Pool and chute layout

- Dam Crest
- High fish passage design flow
- Passage Corridor
- Shoulder slope
- Shoulder height
- Shoulder
- Notch
- Orifice (larger fishways)
Town Dam
Rkm 475
Spring Chinook; 1991, 92
Spring Chinook radio tracking; 1991, 92

Roza Dam
Rkm 425
Rate 20-25 km/day

Prosser Dam
Rkm 370
Rate 10 km/day
Pool and Chute Fishway Characteristics

- + Wide flow range
- + Shorter pools than pool and weir
- + Variety of passage paths and conditions
- + Less vulnerable to debris problems
- + No additional entrance or auxiliary water
- - High energy hydraulics are precarious. Use at low head only or study more.
- - No fishway bends
Roughened Channel Fishways

Alaska Steeppass

Denil

Alden Lab pic
Denil Fishway

Baffle angle: 45°

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<thead>
<tr>
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<th>a</th>
<th>b</th>
<th>c</th>
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<td>4'</td>
<td>2'-4&quot;</td>
<td>2'-0&quot;</td>
<td>12&quot;</td>
<td>2'-9&quot;</td>
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<tr>
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<td>1'-9&quot;</td>
<td>2'-6&quot;</td>
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</tr>
<tr>
<td>2'</td>
<td>1'-2&quot;</td>
<td>1'-0&quot;</td>
<td>6&quot;</td>
<td>1'-4&quot; 65&quot;</td>
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</tbody>
</table>
Denil fishway
In NW Primarily for temporary passage

Rivermill, Clackamas, R.
D. Cramer pic
Alaska Steeppass Fishway
Alaska Steeppass fishway
In NW Primarily for trapping and sorting
Denil, Steeppass Fishway Summary

- + Low flow; depends on style, dimensions, slope
- + Good attraction at low tailwater
- - Backwater drowns attraction
- - Narrow operating flow range
- + Inexpensive, portable, modular
- + Steep slopes
- - Vulnerable to debris blockage
- - Turbulence may block small fish
- - Not generally accepted in NW for permanent passage installations
“Natural” Roughened Channels

Bypass channel
Denmark
The objective…
Chutes and Pools Roughened Channel

S. Platte R.
Denver
Roughened Channel
Fishway Design Parameters

- Diversity of hydraulics and migration paths
- Chutes and pools or continuous
- Calculate hydraulics; velocity, depth, length
- Roughness pattern, scale, and source
- Stability; semi-rigid structure
- Bed seal and construction practices
- Recreation safety
Mechanical Lifts

- Locks
- Lifts
- Trams
- Trap and Haul
Locks and Lifts

Fish Lock

- Lock
- Gate
- Crowder
- Follower
- Channel or flume
- Water supply
Lock (France)
Trap and Haul

Fish loading hopper
Former Baker Hopper
Sunset Falls Fishway
Mechanical Fish Lift Characteristics

- Nothing volitional here
- ++ Unlimited slope, height, distance
- + Applicable to wide variety of fish species
  – Problematic for lamprey
- - Mechanical flow control required
- - High capital, maintenance, and operating costs
- - Potential for mechanical failure
- Entrance, trapping holding, auxiliary water required
Fishway Flow Control

Fishway flow control limits fishway flow to operating range.

Fish passage design flow range  Fishway hydraulic limitations range

Flow control

Styles of flow control
• Spillway control
• Self adjusting
• Orifice or vertical slot control
• Adjustable weirs
• Multi-level outlet
Spillway Flow Control
Self Adjusting Flow Control
Vertical Slot
Flow Control
Section
Fishway with Orifice Flow Control (or vertical slot)

High Forebay normal

Low Forebay

Dam

Orifice Flow Control
HFB: 26 cfs
LFB: 8 cfs

Fishway 26 cfs

Auxiliary Water
HFB: Off
LFB: 18 cfs
Orifice flow control
Lock with Orifice Flow Control

High Forebay

Low Forebay

Orifaces

Variable bleed-off

Lock
Multi-Level Outlet
Adjustable Weirs
Fishway Exit

- Debris protection
  - Trash rack, cleaning
  - Velocity
  - Automatic closure
- Fish passage
  - Open dimensions
  - Location
    - Avoid bedload deposition
    - Fish guidance to avoid fallback
      - Bankline
      - Flow pattern
      - Guide wall
Exit guide wall
DOWNSTREAM FISH PASSAGE

Bryan Nordlund, P.E.
National Marine Fisheries Service
Lacey, Washington

Note: this presentation represents the views of the presenter based on fishway design experience in working for NMFS
Positive Exclusion Fish Screen and Bypass Criteria

- Originally developed by NMFS and WDFW
- Current (July 2011) version has been adopted by FSOC for use in waters inhabited by anadromous salmonids in OR, WA, ID and MT.
- Available at: http://www.nwr.noaa.gov/Salmon-Hydropower/FERC/upload/Fish-Passage-Design.pdf
Fish Screen Criteria

- A second basic principle is that fish that avoid the screen will be swept downstream towards the bypass at a rate exceeding the screen approach velocity.
- This principle has not been specifically tested scientifically. Rather, this has been verified by successful screen and bypass testing and refinement of screen and bypass designs over the years.
Top 5 - Fish Screen and Bypass Criteria

- 0.4 ft/s max screen approach velocity
- 0.8 ft/s min sweep velocity, suggest 2-3 ft/s
- No deceleration or rapid acceleration along screen face or into bypass
- Proven screen cleaner (most screens)
- 3/32” circular or square openings, 1.75 mm slotted openings
The “Design” Fish – for NWR Criteria

- Pacific Salmon and Steelhead fry
- Downstream-migrating salmonids
- Passage barriers and screens
Objective

Practical Knowledge of:

1. Hazards for fish
2. Biological basis of design
3. Educate participants in project
4. Data requirements
5. Apply design data
6. Screen types
7. Screen materials
8. Perform calculations
9. Draw conceptual layouts
10. Expedite permit review process
1. The Typical Water Diversion
2. Swimming Capabilities of Juvenile Salmonids
3. Behavior of Juvenile Salmonids
4. Basic Methods of Guiding Juvenile Salmonids
5. Design Objectives