ship wakes produced by deep-draft vessels traveling at speeds greater than the estimates for LNG carriers to be used in the Coos Bay estuary have been observed to cause occasional stranding of juvenile salmon (Pearson et al. 2006). When stranding occurred, however, none was observed as a result of vessels traveling at speeds under 9 knots (10.4 mph). Pearson et al. (2006) also found that salmon larger than 90 mm were generally not susceptible to stranding. The hull geometry of the LNG carriers is such that bow wakes are minimized, especially at the slower speeds of four to six knots that would be typical along most of the transit route through Coos Bay. Therefore, the LNG carriers would be traveling at speeds less than that observed by Pearson et al. (2006) that caused stranding. In models and research conducted by Jordan Cove, wave heights produced by LNG carrier traffic would be less than background levels from existing Coos Bay vessel traffic. Overall, vessel-generated waves would contribute a small proportion of the total waves that occur in the bay when waves caused by natural winds are considered (see models described in section 3.5.1.3). In addition, the LNG carriers would be arriving and leaving the bay at high tide when gently sloping beaches are mostly submerged and less likely to contribute to fish stranding risk.

While more species and life stages would be present year-round in Coos Bay for groundfish than coastal pelagic species, their susceptibility to stranding and loss from vessel wake should not be markedly different for either FMP group than those described below for salmon. Considering that LNG carriers and accompanying tugs would enter and leave the bay at high slack tide and would typically travel at low speeds of 6 knots (6.9 mph) generating wave heights within the normal range of background conditions, Project-related vessel wakes are not expected to adversely affect EFH for the coastal pelagic and groundfish FMPs.

The assessment of potential effects of stranding from Project-related vessel wakes was described for coho salmon in section 3.5.4.3. Based on that analysis, vessel wakes are not expected to adversely affect Pacific salmon EFH in Coos Bay that support both coho and juvenile Chinook salmon. While age 0 Chinook salmon tend to be more susceptible to stranding, partly because of their apparent nearshore distribution, proposed vessel traffic procedures for LNG carriers in Coos Bay that include low travel speeds only at high tide have been found to reduce the stranding loss of even age 0 Chinook salmon in the lower Columbia River to insignificant levels (Hinton and Emmett 1994). The outer mile of the channel, where vessel speed would be the highest, would appear to be a region of greatest potential stranding from large waves generated by vessels. Additionally, LNG carriers could be traveling at 10 knots during outgoing trips, increasing overall risk of stranding as waves would be higher with higher speed, although vessels may not travel at this high a speed on all trips. The outer mile of the channel is also a region of naturally higher waves due to its proximity to the ocean (Wagoner et al. 1990), so ship wake is likely to have a much lower effect than natural conditions relative to frequency and magnitude of shore waves in this region. Although data for Coos Bay are not specifically available, radio-tagging studies of juvenile salmonids in the Columbia River suggest that even age 0 Chinook salmon tended to be more commonly offshore when they are approaching the marine environment near the mouth of the Columbia River (Carter et al. 2009). If this behavior should occur in Coos Bay, it would further reduce the risk of age 0 Chinook salmon from potential stranding by vessel wakes. Overall stranding potential is higher for age 0 Chinook salmon in Coos Bay from vessel wakes than for larger Chinook or coho salmon. Available information suggests stranding of all juvenile salmonids would not be substantial due to limitation wave height, tide, frequency and location. Project-related vessel wakes, therefore, are not expected to adversely affect Pacific salmon EFH.

4.2.2.7 Ballast Water Exchanges and Exotic, Invasive Species

As described in further detail in section 3.5.1, LNG carriers must discharge ballast water into the terminal slip when taking on cargo. See section 3.5.1.3 for details of potential ballast water effect on invasive species. Each LNG carrier would discharge approximately 9.2 million gallons of ballast water during the loading cycle, which would occur about 120 times per year. While no wastewater would be discharged to the slip, BWEs could introduce exotic, non-native species into Coos Bay. Should this occur, such organisms may threaten to outcompete and exclude native species thereby affecting the overall health of the estuarine ecosystem. Potential adverse effects of BWEs to the EFH of all three FMP groups would be mitigated by federal mandates that regulate how and where vessels must conduct a BWE before entering U.S. ports. Enforced by the Coast Guard, these protocols require complete exchange of ballast water in the open sea at least 200 miles from U.S. waters and have been reported to reduce the introduction of exotic and invasive organisms by 88 to 99 percent (NRC 2011). An additional requirement for many marine vessels (depending on size and when constructed) was implemented beginning in 2013. It requires regulated vessels from foreign ports to also treat ballast water, rather than just exchange it with ambient seawater, and to "flush" potential invasive organisms to further reduce the risk of invasive species being discharged at U.S. ports (see section 3.5.1.3 for details of these regulations). Compliance with these regulations by LNG carriers transiting to and from the LNG Project, therefore, should effectively reduce risks of introducing exotic, invasive species to the Coos Bay ecosystem.

Ballast water discharges also could affect certain estuarine water quality parameters on a local basis near the point of discharge. For example, salinity could be increased and dissolved oxygen could be reduced as a result of the periodic influx of seawater at the LNG terminal. While 9.2 million gallons of ballast water would be typically discharged from each LNG carrier, this represents only 0.3 percent of the water passing by the LNG terminal and only 2.4 percent of the total volume of 374 million gallons in the slip. Relative to the total water volume of Coos Bay, the net change in salinity would be extremely small and discountable. Potential net effects on other water quality parameters, including dissolved oxygen and pH, also would not be notable as described in further detail in section 4.3.2 of our EIS (FERC 2019). Therefore, BWEs may affect but would not adversely affect EFH for the three FMP groups.

4.2.2.8 Entrainment and Impingement

Dredging

During dredging operations, small fish, larvae, fish eggs, and benthic prey species could be entrained. Larger fish with greater swimming ability would be able to actively avoid areas where disturbance from dredging operations occurs. In a review of many maintenance dredge studies through 1998, Reine et al. (1998) concluded that "much of the available evidence suggests that entrainment is not a significant problem for many species of fish and shellfish in many bodies of water that require periodic dredging." Dredge entrainment studies over a four-year period in the

Columbia River found no juvenile or adult salmonids entrained during dredging, although some other pelagic fish were entrained (Larson and Moehl 1990). Juvenile salmonids also generally remain in shallower depths likely away from the typically deeper bottom dredge areas (Carlson et al. 2001) and dredging would occur when few or no rearing or migrating juvenile salmon would be present.

Dredging could affect certain bottom-dwelling fishes, such as Pacific sand lance (*Ammodytes personatus*) which frequently inhabit sands and fine-grain sediments for rest and predator avoidance. Sand lance are an important prey species for many marine mammals, birds, and fishes including marbled murrelet and Pacific salmon. While sand lance could be subject to mortality or injury from proposed dredging, the timing and extent of their presence in lower Coos Bay at the Marine Waterway Modification sites has not been confirmed.

Therefore, while entrainment of fish, shellfish, and other benthic species from dredging would be minor, it may adversely affect EFH for the coastal pelagic, groundfish, or Pacific salmon FMP groups. Direct or indirect impacts would be minimized by limiting work to the in-water work window (October 1 to February 15) and by maintaining the dredge cutterhead near the bottom.

Entrainment and Impingement through Vessel Cooling Water Intake at the Terminal Dock

During operation of the LNG Project, carriers at the export terminal slip may entrain fish and other marine organisms through the intake of cooling water, which is needed for vessel power plant operations. The potential effects to EFH for three of the FMP fish groups are twofold. The first is direct entrainment or impingement of individuals of these groups, and the second is the entrainment or impingement of pelagic food organisms that these groups feed upon (see section 3.5.4.3 regarding further details on entrainment and impingement of fish and related food organisms from LNG carrier cooling water intake systems at the LNG terminal dock).

For purposes of this analysis, typical cooling water flow rates were estimated at 3,200 m^3/hr (845,376 gallons per hour or 14,000 gpm) for 160,000 – 170,000 m^3 carriers with dual fuel diesel electric propulsion. This would result in a total of approximately 22 million gallons of cooling water being recirculated to the slip over a 26-hour loading cycle of LNG cargo. Cooling water flow rates would be 11,000 m^3/hr (2.9 million gallons per hour or 48,430 gpm) for 148,000 m^3 carriers with steam turbine propulsion systems. For a 148,000 m^3 carrier, this would total approximately 69.7 million gallons of water being recirculated during the 24-hour loading cycle of LNG cargo.

The intake ports for engine cooling water would be through the ship's sea chests. A typical LNG carrier has two sea chests. The lower unit is usually located just above the keel of the ship, approximately 10 meters (33 feet) below the water line about 15 to 20 feet above the channel bottom. It is approximately 3.5 to 4.2 square meters (37.7 to 45.2 square feet) covered by a screen with 4.5 mm (0.18 inch) wide bars, spaced every 24 mm (0.94 inch). Additional finer mesh screens are located internally on the vessels to prevent larger items from entering the system. The estimated velocity at the opening of the cooling water intake for a steam propulsion system ranges from 3.4 to 4.3 feet per second (ft/sec) (1.04 to 1.32 meters/second), depending on the dimensions of the cooling water intake. The estimated velocity at the opening of the cooling water intake for a dual propulsion system is approximately 1.0 to 1.3 ft/sec (0.30 to 0.38 meters/second), depending on the dimensions of the cooling water intake. No additional screening system other than that already employed on the LNG carriers is proposed for water intakes.

NMFS recommends that the approach velocity for screening systems operating where salmonid fry less than 60 mm in length are present should not exceed 0.33 ft/ sec (0.11 meter per second) or 0.8 ft/sec (0.26 meter/second) for larger juvenile salmonids in tidal systems (NMFS 1997c). These guidelines also include other requirements such as sweeping velocity and type and size of openings that are not present on these screens. Based on the anticipated range of velocities at the opening of the cooling water intake, fish ranging in size from fry to possibly larger juvenile salmonids (including coho and Chinook salmon) may be entrained or impinged at cooling water intakes if they swim near the intake screens.

In the case of coho salmon, it is anticipated that few in the vicinity of the cooling water intake would be as small as 60 mm (2.4 inches) and subject to potential entrainment or impingement because most coho outmigrate at age 1+ and likely would be greater than 120 mm (4.7 inches) with a strong swimming ability. Similarly, age 1+ Chinook salmon would be of comparable size and swimming ability as coho salmon which also would allow them to be less susceptible to potential entrainment or impingement. Age 0 Chinook, however (which may be present in the Coos Bay estuary during summer) would be more susceptible to entrainment and impingement due to their smaller size. If present in the Terminal slip, many of the juvenile coho and Chinook salmon would, therefore, have sufficient swimming ability to actively avoid being entrained or impinged at cooling water intakes of berthed LNG carriers. Also, because the LNG terminal slip would be excavated from upland habitat that extends landward from the main channel of Coos Bay, this may reduce the distribution of juvenile salmon in the vicinity of the water intakes of LNG carriers while berthed at the terminal dock. Salmon distribution patterns in Coos Bay are unknown, making it speculative to predict potential losses of fish to cooling water intake entrainment. Studies on the Columbia River, however, found that coho salmon and even smaller Chinook salmon occupied offshore portions of the river channel where the current is greater as they approached the ocean. Should distribution patterns for outmigrating coho and Chinook salmon in Coos Bay also occur primarily in the main channel, this would tend to minimize their potential exposure to cooling water intake entrainment.

Given the LNG carrier water intake and velocity characteristics as previously described, entrainment and impingement would primarily affect zooplankton, larval life stages, and small juvenile fish, because larger organisms could more actively avoid entrainment. Of the EFH species that inhabit Coos Bay, species with planktonic/pelagic eggs and larval life stages include the groundfish species English sole, rex sole, sand sole, starry flounder, lingcod, cabezon, and possibly bocaccio. A recent study found less diverse species near the mouth of the proposed slip (Shanks et al. 2011), but other larval or juvenile fish, including English sole, buffalo sculpin, anchovy, and pipefish, were found to be more abundant. A total of nine fish species were captured near the proposed slip site by Shanks et al. (2011).

Miller and Shanks (2005) collected a total of 35 species of ichthyoplankton in Coos Bay, the most abundant of which were pinpoint gunnel, northern anchovy, rosylip sculpin, Pacific sardine, and surf smelt. These five species consistently comprised more than 70 percent of the total catch. All of these are small, abundant, forage species, and two, sardine and anchovy, are coastal pelagic species. Miller and Shanks (2005) found that at both ocean-dominated and up-estuary sites in Coos Bay, the majority of the catch occurred from October 1 to May 31, although the seasonal difference was less marked within the estuary than it was at the estuary mouth. It can be expected that large numbers of these life stages, which are widely dispersed within the estuary, would be entrained during seasonal periods of high abundance. As noted above, both coho and Chinook salmon juveniles would be present in Coos Bay primarily in late spring and summer.

Should juvenile or larval fish and invertebrates that are small and unable to avoid entrainment occur in the slip area near the LNG carrier's intake screens, it is expected that a high portion would be entrained or impinged, resulting in their mortality. Their loss to the Coos Bay system would diminish their availability as a food source for coastal pelagic, groundfish, or salmon species.

The loss of these organisms from entrainment can be considered in the context of losses from natural mortality in the bay environment. Instantaneous natural mortality rate (per day) can be defined by the function: $M = \ln (N_0/N_t)/-t$, where M is instantaneous mortality rate, and N_0 and N_t are the initial and final abundance of larvae after time t (Rumrill 1990). The comparison of losses of larval food organisms between entrainment and natural mortality was based on the assumption that 100 percent mortality would occur to organisms entrained while water intakes were operating and that all mortality would occur during a single day. Additionally, it was assumed that all pelagic zooplankton in the Project area during water exchange on an average day (i.e., 106.0 million m^3) suffered one day's natural mortality at the rate determined in the literature.

Rumrill (1990) provides estimates of mortality rates for a variety of marine invertebrate larval, and in some cases, through juvenile stages. McGurk (1986) supplies similar information for a variety of larval stages of marine fish. These values provide the basis for the comparison of potential Project entrainment loss to that from natural mortality. See section 3.5.4.3 (Oregon Coast coho) for details of estimates of loss of organisms through cooling water entrainment. Average loss of organisms from entrainment during one LNG carrier loading event would be low, ranging from 0.3 to 1.7 percent of the natural morality that would occur in one day. On average, water intake would be less than 0.25 percent of the water passing the Project on a daily tidal cycle, so relatively few organisms would be subject to entrainment assuming similar planktonic organism distribution at the intake. Typical "loss" on average would be about 1.7 percent or less of loss from natural mortality of invertebrate and fish larvae during the day of LNG cargo loading (table 3.5.4-14). These values are conservative estimates when compared to natural mortality that would occur in the Coos Bay system overall because entrainment would not occur daily whereas natural mortality would, not all entrained organisms would suffer mortality, and, as noted, we assumed half the daily water volume passing the loading area.

While the loss from entrainment of marine fish, including groundfish, coastal pelagic fish, and their prey resources relative to natural mortalities in Coos Bay may be minor, it may adversely affect the supply of food resources to coastal pelagic, groundfish, and Pacific salmon. Further details of how entrainment may affect smaller organisms (e.g., zooplankton and larval fish) are presented in section 3.5.4.3.

4.2.2.9 Temperature Effects in the Marine Slip from LNG Carriers at the LNG Terminal

Moderate to large temperature increases have the potential to reduce fish and invertebrate growth, reproductive success, and, if high enough, cause direct mortality. LNG carriers at berth in the LNG terminal slip have the potential to both warm the water temperature while discharging engine cooling water and to cool the water temperature while loading LNG cargo.

Analysis and numerical modeling were performed to identify potential impacts of LNG carrier cooling water discharge on water quality in the slip and adjacent area of Coos Bay (CHE 2011; Moffatt & Nichol 2017e). Results of the earlier modeling by (CHE 2011) showed that for typical ambient flow conditions at a distance of 50 feet from the discharge point (LNG carrier sea chest), temperatures from dual fuel diesel electric LNG carriers would not exceed 0.3°C (0.54°F) above the ambient temperature. This difference would decrease with further distance. Based on estimated slip volume, this total heat could result in an average water increase for the total slip volume during one day when the carrier is loading from 0.03 to 0.06°F. No temperature effects would extend beyond the slip due to the much larger water volume of Coos Bay. However, the slight increase in water temperature in the slip due to the release of engine cooling water while the vessel is at dock would be ameliorated by cooling of the slip water during cargo load, due to the fact that LNG is at a temperature of -260°F. There would be a heat exchange between the cold hull of the vessel and the surrounding slip water, as discussed below.

The Moffatt & Nichol (2017f) analysis used the numerical thermal plume dispersal model from the EPA's "Visual Plume Model" (EPA 2003) in combination with the Coos Bay hydrodynamic model (Moffatt & Nichol 2017g) to study possible slip temperature changes resulting from the discharge of engine cooling water by an LNG carrier at the LNG terminal berth. The models simulate hydrodynamic mixing processes of submerged discharges and predict temperature fields and dispersion of non-conserved substances in ambient waterbodies. The 2017 modeling by Moffatt & Nichol (2017e) with thermal plume investigated the extent of the regulatory mixing zone (RMZ) where cooling water discharge would be greater than 0.3 degrees Celsius above ambient. The RMZ used in the temperature plume modeling is defined as the three-dimensional extent where water quality standards may be exceeded as long as acutely toxic conditions are prevented and fish habitat and other uses are protected. This modeling analyzed both steam turbine and dual fuel diesel electric LNG carriers with capacity of 148,000 m^3 and 170,000 m^3. It also modeled cooling water discharges of 10 degrees to nearly 21°C into various ambient temperatures ranging from 8 degrees to 18°C and under constant and stratified salinity conditions.

Results of the modeling showed that for typical ambient flow conditions the estimated water temperature of the discharged water would be up to about 2 to 3°C (3.6 to 5.4°F) warmer at the discharge port than ambient water temperature. The results indicated the maximum distance of the RMZ zone (0.3ºC [0.54ºF]) above the ambient temperature] from the port discharge point where the plume would reach this temperature was 80 and 37 feet for the steam turbine vessel and dual fuel diesel electric vessel, respectively (Moffatt & Nichol 2017f). Distance to achieve this temperature would be less under many environmental conditions. We expect the actual average increase in water temperature in the slip would be less than the higher value estimated due to tidal exchange and the vessel uptake of heat from its surroundings due to the transfer of liquid gas into the vessel at -260°F (-162°C).

As a result, water in the LNG terminal slip would be subject to negligible, localized temperature increases during carrier loadings that would not adversely affect EFH of the coastal pelagic, groundfish, or Pacific salmon FMP groups.

4.2.2.10 Operational Lighting

Localized changes in light regime have been shown to affect fish species behavior in a variety of ways (see discussion in sections 3.5.1.3 and 3.5.4.3). As described in further detail in section

1.2.1.4, lighting at the LNG terminal would likely include a mixture of low-power fluorescent lighting and higher intensity lighting for operations and maintenance, safety, and security. Lighting would primarily be located on shore, in and adjacent to the slip. When an LNG carrier is not in the berth, lighting would be reduced to that required for security. It would be focused upon the structures and not along the water, so as to serve as an attractant or deterrent to fish species. When an LNG carrier is at the berth, it would physically block light from the slip waters and, due to its proximity to the slip wall, would block the fish from getting too close to the lighting on the berth. Lighting would be similar to that already in place at other Coos Bay facilities.

Lighting on the tug dock would be low intensity sufficient for safety and for personnel movements on the trestle out to the tug berth and along the berth itself. The reduced lighting levels near the water would lessen or eliminate any behavioral effects to fish in the Project vicinity. The final details of the lighting design would be determined through consultation with resource agencies, including NMFS and ODFW, in order to minimize potential adverse effects on fish and wildlife resources.

Considering the limited distribution of light that would occur at the LNG terminal and tug dock areas, mitigation measures to be implemented to reduce light intensity, the availability of ample deep water adjacent to these areas where fish could avoid lights, and based on additional measures to be developed during final design to further minimize light on the water, lighting may affect but would not likely adversely affect EFH of coastal pelagic, groundfish, and Pacific salmon species.

4.2.2.11 Acoustic Effects from Construction and Operation

Underwater noise may affect fish by disturbing their behavior or causing injury or mortality. Effects of noise on aquatic species in Coos Bay from Project-related construction, operation, and maintenance activities were previously discussed for green sturgeon and coastal coho salmon in sections 3.5.1.3 and 3.5.4.3, respectively. Underwater noise would be generated from:

- installation of the sheet pile bulkhead at the LNG berth;
- installation of piles to support the LNG berth, tugboat dock, APCO sites, and temporary dredging pipelines;
- initial excavation and dredging and periodic maintenance dredging of the LNG terminal slip and access channel, and marine waterway modifications;
- dredging of the eelgrass mitigation site and entrance to the Kentuck project;
- LNG carrier transit in Coos Bay;
- general operations at the LNG terminal; and
- Trans-Pacific Parkway/US-101 intersection widening.

The location and number of in-water pilings to be installed is shown in tables 3.5.1-1a and 3.5.1-1b (section 3.5.1) and range over much of Coos Bay during construction. Individually or combined, these activities would generate underwater sound pressure levels that could elicit behavioral responses and in some locations injury in fish and other aquatic organisms.

As discussed in section 3.5.1.3, dB levels ranging from over 206 dB down to 183 dB can cause adverse effects to fish (Fisheries Hydroacoustic Working Group 2008). Underwater noise may be generated by driving piles on land (dry piles) because some noise propagates through ground and sediments (especially through harder substrates such as rock and clay) and may transfer to the water column somewhere else (known as sound flanking). Wladichuk et al. (2018) modeled potential impacts of land-based pile driving on fish using both current guidelines (Fisheries Hydroacoustic Working Group 2008) and new proposed guidelines (Popper et al. 2014). This study found that injury to fish from peak sound pressure levels (206 dB in current guidelines) would occur up to 37 meters from the face of the MOF. Also, this study predicted that injury to both small (less than 2 grams) and large (greater than or equal to 2 grams) fish from cumulative sound exposure levels (183 and 187 dB, respectively, under current guidelines) would occur up to 1,723 meters from the shoreline. Figure 3.5.1-2 shows the modeled extent of this potential zone of injury in the Project area from land-based pile driving at the MOF face. All distances assume no sound attenuation minimization measures (e.g., bubble curtain, cushion blocks, etc.) are used.

Based on the results of Wladichuk et al. (2018), installation of land-based piles would increase potential exposure of fish to underwater noise in an area encompassing the navigation channel from the MOF across the bay to the airport and southwest to the vicinity of Southport Lumber yard. These noise thresholds could be reached during pile driving of the 8 mooring bollards at the MOF that would take approximately 14 days to install and the 28 east mooring piles at the LNG berth that would be installed after the berm is breached. These 28 piles would take approximately eight days to install. Individual fish occurring in this area during pile driving could experience physiological effects sufficient to cause injury. Land-based pile driving at the MOF shown to generate injury-level in-water noise would be limited to the approved in-water work window, which is October 1 through February 15 to minimize risk of physical injury or disturbance to individual Oregon Coast coho and other species in the three fish management groups that may occur in the Project vicinity during construction.

A key source of underwater noise from Project operations is associated with LNG carrier transits. LNG carriers would generate the greatest magnitude of noise relative to any vessels operating in the action area. Peak noise values within one meter (three feet) from an LNG carrier hull would likely be 182 ± 2 dB, although this value is based on LNG carriers in open-ocean transit. Peak noise values would likely be less in Coos Bay where vessels would be traveling at a much slower speeds. As a result, no adverse effects to fish in the estuary would result from LNG carrier transit.

Dredging operations can also produce high underwater noise levels that may be harmful to very small fish close to the activity. Fischer (2004) noted dredging source dB levels of 172 and 185 dB at one meter (three feet) from the dredge head. While the upper levels would exceed the lowest effects criteria (the threshold where effects occur to small fish less than two grams), dredging would be constrained to the in-water work period when the abundance of juvenile salmonids in the bay is low. Additionally, it is expected fish would avoid areas within one meter (three feet) of the dredge head. Initial slip dredging would have some sediment removal from shallow water but maintenance dredging would occur in the deepest channel areas where fewer juvenile salmonids would be present. As a result, underwater noise levels from dredging would be minor and would not adversely affect EFH of all three fish management groups.

4.2.2.12 Habitat and Food Source Effects –Slip, Access Channel, and Pile Dike Rock Apron

Prey species important to local EFH fish species rely on many of the same habitat conditions as the EFH fish species themselves. The food web components, including phytoplankton, zooplankton, detritus, epiphyton, and submerged aquatic vegetation (e.g., eelgrass, macrophytic algae), are all important in supplying the habitat and food base for EFH species within Coos Bay. Eelgrass is one of the more important components that provides refuge for a variety of fish, such as salmon and anchovy. Such refuge may lower predation and allow more opportunity for foraging. The protective structure attribute of eelgrass is primarily for smaller organisms and juvenile life history stages of fish. For example, submerged aquatic grasses are important habitat for small prey species of adult lingcod (in Appendix B-2 of PFMC 2008). Submerged grass meadows provide cover and food for a large number of organisms, including burrowing, bottom-dwelling invertebrates; diatoms and algae; herring that deposit eggs clusters on leaves; tiny crustaceans and fish that hide and feed among the blades; larger fish, and crabs that forage in the meadows at various tides. Previous studies (Akins and Jefferson 1973) have reported that Coos Bay has 1,400 acres of lower intertidal and shallow subtidal flats covered by eelgrass meadows. Other inter- and sub-tidal habitat components also supply food resources or provide refuge for a variety fish resources, so that modification, disruptions, or loss of these conditions, especially eelgrass, may have adverse effects on EFH resources.

Construction of the LNG Project facilities, including the slip, access channel, pile dike rock apron, MOF, the four sites where the marine waterway modifications would be conducted, Trans-Pacific Parkway/US-101 Intersection Widening, and temporary impact areas, would affect existing estuarine habitat. Where dredging is involved, this would affect about 14.7 acres of intertidal to shallow subtidal habitat, 1.9 acres of eelgrass habitat, and 0.1 acres of salt marsh. These areas would be converted to primarily deep subtidal habitat by dredging the slip, access channel, and MOF (see table 3.5.1-4 in section 3.5.1.3). About 36.7 acres of upland habitat would be converted to open water, primarily deep subtidal habitat down to -45 feet (NAVD88). In addition, about 2.3 acres of intertidal, eelgrass, and subtidal habitat, would be covered by a three-foot thick layer of rock. This would be accomplished by placing 6,500 cubic yards of well graded 6-inch to 22-inch angular stone with a median size of 14 inches over a 50-foot wide by 1,100 foot long area. The purpose of the new rock apron is to prevent anticipated slope migration near the pile dike after the access channel is dredged.

Benthic and epibenthic invertebrates that presently inhabit shallow intertidal and subtidal regions within the boundaries of the proposed access channel dredging area would be removed from the bay with the dredged materials are transferred to upland disposal sites. Ghost shrimp and sand shrimp (adults, juveniles, and larvae), amphipods, clams, Dungeness crab, and various demersal (bottom) fish species are important prey for many other fish species, including salmon and groundfish. As a result, the available food supply for EFH fish in the bay would be reduced until the affected benthic and epibenthic communities are re-established within the dredged areas. The resulting deeper habitat would have a character that is less diverse and less productive as benthic food sources.

Many groundfish species are known to occur within the estuary, either seasonally or year-round. Project activities related to dredging are likely to have the greatest impact on flatfish residents of the lower bay, including English sole and starry flounder. Access channel dredging would convert 14.76 acres of shallow water habitat to deepwater habitat. Juvenile English sole and starry flounder are typically found in shallow nearshore waters in estuarine environments. Therefore, the conversion from shallow water to deep water habitat would represent a reduction in habitat quality and quantity over existing conditions. Flatfish and other demersal species are expected to return to the area after dredging is completed. Most rockfish species in the lower bay prefer rocky reef habitat and do not commonly utilize sand/mud substrates that would be affected by dredging. The new rock apron at the pile dike would provide additional habitat for rockfish, ling cod, cabazon, and bocaccio. Juvenile lingcod and adult cabazon and bocaccio are known to occasionally utilize sandy flats habitat and would experience some loss of such habitat. However, the sandy habitats that would be removed by dredging are common within the estuary. It is anticipated that groundfish species would be able to relocate to nearby suitable habitats.

While short-term loss of important eelgrass habitat is of concern, it would be a small portion of the total Coos Bay area eelgrass beds of 1,400 acres. Also, the loss of the 2.08 acres of eelgrass by construction and operation of the LNG Project would be mitigated at a proposed off-site eelgrass mitigation area south of the west end of the Southwest Oregon Regional Airport where approximately 6 acres of new eelgrass habitat would be created. The 3:1 mitigation ratio would offer a net long-term gain in eelgrass habitat; while the interim loss of unvegetated mud flat (intertidal and shallow subtidal habitats) would be restored at the Kentuck project (see appendix O.1 – Compensatory Wetland Mitigation Plan).

LNG carrier transits through the Coos Bay channel combined with tugboat turning operations would disturb small areas of the channel bottom during arrival and departure. This would cause some short-term loss and/or displacement of organisms. Large organisms (crabs/shrimp) would be able to move and return, while some benthic organisms would have a more extended loss. Overall, an undefined loss of benthic organisms may result from LNG carrier propwash scour during each trip near the slip approach. The magnitude of such loss, however, likely would be small and less than what currently results from bottom disturbance by existing large deep-draft vessel trips. Modeling results have indicated that bottom velocities and related channel disturbance from existing deep-draft vessels would be slightly greater than what would occur from slower traveling LNG carriers (see section 3.5.1.3).

While studies in Coos Bay have indicated that benthic communities inhabiting mud substrates recovered to pre-dredging conditions in four weeks (McCauley et al. 1977), recovery in estuarine channel muds has been reported to typically require six to eight months (Newell et al. 1998). McCabe et al. (1997, 1998) noted benthic organism recovery in the lower Columbia River occurred in three months. Because of the large quantity of proposed dredging, including areas outside the Federal Navigation Channel that have a more varied substrate, it may take longer than four weeks to recover the affected habitat relative to what may be more typical as a result of Coos Bay dredging. A short-term loss in bottom habitat, likely less than one year in slip and some other areas but possibly closer to a year in the marine waterway modifications site due to type of substrate (see section 3.5.1.3) that would affect benthic communities and potential food resources for the EFH fish species in the three FMP groups. Proposed mitigation, including restoration of the Kentuck site and development of new eelgrass habitat, is expected to result in long-term net benefits to EFH. Therefore, while temporary adverse effects to EFH fish species in the three FMP groups may occur, long-term effects are not expected.

4.2.2.13 Habitat Effects –Pipeline HDD

As discussed above, inadvertent return during any of the three HDDs (two across Coos Bay, one across the Coos River) could occur, although available information suggests the likelihood is remote. Bentonite by itself is a non-toxic drilling mud (Breteler et al. 1985; Hartman and Martin

1984; Sprague and Logan 1979) although according to Reid and Anderson (1998), the toxicity of bentonite (sodium montmorillonite) in fresh water ranges from 5,000 to 19,000 ppm (mg/liter) based on 96-hour tests for LC_{50} (the concentration at which 50 percent of the test population dies after 95 hours of exposure) on rainbow trout. The toxicity classifications based on LC_{50} values ranged from "slightly toxic" to "practically non-toxic" (Reid and Anderson 1998). In other tests, toxicities to lake whitefish and rainbow trout demonstrated threshold concentrations of 16,613 and 49,838 ppm (mg/liter), respectively (Reid and Anderson 1998). LC_{50} concentrations greater than 10,000 ppm would be considered "practically non-toxic" (Reid and Anderson 1998).

Bentonite, as with any fine particulate material, can interfere with oxygen exchange by the gills of aquatic organisms (EPA 1986). The degree of interference generally increases with water temperature (Horkel and Pearson 1976). Impacts would be localized and would normally be limited to individual fish in the immediate vicinity of the inadvertent return. The majority of highly mobile aquatic organisms, such as fish, would be able to avoid or move away from turbidity spots and plumes (Reid and Anderson 1999). Short-term pulses of suspended sediments (sharp increases within an hour) disrupt the feeding behavior and dominance hierarchies of juvenile coho salmon and elicit alarm reactions that may cause fish to relocate downstream to undisturbed areas (Wilber and Clarke 2001; Berg and Northcote 1985). Other less mobile or immobile organisms, such as clams, mussels and other macroinvertebrates, would incur direct mortality (Wilber and Clarke 2001). Bentonite can smother macroinvertebrates and adversely affect filter-feeders (Falk and Lawrence 1973 in Hair et al. 2002 and Land 1974 in Cameron et al. 2002). Bentonite can also exacerbate or enhance the effects of toxic compounds to fish and aquatic invertebrates if those compounds are present in aquatic habitats (Hartman and Martin 1984). Similar to other fine-grained particulates, bentonite in flowing water is more likely to remain in suspension longer than in standing water. Consequently, effects to coho salmon by a release of bentonite into a waterbody would ultimately depend on volume of the release, volume of water present, and current. Coho salmon inhabiting larger waterbodies with swift currents would be less affected by a given volume of bentonite than those inhabiting small waterbodies with no current. Considering the small size of the area, and short duration of effects to the benthic community, the loss of potential food resources for EFH species, including salmon and groundfish such as starry flounder, would be small.

4.2.2.14 Shading Effects

Shading from over-water structures reduces the amount of light available to phytoplankton and aquatic macrophytes. These may also be areas where predators can hide. The estuarine habitat where shading would occur would involve an industrial area of the slip excavated from upland habitat that would generally provide poor habitat conditions (deep, riprap) and was not originally estuarine habitat. This is a small area with facilities as described in section 3.5.1.3. Consequently, shading impacts to EFH, such as benthic production and potential increased predations, would be small and unsubstantial. Consequently, shading impacts to EFH, such as benthic production and potential increased predations, would be small and unsubstantial.

4.2.2.15 Aquatic Nuisance Species in Coos Bay Estuary

Invasive species have the potential to modify the food base and induce other ecological modifications in the estuarine area of Coos Bay. Another potential source of invasive species, other than LNG carrier ballast water, is the transfer of organisms between water bodies by construction equipment used in the water, or through other water transfer actions. See section 3.5.1.3 for details of invasive species issues relative to ballast water management and regulation that limit potential effects of invasive species release to Coos Bay. Pacific Connector has stated that it would not obtain hydrostatic test water from either Coos Bay or the Coos River, in order to prevent the spread of NAS from the estuary to inland watersheds. Pacific Connector currently has procedures in their *Hydrostatic Test Plan* (see appendix U) to reduce or eliminate the spread of invasive species. Indirect adverse effects to EFH for the three FMP groups are not anticipated to occur, considering the proposed reasonable actions that would be taken to prevent introduction.

4.2.3 Riverine Analysis Area

The riverine analysis area includes all freshwater sources that may be affected by Project actions and that may affect waters historically accessible to salmon. This area primarily includes waters crossed or adjacent to the freshwater portion of the Pipeline Project, as reported in sections 3.5.3 and 3.5.4 for the two ESA-listed coho salmon ESUs. Effects to EFH in this area would be associated with pipeline construction and operation, associated reconstructed, temporary and permanent road construction, and ancillary facility construction (e.g., meter stations, storage yards).

Effects to coho salmon and their habitat have been addressed in detail in section 3.5.3.3 for the SONCC coho salmon ESU and in section 3.5.4.3 for the Oregon Coast coho salmon ESU. While there are some differences of life history timing among the other Pacific salmon species in the riverine analysis area, Chinook salmon and their distribution are generally a subset of that covered for these two coho salmon. The types of effects to Chinook salmon EFH from Project actions would be mostly the same as for coho salmon. Effects as described in those sections are descriptive of the effects to Pacific salmon EFH in the riverine analysis area, and descriptions below are mostly summaries of those analysis.

4.2.3.1 Acoustic Shock and Underwater Noise

There are many crossings within the range of Pacific salmon where shallow bedrock may occur and where blasting and/or mounted impact hammers may need to be used to construct a trench through the bedrock substrates. Explosives detonated near water produce shock waves that can be lethal to fish, eggs, and larvae by rupturing swim bladders and addling egg sacs (British Columbia Ministry of Transportation 2000). Pacific Connector may opt a variety of actions to reduce the effects to fish, including bubble/air curtains, scare noise to move fish away from the site, and fish removal from the affected area. These and other actions are included in the *Blasting Plan*, and fish removal from the area would be done under the *Fish Salvage Plan* (see section 4.3.3 below); both plans are intended to reduce adverse effects to fish. Prior to any blasting, proper permits would be obtained and agencies notified as required by the associated permits.

Noise, like that generated from an impact hammer at bedrock stream crossings, can also have adverse effects to Pacific salmon. The noise produced by the impact hammer in air would be equivalent to about 182 dB re: 1 µPa @ 1 meter (3 feet) in water. This is near the lower level considered to be directly harmful to fish. Sound levels less than this (e.g., 90 dB) are at the hearing threshold of some salmonids, so some avoidance may occur at lesser sound levels. With the fish removal practices in place, Pacific salmon would not be in the zone of direct impact of such sound.

However, associated salvage of fish remaining in isolated crossing areas where blasting or impact hammers are used would likely result in some mortality.

Overall, considering plans and procedures that are in place, and the limited need for blasting or air hammer use, direct impacts to Pacific salmon and their EFH from blasting or impact hammer use would not occur, although associated fish salvage operations would have adverse effects.

4.2.3.2 Suspended Sediment Effects from Stream Crossings

Four crossing methods (dry open cut, direct pipe, HDD, and diverted open cut) would be used for stream crossings along the route where Pacific salmon would occur (see sections 3.5.3.3 and 3.5.4.3). All but four of the stream crossings in the range of the Pacific salmon would be dry open cut (either dam-and-pump or flume). Dry crossing methods, including diverted open cut, would result in minimal impacts but would include temporary increases in suspended sediments in restricted areas. Direct pipe and HDDs would be installed without in-water work, and would not directly affect the aquatic environment and associated species—except in the case of an inadvertent return during an HDD crossing, which could affect stream suspended sediment levels.

Salmonids exposed to moderate to high levels of suspended sediment for extended periods could be adversely affected. At high levels, turbidity directly affects survival and growth of salmonids and other species, interferes with gill function, and adversely affects substrate for egg development (Bash et al. 2001). Turbidity can also reduce macrophyte cover over the long-term by limiting photosynthesis (Goldsborough and Kemp 1988), as well as adversely affecting fish vision, which is a requisite for social interactions (Berg and Northcote 1985), feeding (Vogel and Beauchamp 1999; Gregory and Northcote 1993), and predator avoidance (Meager et al. 2006; Miner and Stein 1996).

Suspended Sediment – Dry Open Cut

Estimated effects on salmonids from suspended sediment were based on models of concentrations at crossings and on literature detailing what effects occurred at other typical crossing types. Newcombe and Jensen (1996) compiled research from many sources that demonstrate effects to anadromous and resident salmonids by various levels of suspended sediment and exposure over time. The model developed in Newcombe and Jensen (1996) is considered reasonable for assessing effects to listed coho salmon, and the results are considered suitable for assessing effects to Pacific salmon EFH. The details of the model are in section 3.5.

Output from each model provides SEV scores. Values range from 0 to 14, where an SEV of 0 indicates no effects, an SEV between 1 and 3 indicates behavioral effects, an SEV from 4 to 8 indicates sublethal effects, and an SEV from 9 through 14 indicates lethal and paralethal effects (see Table 1 in Newcombe and Jensen 1996).

Modeled estimates of the effects of suspended sediment to coho salmon resources from pipeline installation across streams would remain mostly low to moderate (SEV 3 to 5) in the short term. These effects to coho salmon would likely include short-term avoidance, short-term reduction in feeding, and minor physiological stress. Based on modeled results, effects would be similar among most fifth-field watersheds where salmon are present along the route. A few modeled effects would have higher impact levels if any of the crossing methods have failures.

Overall, the result for either dry crossing method would be that suspended sediment generated during crossing construction would cause at least some short-term adverse effects, primarily avoidance, short-term feeding reduction, and likely some minor stress. No long-term adverse effect would likely occur to Pacific salmon or their EFH unless some major failure occurred during construction.

Following review of an earlier BA draft, we requested an analysis of any coho salmon or EFH stream that is not directly crossed by the Pipeline Project, but has a tributary that would be crossed that could have an effect on this fish stream from the tributary stream's downstream sediment distribution based on the severity of ill effects value indicated. However, addressing this comment requires a different methodology than used in the nearest neighbor analysis provided for SONCC coho in section 3.5.3.3 and Oregon Coast coho in section 3.5.4.3. In that analysis, NMFS assumed that the nearest neighbor distance was equivalent to the downstream confluence of the two. However, FERC's request requires measuring the actual distance from the point where the tributary is crossed to the confluence with coho/EFH and would include most of the streams crossed in appendix M (table M-1). For example: a tributary to Trail Creek at MP 119.84 is 824 meters from the confluence with Trail Creek which provides Pacific salmon EFH. The tributary is an intermittent stream, two feet wide crossed by dry open-cut (flume) requiring two hours of instream work. Using the appropriate regression model in table 3.5.3-3, at 824 meters downstream, the TSS = 14.2 mg/l which yields SEV = 3 (using the Newcombe and Jensen [1996] Model #1 for juvenile and adult salmonids). Thus, at the confluence, SEV in the Tributary = 3, but that does not equate to SEV = 3 in Trail Creek because the TSS concentration entering from the Tributary would be diluted from 14.2 mg/l. SEV in Trail Creek EFH would be less than 3. Similar estimates were made for all tributaries (except for ditches) to streams with EFH, either Known or Assumed to be occupied by coho, and are included in table 4.3.3-1. Effects to waterbodies crossed that support or are assumed to support SONCC coho and Oregon Coast coho and effects by crossing nearest neighbor streams are provided in table 3.5.3-23 (SONCC coho) and table 3.5.4-28 (Oregon Coast coho), but are not included in table 4.3.3-1.

TABLE 4.3.3-1

Downstream Effects of Instream Construction to Waterbodies with Pacific Salmon EFH Due to Crossing Tributaries with No EFH

Waterbodies Crossed and Waterbody ID	Pipeline Milepost (MP)	Flow	Proposed Crossing Method a/	OHM Width (feet) b/	Tributary to Stream with Salmon EFH c/	EFH Known or Assumed at Confluence	Distance from Pipeline Crossing to Confluence (meters) d/	Instream Duration (hours) e/	Estimated TSS Concentration at Confluence (mg/l) f/	SEV Score at Confluence g/	Risk of TSS at Confluence by Crossing Tributary (rationale) h/
Coos Subbasin (HUC 17100304), Coos Bay-Frontal Pacific Ocean (HUC 1710030403) Fifth-Field Watershed											
Trib. to Stock Slough (BR-S-31)	14.72BR	Intermittent	Flume	2	Laxstrom Gulch	Assumed	27	2	57.8	4	None-Low (intermittent)
Coquille Subbasin (HUC 17100305), North Fork Coquille River (HUC 1710030504) Fifth-Field Watershed											
Steinnon Creek (SS-500-003; BR-S-63)	20.20BR	Perennial	Flume	8	Steinnon Creek	Assumed	1,322	2	12.4	3	Moderate-High (perennial)
Trib. to Middle Creek (S-T02-001 / EE-SS-9073)	25.18	Intermittent	Flume	2	Tributary to Middle Creek	Known	1,135	2	13.9	3	None-Low (intermittent)
Trib. to Middle Creek (BSI-137)	27.01	Intermittent	Flume	7	Middle Creek	Known	50	2	44.3	4	None-Low (intermittent)
Coquille Subbasin (HUC 17100305), East Fork Coquille River (HUC 1710030503) Fifth-Field Watershed											
Trib. to E. Fork Coquille (SS-003-007A)	30.22	Perennial	Flume	10	Trib. to East Fork Coquille	Assumed	144	2	36.8	4	Moderate-High (perennial)
Trib. To E. Fork Coquille (BSI-70)	31.64	Intermittent	Flume	1	East Fork Coquille River	Known	1,375	2	16.8	4	None-Low (intermittent)
Trib. To Elk Creek (S-T01-004 / SS-100-030)	32.56	Intermittent	Flume	4	Tributary to Elk Creek	Assumed	70	2	43.2	4	None-Low (intermittent)
Trib. To Elk Creek (BSP-49)	33.00	Perennial	Flume	10	Elk Creek	Known	1,790	2	14.4	3	Moderate-High (perennial)
Trib. To S. Fork Elk Creek (BSI-251)	35.51	Intermittent	Flume	4	Trib. to South Fork Elk Creek	Known	365	2	28.5	4	None-Low (intermittent)
Coquille Subbasin (HUC 17100305), Middle Fork Coquille River (HUC 1710030501) Fifth-Field Watershed											
Trib. to Big Creek (BLM 35.87 (CSP-2))	35.87	Intermittent	Flume	2	Big Creek	Known	1,142	2	16.0	4	None-Low (intermittent)
Trib. To Big Creek (BLM 36.48)	36.48	intermittent	Flume	2	Big Creek	Known	408	2	24.6	4	None-Low (intermittent)
Trib. To Big Creek (GSI-25/BSI-253)	36.54	intermittent	Flume	6	Big Creek	Known	414	2	24.4	4	None-Low (intermittent)
Trib. To Big Creek (BLM 36.85)	36.85	intermittent	Flume	2	Big Creek	Known	431	2	24.1	4	None-Low (intermittent)

TABLE 4.3.3-1 (continued)

Downstream Effects of Instream Construction to Waterbodies with Pacific Salmon EFH Due to Crossing Tributaries with No EFH

Waterbodies Crossed and Waterbody ID	Pipeline Milepost (MP)	Flow	Proposed Crossing Method a/	OHM Width (feet) b/	Tributary to Stream with Salmon EFH c/	EFH Known or Assumed at Confluence	Distance from Pipeline Crossing to Confluence (meters) d/	Instream Duration (hours) e/	Estimated TSS Concentration at Confluence (mg/l) f/	SEV Score at Confluence g/	Risk of TSS at Confluence by Crossing Tributary (rationale) h/
Trib. To Big Creek (BSI-252)	36.92	intermittent	Flume	3	Big Creek	Known	307	2	26.9	4	None-Low (intermittent)
Trib. To Big Creek (ESI-19)	37.32	intermittent	Flume	3	Big Creek	Assumed	69	2	39.3	4	None-Low (intermittent)
Trib. To Big Creek (ESP-20)	37.35	Perennial	Flume	15	Big Creek	Assumed	63	4	40.1	5	Moderate-High (perennial)
South Umpqua (HUC 17100302) Subbasin, Olalla Creek-Lookingglass Creek (HUC 1710030212) Fifth-Field Watershed											
Trib. to Shields Creek (BSI-203)	55.94	Intermittent	Flume	8	Shields Creek	Known	735	2	19.1	4	None-Low (intermittent)
Trib. to Shields Creek (Denied Access 13)	56.28	Intermittent	Flume	4	Shields Creek	Known	1,121	2	15.9	4	None-Low (intermittent)
Trib. to Shields Creek (Denied Access 14)	56.34	Intermittent	Flume	4	Shields Creek	Known	1,142	2	15.7	4	None-Low (intermittent)
Trib. to Olalla Creek (S-T02-002)	56.80	Intermittent	Flume	4	Olalla Creek	Known	1,560	2	13.3	3	None-Low (intermittent)
Trib. to Olalla Creek (BSI-140)	57.11	Intermittent	Dam-and-Pump	13	Olalla Creek	Known	1,060	4	3.7	3	None-Low (intermittent)
Trib. to Olalla Creek (BSI-140)	57.14	Intermittent	Dam-and-Pump	13	Olalla Creek	Known	1,060	4	3.7	3	None-Low (intermittent)
Trib. to Olalla Creek (BSI-138)	57.31	intermittent	Flume	10	Olalla Creek	Known	710	2	19.4	4	None-Low (intermittent)
Trib. to Olalla Creek (BSI-147/EE-12)	57.84	intermittent	Flume	4	Olalla Creek	Known	202	2	29.1	4	None-Low (intermittent)
Trib. to Olalla Creek (BSI-151)	58.20	intermittent	Flume	3	Olalla Creek	Known	173	2	30.3	4	None-Low (intermittent)
Trib. to Olalla Creek (BSP-159)	58.55	Perennial	Dam-and-Pump	10	Olalla Creek	Known	51	2	9.1	3	Moderate-High (perennial)
Trib. to Olalla Creek (BSI-132)	59.29	Intermittent	Flume	9	Olalla Creek	Known	636	2	20.2	4	None-Low (intermittent)
Trib. to McNabb Creek (NSP-14)	60.13	Perennial	Dam-and-Pump	6	McNabb Creek	Known	423	2	5.4	3	Moderate-High (perennial)
South Umpqua (HUC 17100302) Subbasin, Clark Branch-South Umpqua River (HUC 1710030211) Fifth-Field Watershed											
Trib. to Willis Creek (BSI-169)	67.00	Intermittent	Dam-and-Pump	2	Willis Creek	Known	111	2	8.1	3	None-Low (intermittent)

TABLE 4.3.3-1 (continued)

Downstream Effects of Instream Construction to Waterbodies with Pacific Salmon EFH Due to Crossing Tributaries with No EFH

Waterbodies Crossed and Waterbody ID	Pipeline Milepost (MP)	Flow	Proposed Crossing Method a/	OHM Width (feet) b/	Tributary to Stream with Salmon EFH c/	EFH Known or Assumed at Confluence	Distance from Pipeline Crossing to Confluence (meters) d/	Instream Duration (hours) e/	Estimated TSS Concentration at Confluence (mg/l) f/	SEV Score at Confluence g/	Risk of TSS at Confluence by Crossing Tributary (rationale) h/
Trib. to South Umpqua River (SS-004-004/SS-100-012)	69.29	Perennial	Flume	23	South Umpqua River	Known	1,547	4	5.5	3	Moderate-High (perennial)
Trib. to South Umpqua River (SS-004-005/SS-100-013)	69.35	Perennial	Flume	20	South Umpqua River	Known	1,570	4	5.3	3	Moderate-High (perennial)
Trib. to South Umpqua River (SS-004-006/SS-100-014)	69.57	intermittent	Flume	3	South Umpqua River	Known	1,980	2	3.1	2	None-Low (intermittent)
Trib. to South Umpqua River (SS-005-009/SS-100-019)	73.04	intermittent	Flume	3	South Umpqua River	Known	3,762	2	0.3	1	None-Low (intermittent)
Trib. to South Umpqua River (SS-005-013 SS-100-020)	73.51	intermittent	Flume	3	Richardson Creek	Known	2,105	2	2.6	2	None-Low (intermittent)
Trib. to South Umpqua River (SS-005-011 & -12 SS-100-021)	73.56	intermittent	Flume	3	Richardson Creek	Known	2,110	2	2.6	2	None-Low (intermittent)
Trib to Richardson Creek (SS-005-010)	73.73	intermittent	Flume	3	Richardson Creek	Known	2,302	2	2.1	2	None-Low (intermittent)
South Umpqua (HUC 17100302) Subbasin, Myrtle Creek (HUC 1710030210) Fifth-Field Watershed											
Little Lick Creek (BSP-6)	77.71	Perennial	Flume	7	Little Lick Creek	Known	2,075	2	10.0	3	Moderate-High (perennial)
Trib. to Little Lick Creek (BSI-8)	77.93	Intermittent	Flume	13	Little Lick Creek	Known	1,740	4	12.1	4	None-Low (intermittent)
Trib. to Little Lick Creek (BSI-8)	78.02	Intermittent	Flume	2	Little Lick Creek	Known	1,640	2	12.7	3	None-Low (intermittent)
Trib. to North Myrtle Creek (NSP-38)	79.15	Perennial	Dam-and-Pump	8	North Myrtle Creek	Known	130	2	9.6	3	Moderate-High (perennial)
Trib. to N. Myrtle Creek (EE-SS-9038)	79.17	Intermittent	Flume	4	North Myrtle Creek	Known	152	2	40.2	4	None-Low (intermittent)

TABLE 4.3.3-1 (continued)

Downstream Effects of Instream Construction to Waterbodies with Pacific Salmon EFH Due to Crossing Tributaries with No EFH

Waterbodies Crossed and Waterbody ID	Pipeline Milepost (MP)	Flow	Proposed Crossing Method a/	OHM Width (feet) b/	Tributary to Stream with Salmon EFH c/	EFH Known or Assumed at Confluence	Distance from Pipeline Crossing to Confluence (meters) d/	Instream Duration (hours) e/	Estimated TSS Concentration at Confluence (mg/l) f/	SEV Score at Confluence g/	Risk of TSS at Confluence by Crossing Tributary (rationale) h/
Trib. to N. Myrtle Creek (EE-SS-9039)	79.19	Intermittent	Flume	4	North Myrtle Creek	Known	154	2	40.0	4	None-Low (intermittent)
Trib. to S. Myrtle Creek (BSP-259)	81.38	Intermittent	Flume	2	South Myrtle Creek	Known	263	2	33.9	4	None-Low (intermittent)
Trib. to S. Myrtle Creek (SS-100-023)	81.45	Intermittent	Flume	17	South Myrtle Creek	Known	281	4	33.1	4	None-Low (intermittent)
Trib. to S. Myrtle Creek (EE-SS-9074)	81.93	Intermittent	Flume	5	South Myrtle Creek	Known	806	2	20.9	4	None-Low (intermittent)
South Umpqua (HUC 17100302) Subbasin, Days Creek-South Umpqua River (HUC 1710030205) Fifth-Field Watershed											
Wood Creek (BSP-226)	84.17	Perennial	Dam-and-Pump	8	Wood Creek	Known	1,250	2	0.9	1	Moderate-High (perennial)
Trib. to Fate Creek (BSI-236)	88.2	Intermittent	Dam-and-Pump	2	Fate Creek	Known	440	2	1.4	2	Moderate-High (perennial)
Trib. to Fate Creek (BSI-238 (MOD))	88.23	Intermittent	Flume	1	Fate Creek	Known	450	2	6.0	3	None-Low (intermittent)
Trib. to South Umpqua River (ASI-193 / ASI-191)	94.85	intermittent	Flume	10	South Umpqua River	Known	475	2	5.9	3	None-Low (intermittent)
Trib. to South Umpqua River (ASI-193 / ASI-191)	95.03	Intermittent	Flume	10	South Umpqua River	Known	1,383	2	3.5	2	None-Low (intermittent)
South Umpqua (HUC 17100302) Subbasin, Upper Cow Creek (HUC 1710030206) Fifth field Watershed											
None											
Upper Rogue (HUC 17100307) Subbasin, Trail Creek (HUC 1710030706) Fifth-Field Watershed											
Trib. to West Fork Trail Creek (SS-100-032)	118.80	Intermittent	Flume	2	West Fork Trail Creek	Known	300	2	17.5	4	None-Low (intermittent)
Trib. to Trail Creek (S1-06 (DA-16 (MOD))	119.84	Intermittent	Flume	2	Trail Creek	Known	824	2	14.2	3	None-Low (intermittent)
Trib. to Trail Creek (ASI-205)	120.90	intermittent	Flume	6	Trail Creek	Known	643	2	15.3	3	None-Low (intermittent)
Upper Rogue (HUC 17100307) Subbasin, Shady Cove-Rogue River (HUC 1710030707) Fifth-Field Watershed											
Trib. to Indian Creek (ASI-223)	125.91	Intermittent	Flume	5	Tributary to Indian Creek	Assumed	2,625	2	4.7	3	None-Low (intermittent)

TABLE 4.3.3-1 (continued)

Downstream Effects of Instream Construction to Waterbodies with Pacific Salmon EFH Due to Crossing Tributaries with No EFH

Waterbodies Crossed and Waterbody ID	Pipeline Milepost (MP)	Flow	Proposed Crossing Method a/	OHM Width (feet) b/	Tributary to Stream with Salmon EFH c/	EFH Known or Assumed at Confluence	Distance from Pipeline Crossing to Confluence (meters) d/	Instream Duration (hours) e/	Estimated TSS Concentration at Confluence (mg/l) f/	SEV Score at Confluence g/	Risk of TSS at Confluence by Crossing Tributary (rationale) h/
Trib. to Indian Creek (ASI-222)	125.98	Intermittent	Flume	1	Tributary to Indian Creek	Assumed	2,244	2	5.7	3	None-Low (intermittent)
Trib. to Indian Creek (RS-4)	126.53	Intermittent	Flume	1	Tributary to Indian Creek	Assumed	2,793	2	4.3	3	None-Low (intermittent)
Trib. to Indian Creek (ASI-221)	126.56	Intermittent	Flume	5	Tributary to Indian Creek	Assumed	2,820	2	4.2	3	None-Low (intermittent)
Deer Creek (ASP-307)	128.49	Perennial	Dam-and-Pump	15	Indian Creek	Known	251	4	3.5	3	Moderate-High (perennial)
Trib. to Indian Creek (ASI-277)	129.46	Intermittent	Flume	4	Indian Creek	Known	3,110	2	3.7	2	None-Low (intermittent)
Upper Rogue (HUC 17100307) Subbasin, Big Butte Creek (HUC 1710030704) Fifth field Watershed											
Trib. to Neil Creek (SS-201-14b (AW-244))	130.83	intermittent	Dam-and-Pump	10	Neil Creek	Known	1,437	2	1.9	2	Moderate-High (perennial)
Trib. to Quartz Creek (S5-01/ ASI-265)	132.75	Intermittent	Dam-and-Pump	1	Quartz Creek	Known	82	2	5.5	3	Moderate-High (perennial)
Trib. to Quartz Creek (ASP-241)	133.35	Perennial	Flume	10	Quartz Creek	Known	1,190	2	9.9	3	None-Low (intermittent)
Upper Rogue (HUC 17100307) Sub-basin, Little Butte Creek (HUC 1710030708) Fifth field Watershed											
Whiskey Creek (ASI-207)	137.48	Intermittent	Flume	10	Whiskey Creek	Assumed	2,211	2	5.9	3	None-Low (intermittent)
Trib. To Whiskey Creek (SS-200-006)	137.50	Intermittent	Flume	30	Whiskey Creek	Assumed	2,314	5	5.5	3	None-Low (intermittent)
Trib. to Lick Creek (ASI-208)	138.26	Intermittent	Flume	10	Lick Creek	Assumed	2,400	2	5.2	3	None-Low (intermittent)
Trib. to Lick Creek (SS-GM-9)	138.36	Intermittent	Flume	2	Lick Creek	Assumed	2,420	2	5.1	3	None-Low (intermittent)
Trib. to Lick Creek (SS-GM-10)	138.44	Intermittent	Flume	2	Lick Creek	Assumed	2,436	2	5.0	3	None-Low (intermittent)
Trib. to Lick Creek (ASI-210)	138.50	Intermittent	Flume	10	Lick Creek	Assumed	2,360	2	5.3	3	None-Low (intermittent)
Trib. to Lick Creek (SS-GM-11)	138.55	Intermittent	Flume	2	Lick Creek	Assumed	2,332	2	5.4	3	None-Low (intermittent)
Trib. to Lick Creek (ASI-211)	138.71	Intermittent	Flume	15	Lick Creek	Assumed	2,152	4	6.1	3	None-Low (intermittent)

TABLE 4.3.3-1 (continued)

Downstream Effects of Instream Construction to Waterbodies with Pacific Salmon EFH Due to Crossing Tributaries with No EFH

Waterbodies Crossed and Waterbody ID	Pipeline Milepost (MP)	Flow	Proposed Crossing Method a/	OHM Width (feet) b/	Tributary to Stream with Salmon EFH c/	EFH Known or Assumed at Confluence	Distance from Pipeline Crossing to Confluence (meters) d/	Instream Duration (hours) e/	Estimated TSS Concentration at Confluence (mg/l) f/	SEV Score at Confluence g/	Risk of TSS at Confluence by Crossing Tributary (rationale) h/
Trib. to Lick Creek (SS-GM-13)	138.74	Intermittent	Flume	10	Lick Creek	Assumed	2,145	2	6.2	3	None-Low (intermittent)
Trib. to Lick Creek (S-T04-002A/(SS-GM-14)	139.07	Intermittent	Flume	7	Lick Creek	Assumed	2,318	2	5.5	3	None-Low (intermittent)
Trib. to Lick Creek (S-T04-006/((SS-GM-15)	139.21	Intermittent	Flume	8	Lick Creek	Assumed	2,384	2	5.2	3	None-Low (intermittent)
Trib. to Lick Creek (S-T04-007/(SS-GM-16)	139.28	Intermittent	Flume	5	Lick Creek	Assumed	2,405	2	5.1	3	None-Low (intermittent)
Trib. to Lick Creek (S-T04-008/(ASI-217)	139.42	Intermittent	Flume	10	Lick Creek	Assumed	2,445	2	5.0	3	None-Low (intermittent)
Trib. to Lick Creek (ASI-226)	139.59	Intermittent	Dam-and-Pump	7	Lick Creek	Assumed	2,640	2	1.0	1	Moderate-High (perennial)
Trib. to Lick Creek (ASI-227)	139.63	Intermittent	Dam-and-Pump	2	Lick Creek	Assumed	2,650	2	1.0	1	Moderate-High (perennial)
Trib. to Lick Creek (ASI-228)	139.68	Intermittent	Flume	2	Lick Creek	Assumed	2,692	2	4.2	3	None-Low (intermittent)
Trib. to Lick Creek SS-GM-43 (AW-230))	139.75	Intermittent	Flume	10	Lick Creek	Assumed	2,739	2	4.1	3	None-Low (intermittent)
Lick Creek (ASI-233)	140.27	intermittent	Flume	20	Lick Creek	Assumed	3,095	4	3.2	3	None-Low (intermittent)
Trib. to Lick Creek (ASI-189)	140.58	intermittent	Dam-and-Pump	3	Lick Creek	Assumed	3,860	2	0.4	1	None-Low (intermittent)
Trib. to Salt Creek (ASI-187)	141.18	Intermittent	Dam-and-Pump	3	Salt Creek	Known	1,495	2	2.2	2	None-Low (intermittent)
Trib. to Salt Creek (ASI-188)	141.48	Intermittent	Dam-and-Pump	3	Salt Creek	Known	1,155	2	2.8	2	None-Low (intermittent)
Trib. to Salt Creek (RS-17)	141.49	Intermittent	Flume	4	Salt Creek	Known	1,153	2	12.3	3	None-Low (intermittent)
Trib. to Salt Creek (ESI-30)	141.95	Intermittent	Flume	6	Salt Creek	Known	360	2	21.5	4	None-Low (intermittent)
Trib. to Salt Creek (ESI-31)	142.35	intermittent	Flume	10	Salt Creek	Known	542	2	18.9	4	None-Low (intermittent)
Trib. to Salt Creek (ESI-37)	143.12	intermittent	Flume	4	Salt Creek	Known	1,193	2	12.0	3	None-Low (intermittent)

TABLE 4.3.3-1 (continued)

Downstream Effects of Instream Construction to Waterbodies with Pacific Salmon EFH Due to Crossing Tributaries with No EFH

Waterbodies Crossed and Waterbody ID	Pipeline Milepost (MP)	Flow	Proposed Crossing Method a/	OHM Width (feet) b/	Tributary to Stream with Salmon EFH c/	EFH Known or Assumed at Confluence	Distance from Pipeline Crossing to Confluence (meters) d/	Instream Duration (hours) e/	Estimated TSS Concentration at Confluence (mg/l) f/	SEV Score at Confluence g/	Risk of TSS at Confluence by Crossing Tributary (rationale) h/
Trib. to Long Branch Creek (ESI-38)	143.51	intermittent	Flume	3	Long Branch Creek	Assumed	1,100	2	12.8	3	None-Low (intermittent)
Trib. to Long Branch Creek (ESI-39)	143.74	intermittent	Flume	3	Long Branch Creek	Assumed	782	2	16.0	4	None-Low (intermittent)
Trib. to Long Branch Creek (ESI-40)	143.77	Intermittent	Flume	3	Long Branch Creek	Assumed	620	2	17.9	4	None-Low (intermittent)
Hanley North Canal Irrigation Ditch (EDX-42)	144.14	Intermittent	Flume	2	Long Branch Creek	Assumed	3,288	2	2.8	2	None-Low (intermittent)
Trib. to S. Fork Long Branch GSP-5/ESP-48)	144.70	Perennial	Flume	3	Long Branch Creek	Assumed	2,357	2	5.3	3	None-Low (intermittent)
South Fork Long Branch Creek (GSI-6/ESP-59)	145.27	Intermittent	Flume	3	Long Branch Creek	Assumed	1,770	2	8.0	3	None-Low (intermittent)
Trib. to S. Fork Long Branch (ESI-61)	145.54	intermittent	Flume	14	N. Fork Little Butte Creek	Known	736	4	16.5	4	None-Low (intermittent)
Trib. to N. Fork Little Butte Creek (ESI-55)	146.38	intermittent	Flume	3	N. Fork Little Butte Creek	Known	695	2	17.0	4	None-Low (intermittent)
South Fork Little Butte Creek (ASP-165)	162.45	Perennial	Flume	30	S. Fork Little Butte Creek	Assumed	5,866	5	0.5	1	None-Low (intermittent)

a/ Only waterbodies crossed by dry open-cut construction (fluming or dam-and-pump at streams with bedrock substrates) are included.

b/ OHM – ordinary highwater mark provided in wetland and waterbody delineation surveys. OHM is assumed to be the width of the waterbody during instream crossing period.

c/ These streams are either known to support coho with information from ODFW (2017f) or assumed to support coho if steelhead occur.

d/ Distance measured digitally on USGS topographic base maps with Forest Practices statewide hydrography (ODF 2018) superimposed.

e/ Instream durations based on stream widths, see table 3.5.3-21 (SONCC coho) and table 3.5.4-26 (Oregon Coast coho).

f/ Estimated TSS concentrations derived from watershed-specific equations in table 3.5.3-20 (SONCC coho) and table 3.5.4-25 (Oregon Coast coho) with relationships between distance downstream (x) and TSS concentration (y) for fluming and dam-and-pump construction.

g SEV score at the confluence of EFH stream and tributary crossed during construction derived by applying duration of exposure (hours) and TSS concentration (mg/l) in Newcombe and Jensen (1996) Model 1 for juvenile and adult salmonids.

h/ Risks from downstream TSS by crossing all streams with bedrock substrate are considered None to Low; risks of downstream TSS crossing intermittent streams are considered None to Low; risks from downstream TSS by crossing perennial streams are considered Moderate to High.

Every waterbody crossed during construction is eventually connected to an EFH stream. However, downstream distances to an EFH stream may be too large to warrant any meaningful evaluation such as provided in table 4.3.3-1. That was the case for all waterbodies crossed in the Upper Cow Creek watershed. In table 4.3.3-1, risks from downstream TSS by crossing any stream with a bedrock substrate are considered "None-Low" because fine sediment (silt and clay) would not be mobilized in the water column; risks of downstream TSS crossing intermittent streams are considered "None-Low" because those streams would likely be dry during the in-stream construction period (ODFW 2008); risks from downstream TSS by crossing perennial streams are considered "Moderate-High" because flowing water would be present at the time of construction. The highest risk for SEV = 5 (causing minor physiological stress) would occur at the confluence of a tributary to Big Creek (Middle Fork Coquille River watershed), assumed to support coho and EFH because it is occupied by steelhead. All other SEV values at a tributary's confluence to an EFH stream are SEV ≤ 4. However, the estimated TSS concentration at any tributary confluence would be diluted by greater flow rates and water volumes in larger EFH streams and therefore the estimated SEV in the EFH stream would be considerably less than at the confluence.

Suspended Sediment – Other Crossing Methods

The other crossing methods include two HDDs (including the Coos River, discussed above, and the Rogue River), one diverted open cut, and one DP (both in the South Umpqua River). These methods would all be used on large streams containing both coho and Chinook salmon. Considering the low likelihood of elevated sediment from these crossings, the potential for rapid dilution of any excess sediment discharge (e.g., HDD inadvertent return) because of substantial flow in these streams and construction and contingency plans in place (e.g., Drilling Fluid Contingency Plan for Horizontal Directional Drilling Operations), and other factors noted in sections 3.5.3.3 (SONCC coho) and 3.5.4.3 (Oregon Coast coho) no adverse effects to Pacific salmon EFH from elevated levels of suspended sediment is expected to occur at these crossings.

4.2.3.3 Movement Blockage

Dry open-cut construction is expected to cause short-term inhibition of upstream movement by adult salmon, as well as within-stream movements of juvenile coho and Chinook salmon. Restrictions on migration could occur from short-term elevation of suspended sediment and the method of water diversion around the stream crossing area. The fluming process is expected to require from 36 to 96 hours of in-stream work, and dam-and-pump construction is expected to require between 20 and 56 hours of in-stream work. Short-term elevation of turbidity could delay upstream movements during this period. Flume sites would allow some upstream and downstream movement, but complete movement restrictions would occur at dam-and-pump sites. Overall, the levels of suspended sediment and physical structures would not cause lengthy delays to adult coho or Chinook salmon migrating upstream, resulting in unsubstantial effects to the EFH of Pacific salmon.

4.2.3.4 Entrainment and Entrapment

Waterbody crossings using the "dry" crossing methods (i.e., flume or dam-and-pump) may result in some rearing coho and Chinook salmon juveniles being entrapped in streams during fluming or dam-and-pump installations. For typical crossings, once streamflow is diverted through the flume pipe, but before trenching begins, fish trapped in any water remaining in the work area between the dams would be removed and released (salvaged) using the *Fish Salvage Plan* (see appendix T).

Salvage methods, which all have a risk of fish injury or mortality, could include seining, dip netting, and electrofishing (see section 4.3.3). Fish not removed successfully could be entrained or impinged in water removal pumps. Overall, some juvenile coho and Chinook salmon are likely to suffer injury or mortality, but with the implementation of Project conservation measures, the numbers would be slight, resulting in a short-term adverse effect to the EFH of Pacific salmon.

4.2.3.5 Riparian Vegetation Removal and Modification

Aquatic resources associated with the EFH of Pacific salmon could be affected as a result of removal of vegetation and habitat at the waterbody crossing sites, as required for pipeline construction and associated facilities. In areas of riparian vegetation, Pacific Connector would narrow to a 75-foot-wide construction right-of-way at waterbody crossings, and maintain a setback between waterbody banks and TEWAs in forested areas. As discussed in sections 3.5.3.3 (SONCC coho) and 3.5.4.3 (Oregon Coast coho), various actions would be taken to reduce the loss of vegetation and restore the habitat. The ECRP (see appendix F) describes the procedures that would be implemented to minimize erosion and enhance revegetation success for the entire Project.

Restricting the low-growth vegetation area to a small portion of the total riparian right-of-way clearing would allow much of ecological function of the riparian conditions to continue. This would limit the overall long-term impacts from loss of riparian habitat to a small portion of each stream crossed, reducing future negative effects to Pacific salmon resources. Some limited intermediate-term adverse effects to salmon habitat function would remain, primarily relating to LW reduction. The effects of riparian vegetation removal on water temperature and LW are presented below.

Water Temperature

Clearing the right-of-way would remove shading vegetation from uplands and riparian areas, exposing the land and water to increased sunlight, potentially resulting in direct increases in water temperatures. Additionally, indirect increases in stream water temperatures may occur as water flows over the warmer land surface and eventually reaches the waterbody (Beschta and Taylor 1988). The details of the literature and model assessments of likely temperature changes and effects to EFH are presented in sections 3.5.3.3 and 3.5.4.3. The main conclusion is that water temperature changes to fish-bearing streams from clearing would be slight, possibly a few tenths of a degree Celsius increase. These increases would not be biologically significant, and would result in no substantial adverse effect to Pacific salmon EFH.

Large Wood

A potential effect that would result from forest clearing at waterbody pipeline crossings is the reduction of LW in streams and on adjacent uplands (Harmon et al. 1986; Sedell et al. 1988). Existing conditions associated with riparian vegetation within all fifth-field watersheds in the range of the Oregon Coast and SONCC coho salmon ESUs are generally undesirable. Streams in these watersheds are generally deficient in LW. Though most of crossings have less than mature sources of LW, the Project would remove some of these sources, primarily by clearing the 75-foot-wide right-of-way and maintaining a portion of this area in less than mature forest conditions. Pacific Connector has proposed to use on-site mitigation for impacts to waterbodies by installing LW at appropriate agency and landowner-approved areas within the construction right-of-way across certain waterbodies (see section 4.3.3). Long-term losses of LW input would largely be mitigated through riparian replanting of conifers in the right-of-way, as discussed at the beginning of section 4.2.3.5. While there may be some reduction in total stream LW between the short and long-term, the amount would be relatively small considering the total area that could be affected (75- to 95-foot channel), and the mitigation and enhancements that would be implemented (see section 4.3.3), so that LW changes would result in minor intermediate-term adverse effects to the EFH habitat of Pacific salmon.

4.2.3.6 Streambank Erosion and Streambed Stability

The clearing and grading of the right-of-way during construction could increase erosion along streambanks, resulting in higher turbidity levels in the waterbodies crossed. Alteration of the natural drainage ways or compaction of soils by heavy equipment near streambanks during construction may accelerate erosion of the banks, increase runoff, and induce the transportation of sediments into waterbodies. Stream crossings that are unstable can adversely affect aquatic resources through loss of local habitat, and impacts to downstream habitat from the addition of highly unstable sediment. This increases the recovery time of the specific site to stable conditions.

Because of the Services' concerns for potential adverse effects to bank and bed stability, Pacific Connector has conducted an initial assessment of crossing conditions of all streams suitable for analysis, based on the FWS risk matrix (GeoEngineers 2017d and 2017e). Based on this analysis, no crossing was rated as having both a high risk of Project impact potential and high risk of stream and site response potential within the range of Pacific salmon. Reassessment of the risk would occur prior to construction. Additionally, Pacific Connector would include additional mitigative actions at the higher risk crossings to help reduce the potential for impacts, including post-construction monitoring of all crossings (see sections 3.5.3.3 and 3.5.4.3). Additional site-specific plans would be developed at selected sites to aid ensuring stream habitat protections. Overall, these actions would reduce potential adverse effects from bank and bed stability to unsubstantial levels for the EFH of Pacific salmon.

4.2.3.7 Aquatic Habitat

There also are potential, indirect effects to aquatic habitat from increased suspended sediment from stream crossings. The most likely effect of suspended sediment increases downstream would increase embeddedness of spawning gravels, with increasing habitat effects closer to the construction location. Considering the estimates of likely suspended sediment levels, some measured change in habitat preference may occur but it would not reach the level of moderate habitat degradation. Where uninterrupted dry open-cut construction occurs, indirect adverse effects to Pacific salmon EFH from crossing-induced suspended sediment are thus not expected.

4.2.3.8 Freshwater Stream Invertebrates

Substrates downstream from in-stream construction sites could be impacted by sediments. Mayflies, caddisflies, and stoneflies prefer large substrate particles in riffles, and are adversely affected by fine sediment deposited in interparticulate spaces (Cordone and Kelley 1961; Waters 1995; Harrison et al. 2007). Fish and benthic macroinvertebrate abundances downstream of pipeline construction sites have been reported as short-term reductions (Reid and Anderson 1999). However, rapid colonization by benthic organisms of disturbed substrate following pipeline construction has been demonstrated in several studies (see section 3.5). Most studies finding effects to benthic resources were from wet open-cut crossings, which have much higher sediment levels (see sections 3.5). Therefore, the overall level of effects of the pipeline crossings on waterbodies, unless crossing sealing failures occur, would be even less than that noted by literature, and would not result in substantial reduction in growth or survival of salmon individuals.

4.2.3.9 Hydrostatic Testing

Water would be required on a one-time basis near the end of construction to hydrostatically test the pipeline. Potential impacts associated with hydrostatic testing include entrainment of fish, reduced downstream flows, impaired downstream uses if test water is withdrawn from surface waters, and erosion, scouring, and a release of chemical additives as a result of test water discharge. Pacific Connector would minimize the potential effects of hydrostatic testing on these watersheds by adhering to the measures in its *Hydrostatic Test Plan* (see appendix U), including screening intake hoses to prevent the entrainment of fish and other aquatic organisms. See sections 3.5.3.3 (SONCC coho) and 3.5.4.3 (Oregon Coast coho) for *Hydrostatic Test Plan* details of water withdrawal locations and effects to salmon streams. Additionally, where water cannot be returned to the original water source, it would be discharged upslope (at least 150 feet from streams with no direct discharge features) to prevent direct water return to the stream. Pacific Connector would obtain all necessary appropriations, withdrawal, and discharge permits through the OWRD. With the implementation of these plans and BMPs, and through obtaining and complying with required permits, we have determined that adequate measures would be in place to prevent direct or indirect adverse effects to Pacific salmon EFH.

4.2.3.10 Aquatic Nuisance Species

NAS are aquatic species that degrade aquatic ecosystem function and benefits, in some cases completely altering aquatic systems by displacing native species, degrading water quality, altering trophic dynamics, and restricting beneficial uses (Hanson and Sytsma 2001). Some of the major potential freshwater invasive species are mussels, including the zebra and quagga mussels (*Dreissena polymorpha* and *Dreissena rostriformis bugenisis*), as well as Chytrid fungus and other species of concern. Management priorities in Oregon concentrate on the species whose current or potential impacts on native species and habitats, and economic and recreational activity in Oregon, are known to be significant (Hanson and Sytsma 2001). See sections 3.5.3.3 (SONCC coho) and 3.5.4.3 (Oregon Coast coho) for details on procedures that would be implemented to reduce potential for aquatic nuisance species transfer from freshwater construction activity.

Aquatic nuisance species could potentially be introduced into Project area waters by basin transfer through hydrostatic testing waters, or be carried on equipment that is moved from outside of the region or between basins. Pacific Connector has developed BMPs and guidelines to avoid the potential spread of the aquatic invasive species and pathogens of concern (see *Hydrostatic Test Plan* in appendix U). To prevent the introduction of aquatic nuisance species, Pacific Connector may follow the guidelines of this plan during construction. With the implementation of the details of this Plan and other procedures, introduction of non-native species or movement of species between basins should not occur, resulting in no adverse effects to Pacific salmon EFH.

4.2.3.11 Fuel and Chemical Spills

Fisheries habitats could be adversely affected if petroleum products were accidentally discharged into aquatic environments. Such materials are toxic to algae, invertebrates, and fish. Of the products likely to be present during construction, data compiled from a wide range of sources indicate that diesel fuels and lubricating oils are considerably more toxic to aquatic organisms than other, more volatile products (gasoline) or heavier crude oil (Markarian et al. 1994). Inadvertent spills of fluids used during construction, such as fuels and lubricants, could contaminate wetland soils and vegetation. To minimize the potential for spills and any impacts from such spills, Pacific Connector's SPCCP (see appendix L) would be implemented. In general, hazardous materials, chemicals, fuels, lubricating oils, and concrete-coating activities would be not be stored, nor would refueling operations be conducted within 100 feet (150 feet on BLM and Forest Service lands) of a wetland or waterbody in accordance with FERC's *Procedures* (see appendix C) and the SPCCP (see appendix L), except where no reasonable location is possible and additional containment steps have been taken. The SPCCP would be updated with site-specific information prior to construction. Adherence to these plans and procedures would result in effects to the Pacific salmon EFH that would be unsubstantial.

4.2.3.12 Operation and Maintenance Activities

Once the pipeline is installed, maintenance would include activities such as aerial inspections, gas flow monitoring, visual inspection of surrounding vegetation for signs of leaks, and integrity management, which includes smart pigging to investigate the interior surface of the pipe for any signs of stress cracking, pitting, and other anomalies (see the ECRP in appendix F). All of the proposed maintenance activities would be outlined in the Operations and Maintenance Plan that would be prepared according to operating regulations in USDOT 49 CFR Subpart L, Part 192, and would be completed prior to going in-service. These general maintenance activities would require only surface activities and usage of the existing right-of-way, such as insertion of the pig (an internal pipeline cleaning and inspection tool) at one of the pig launching facilities.

Within stream sites, repair work could require isolated flow from the section of pipe that is to be exposed. Impacts would be similar to those discussed above for initial installation, except on a much smaller scale. Repairs that may need to occur outside the fish window period would likely have more site-specific effects to EFH fish resources. Standard BMPs would be followed and needed permits would be obtained to aid in reducing impacts. Very limited effects would occur to riparian areas if repairs were needed, as a portion of the right-of-way would be permanently maintained as largely vegetation free. No vegetation or tree limitations would occur beyond the 30-foot-wide corridor in riparian areas (i.e., up to 100 feet of streams on federal lands, and 25 feet on non-federal lands).

Herbicide Application

Herbicides have the potential to cause toxic effects to different salmonid life stages and to other aquatic species, causing direct impacts if used improperly. As discussed in sections 3.5.3.3 (SONCC coho) and 3.5.4.3 (Oregon Coast coho), Pacific Connector would not use herbicides for routine vegetation maintenance, but instead would employ hand and mechanical methods (pulling, mowing, biological, disking, etc.) to prevent the spread of potential weed infestations where feasible, and implement management plans specific to land ownership to ensure proper use and to prevent entry of herbicides into streams. The BMPs would minimize the potential spread of invasive species and minimize the potential adverse effects of control treatments. Herbicides would not be applied by aerial or broadcast spraying. With the implementation of the BMPs, elimination of use of herbicides near streams, and only selective use of these chemicals in areas away from streams, meaningful negative effects to Pacific salmon EFH from herbicides would be unlikely to occur.

4.3 CONSERVATION AND MITIGATION MEASURES

All avoidance, minimization, BMP, and mitigative actions that may reduce, avoid, eliminate, or otherwise offset adverse effects to EFH are considered here as EFH conservation measures for the Project. The conservation and mitigative measures described in section 3.5 and incorporated into the text descriptions of the potential effects for the four ESA listed fish species would also apply to the four FMP fish EFHs. These ESA fish conservation measures address the same concern of potential Project-induced adverse effects to habitat for the four FMP fish groups, because portions of the four ESA fish habitat uses overlap in the three Project analysis areas: marine, estuarine, and riverine. Conservation measures for the marine would benefit the EFH of all four FMP fish species; the conservation measures used in the estuarine analysis area would benefit all but the highly migratory EFH; and the measures applied in the riverine analysis area would aid Pacific salmon EFH. While the details of the conservation measures are provided under each of the four ESA-listed species, a summary of the most relevant that apply in each of the three analysis areas is provided below.

4.3.1 Marine Conservation Measures – All Four FMP EFH

- Federal Water Pollution Control Act prohibits discharge of oil in U.S. waters.
- Requirement of all U.S. port vessels to have an SPCCP to address spills.

4.3.2 Estuarine Conservation Measures – Coastal Pelagic, Groundfish, and Pacific Salmon EFH

- Perform all slip, access channel, and marine waterway modifications during lower abundance of the most susceptible fish life stage of the Pacific Coast Salmon Management Group, October 1 through February 15.
- Implement a water quality monitoring program during dredge operations to assess the need for operational controls that ensure turbidity levels remain within seasonal permitted limits.
- Implement operational controls to ensure compliance with water quality criteria in the CWA Section 401 Certification, which may include ceasing dredging, decreasing cutterhead speed, increasing suction flow rates and using a different size or type of dredge, lowering the crest elevation, and/or avoiding sediment stockpiling during peak ebb conditions.
- For the LNG facility, implement a site-specific SPCCP to minimize the potential for accidental releases of hazardous materials.
- During the initial year(s) of operations, monitor LNG carrier transits in Coos Bay to confirm speeds of four to six knots.
- Conduct LNG carrier ballast water exchanges to include both flushing and treatment prior to entering U.S. waters to reduce the transfer of invasive species to the Coos Bay ecosystem.
- Provide low intensity lights on docks and consult on final design to best ensure lighting minimizes conditions that could result in fish attraction or predation.
- To the extent possible, use a vibratory hammer to avoid adverse in-water noise effects. Minimize the use of impact driving except for proofing in-water piles.
- Use sound attenuation measures to minimize adverse in-water noise effects from pile driving with an impact hammer;

- Limit total impact strikes per day to less than 3,000 or another amount determined in consultation with NMFS for in-water piles.
- Conduct much of the slip excavation in the dry out of estuarine waters to reduce effects of turbidity and sedimentation on small forage fish with low swimming ability and on other benthic and epibenthic prey species.
- Implement *Hydrostatic Test Plan* methods to equipment use and cleaning to reduce invasive species spread or entry to the estuary.
- Mitigate for construction that would involve the loss of intertidal and subtidal habitat by restoring habitat at a 3:1 ratio in Kentuck Slough, and for eelgrass lost by planting eelgrass at a 3:1 ratio (appendix O.1 – Compensatory Wetland Mitigation Plan).

4.3.3 Riverine Conservation Measures – Pacific Salmon EFH

- Employ extensive erosion control methods including temporary and permanent slope breakers, sediment barriers, mulch, and erosion control fabric.
- Conduct long-term erosion control including final cleanup, final grading, installation of permanent erosion control structures, backfilling and regrading as necessary, and timely preparation of suitable seedbed.
- Add OHV barriers to reduce post-construction sediment to streams.
- Perform revegetation including tree seedlings and replanting conifers where appropriate within 15 feet of the right-of-way center, which would aid future stream shading, organic input, and future LW supply.
- Retain stumps on stream banks to improve intermediate-term stream bank stability.
- Narrow the right-of-way to 75 feet at most stream crossing to reduce loss of riparian vegetation and function.
- Perform stream bank restoration following trenching including returning banks to preconstruction contours where possible and revegetation (see the ECRP).
- Procedures are in place to keep all petroleum products away from stream entry.
- Provide special additional BMPs at stream crossings that have moderate to high risk of channel or stream bank instability resulting from stream morphology or crossing methods at the specific location.
- Provide post-construction monitoring of all stream crossing sites to ensure streambed and bank conditions remain stable.
- Backfill the surface foot of the excavated stream channel with gravel or native cobble except where stream channels did not have this as native material.
- Follow the *Fish Salvage Plan* details including use of collection methods and procedures that would reduce injury and mortality of fish at pipeline crossings and remove fish from potential adverse noise and blasting effects.
- Return removed LW to the streams following installation and provide additional LW to fish streams and banks to help maintain or enhance the habitat (see appendix O.3).
- Additional mitigation to help maintain the ACS on NFS lands (see appendix O.4 to this BA and table 2.1.5-1 of the EIS [FERC 2019]) would also occur that would have direct and indirect benefits to EFH habitat on these lands. This would include actions in watersheds that contain EFH such as:
  - add LW to several stream miles
  - restore degraded riparian habitat;

- improve fish passage at existing passage barriers;
- improve roads and stabilize culverts; and
- stormproof roads (e.g., waterbars, ditch cleaning) reducing risk of road failure that would add fine sediment to streams.

4.4 EFFECTS DETERMINATION

4.4.1 Highly Migratory Species EFH

The Project **would not adversely affect** EFH for highly migratory species because accidental spills and releases at sea, if they should occur, are not expected to diminish water quality within the marine analysis area. The volumes of hydraulic oil and fuel spills from a single LNG carrier would be very small in relation to the size of the ocean.

4.4.2 Coastal Pelagic Species EFH

The Project **may adversely affect** EFH for coastal pelagic species in the short term due to loss of eelgrass habitat until such habitat is re-established at the Eelgrass Mitigation site and until disturbed estuarine habitat is restored and recovers. Short-term loss of benthic food resources would also result from construction and maintenance dredging of the access channel and marine waterway modifications areas. Small juvenile and larval stages of fish could be entrained or impinged and suffer mortality from the cooling water intakes of LNG carriers while at berth; but a substantive loss is unlikely.

4.4.3 Groundfish EFH

The Project **may adversely affect** EFH for groundfish species in the short term due to loss of eelgrass habitat until such habitat is re-established at the Eelgrass Mitigation site and until disturbed estuarine habitat is restored and recovers. Short-term loss of benthic food resources would also result from construction and maintenance dredging of the access channel and marine waterway modification areas. Over the long term, eggs, larval, and small juvenile life stages of fish occupying waters near the LNG carriers at the terminal dock could be entrained or impinged, and suffer mortality by cooling water intakes, but a substantive loss is unlikely.

4.4.4 Pacific Salmon EFH

Effects to freshwater Pacific Coast Salmon EFH by the Project **may adversely affect** riverine habitats by impacting substrates and suspended sediment water quality over the short term, as well as by removal of riparian vegetation, which could affect LW supply over the long term. Also, juvenile coho or Chinook salmon entrapped in isolated areas at pipeline stream crossings, as well as removal from stream crossing areas, would result in minor fish mortalities. Short-term loss of benthic food resources would also occur from construction and maintenance dredging of slip and access channel, marine waterway modification areas, and other bay sites. Juvenile salmon stages could be entrained or impinged, and suffer mortality from cooling water withdrawal in the estuary.

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