



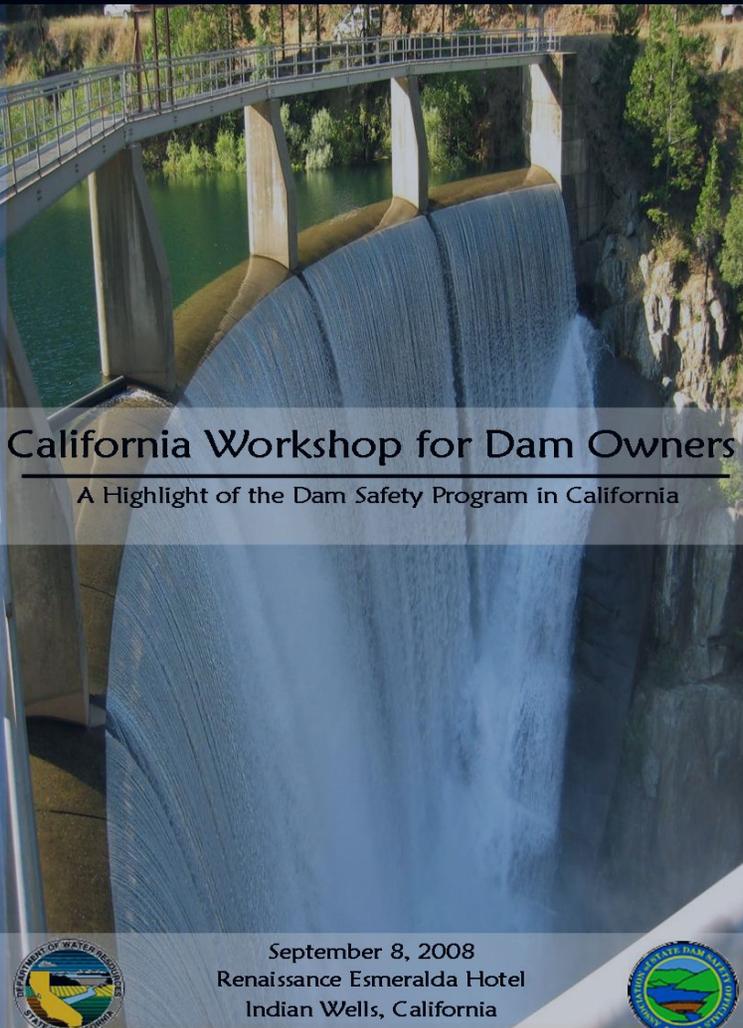
Western Regional Dam Safety Forum

Hydrology Program Update

January 15th 2009

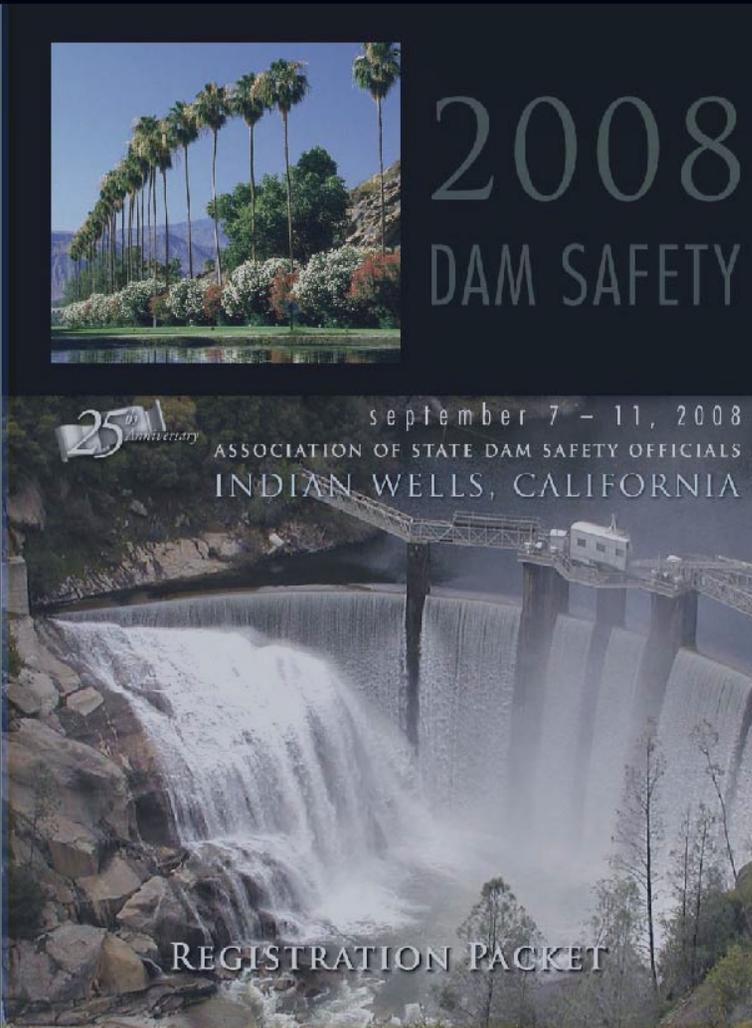
Y-Nhi Enzler, PE
Design Engineering Branch
California Division of Safety of Dams

2008 Dam Safety Conference



California Workshop for Dam Owners
A Highlight of the Dam Safety Program in California

September 8, 2008
Renaissance Esmeralda Hotel
Indian Wells, California

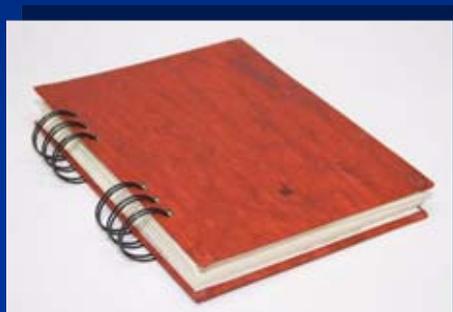


**2008
DAM SAFETY**

25th Anniversary
september 7 - 11, 2008
ASSOCIATION OF STATE DAM SAFETY OFFICIALS
INDIAN WELLS, CALIFORNIA

REGISTRATION PACKET

Hydrology Program Update



Hydrology Manual



Design Flood



Spillway Size



Nacimiento Spillway

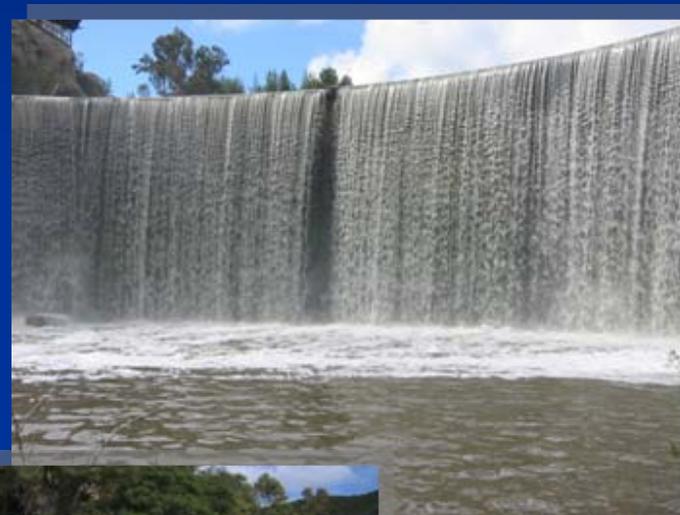


Camp Far West Diversion Spillway



Agenda

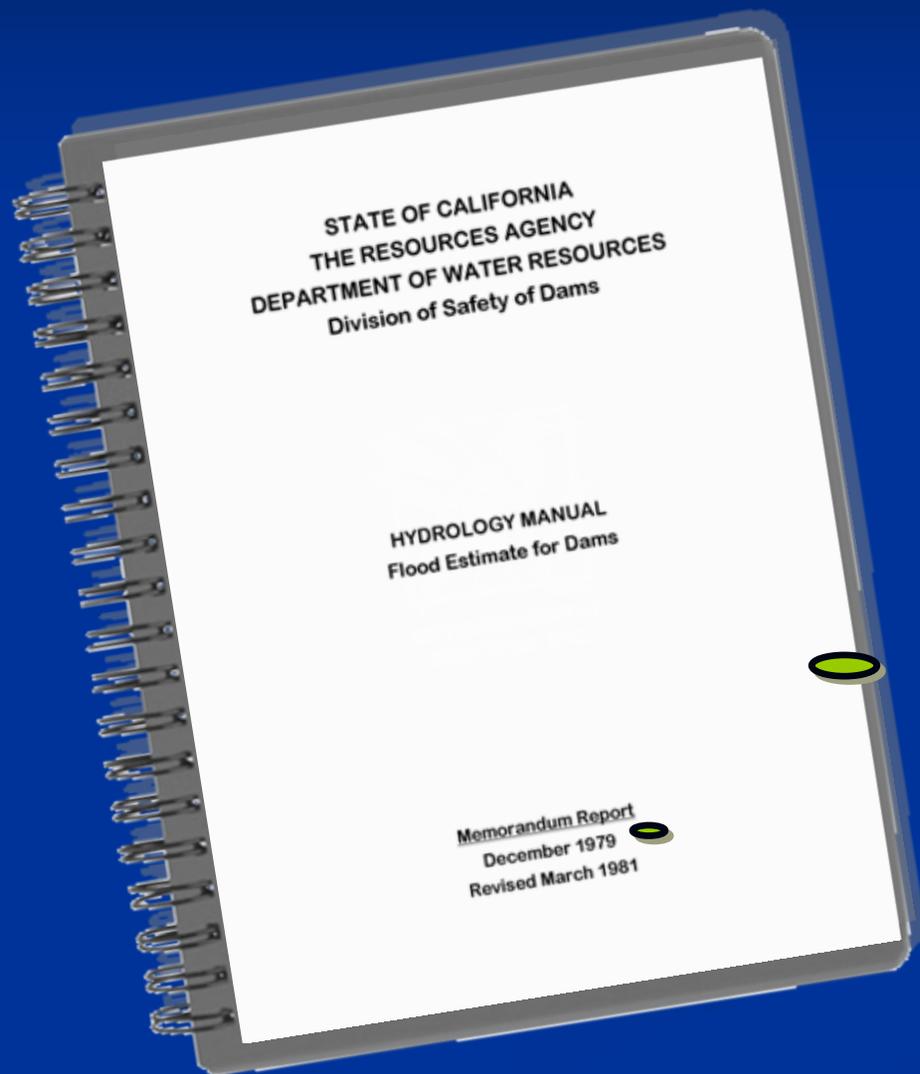
- Why ?
- Components
- Status of Update
 - Work Completed,
 - In-Progress &
 - Future Work.



Malibou Lake
Club Dam



Hydrology Update Program



Memorandum Report
December 1979
Revised March 1981





Past Supporting Reports

April
1979

HYDROLOGIC AND SPILLWAY
PERFORMANCE DATA

Third Edition

April 1979

*Division of
Safety of Dams*

California Department of Water Resources



September
1970

RARE FLOOD ESTIMATES
FOR SMALL UNGAGED WATERSHEDS
IN CALIFORNIA

September 1970

*Division of
Safety of Dams*

California Department of Water Resources





Need for an Update

- Manual almost 30 years old & support data is almost 39 years old.
- No use of stream flow discharge.
- Design Precipitation exceeding the PMP.
- Coarse assumption of parameters within the statistical distribution method.
- High return periods meaningful?
- Equations for watershed routing may be obsolete.

DSOD Hydrology Committee





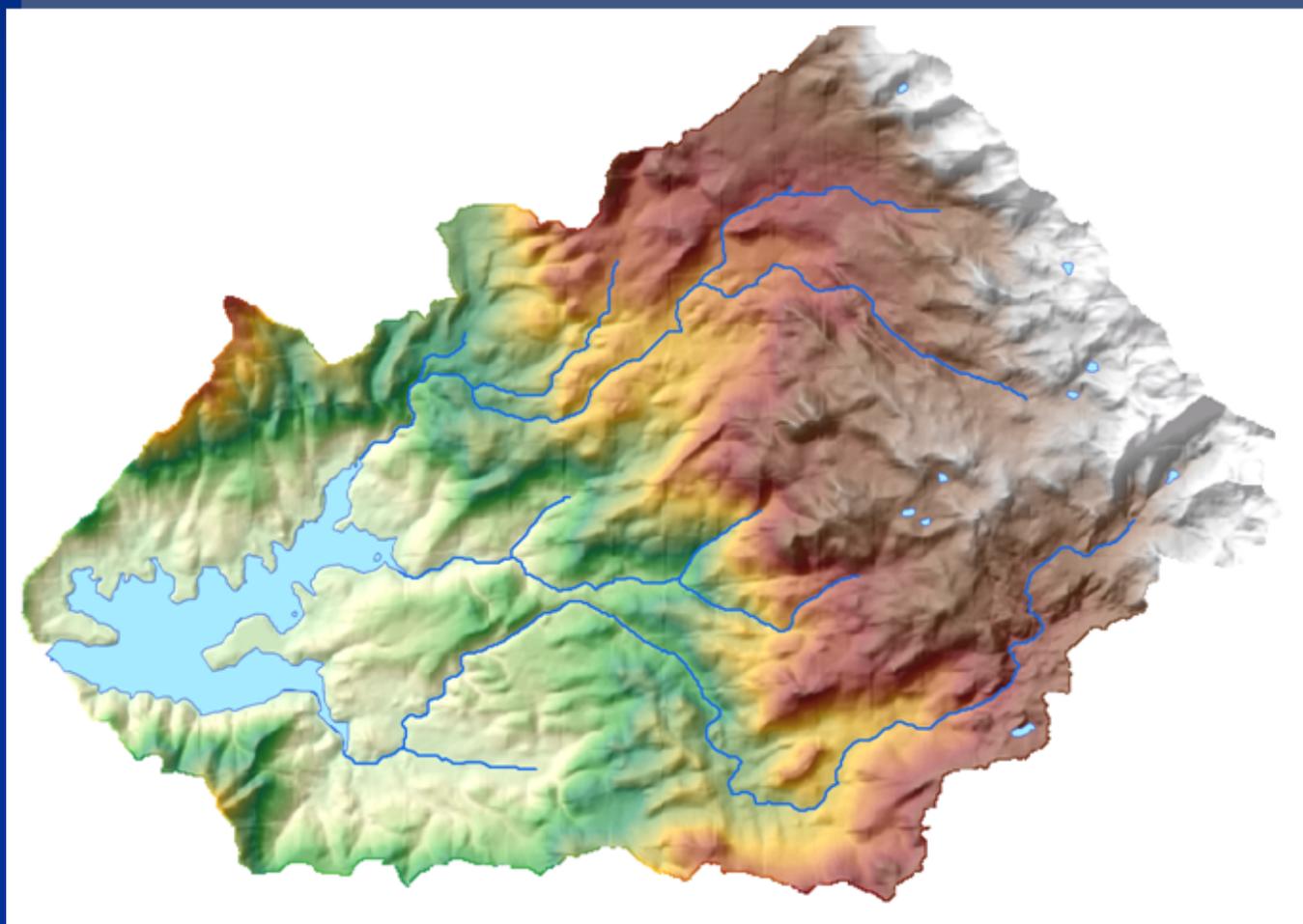
HEC-HMS Training



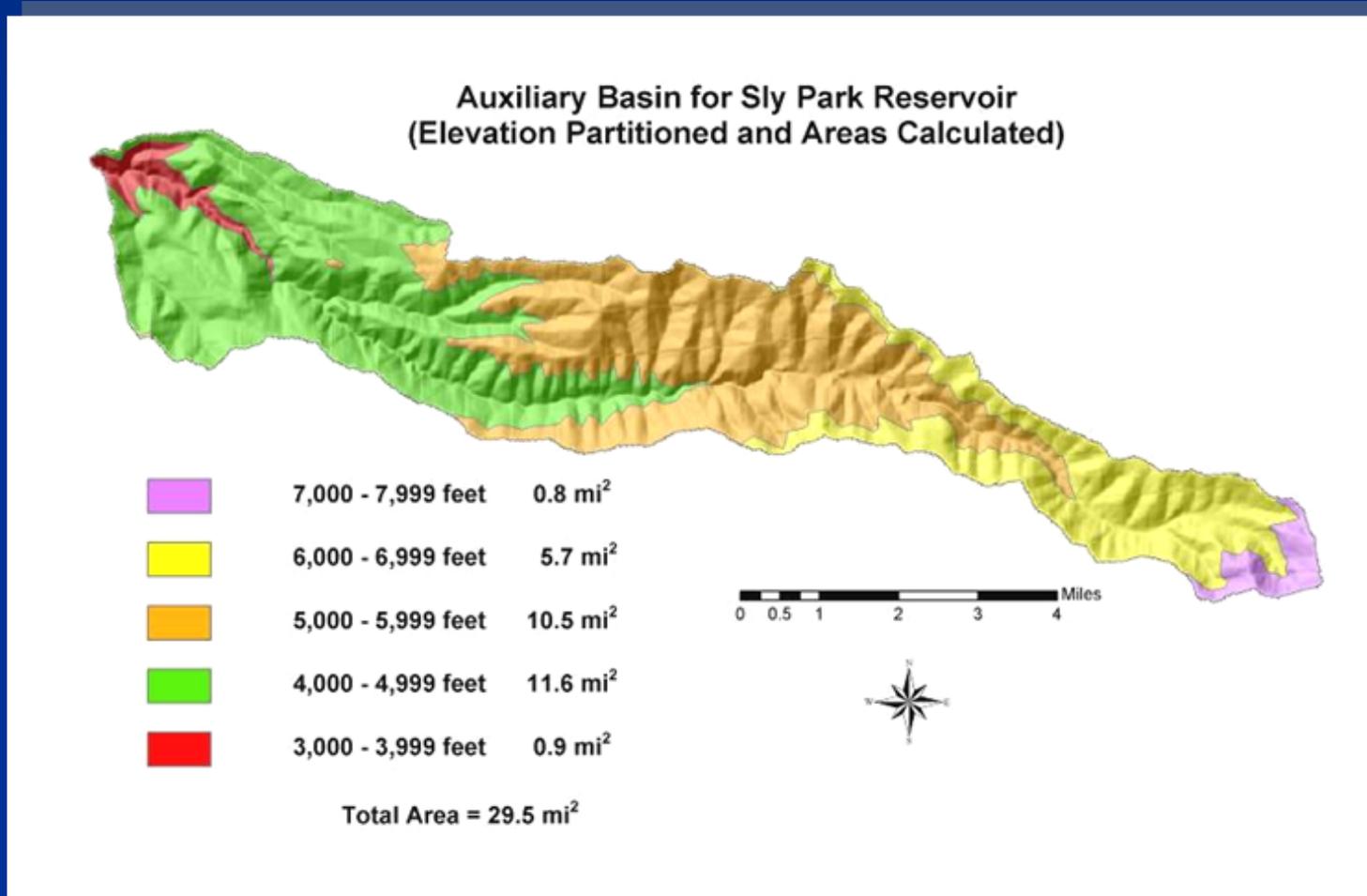
Basic Hydrologic Modeling System with HEC-HMS for DWR
Davis, CA
7—11 April 2008



GIS-Based Hydrologic Analysis of Watersheds

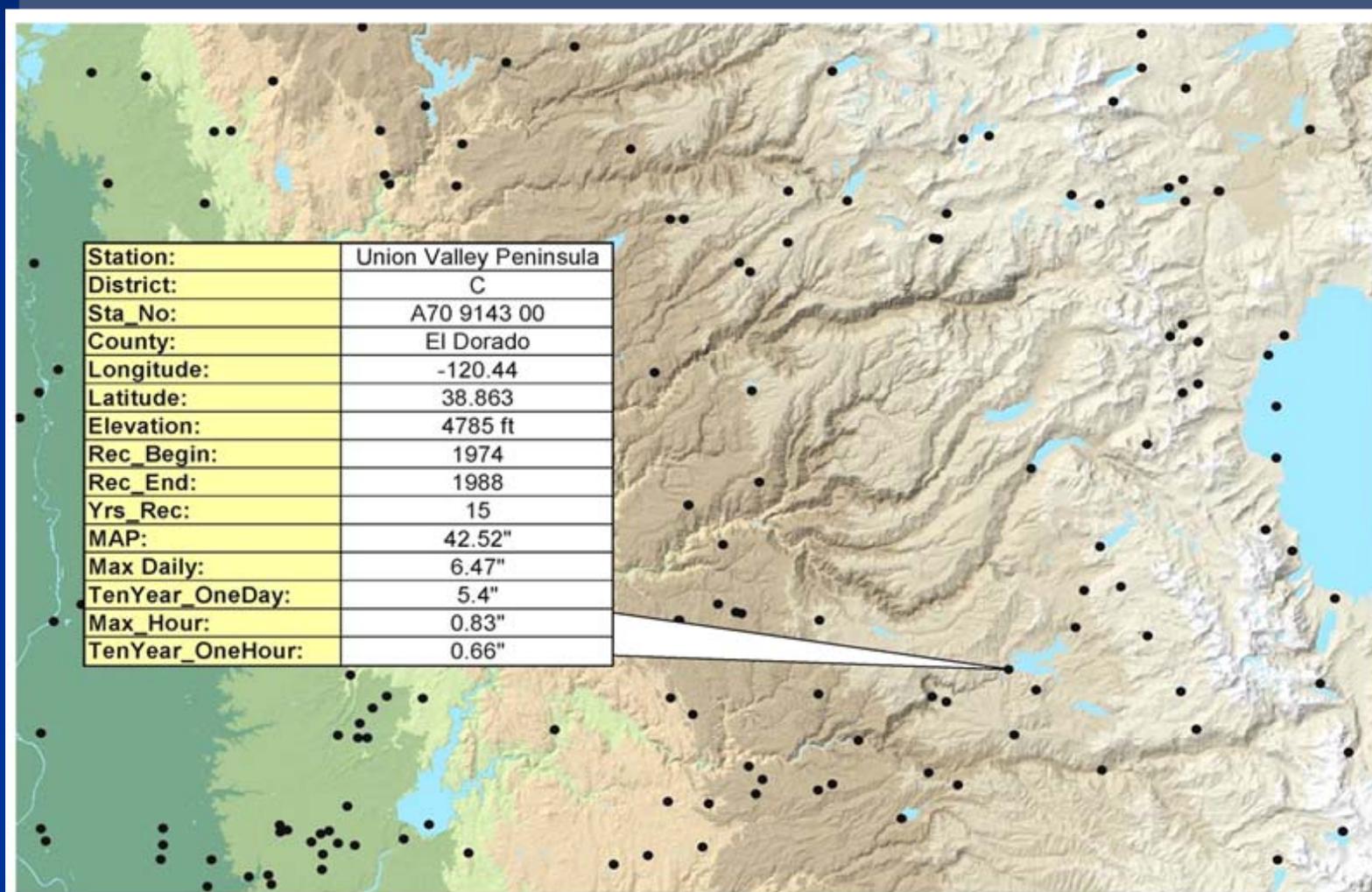


Partitioning of Elevation for HEC-1 Snowmelt Module



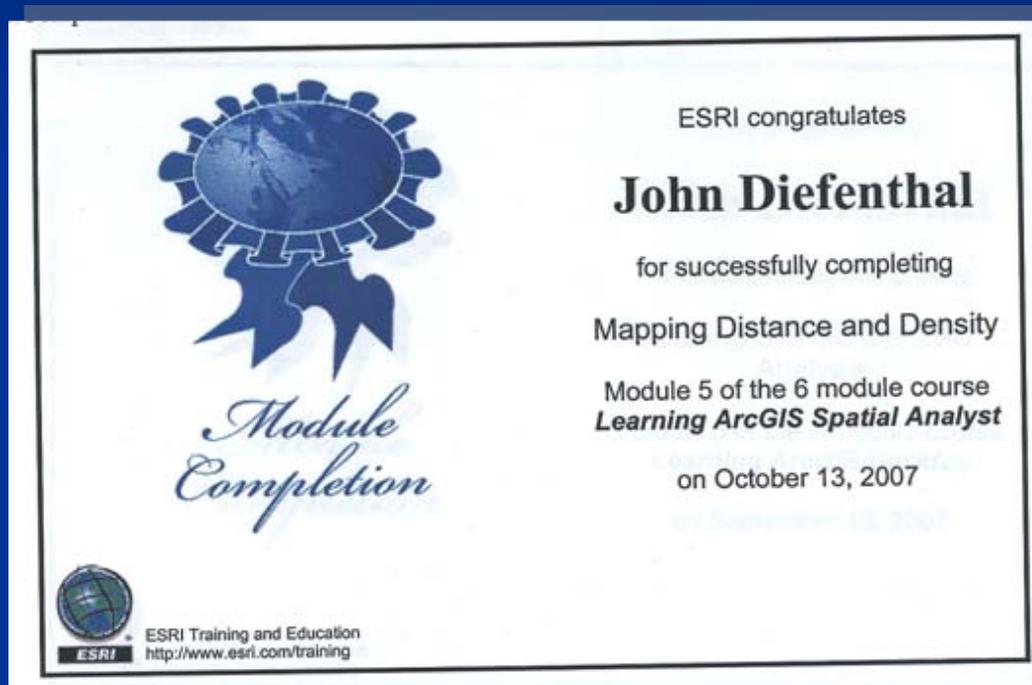


GIS Map of Rainfall Stations





GIS Training



GEOG 334 Introduction to Desktop GIS

GEOG 344 Spatial Analysis and Modeling in GIS



FERC/DSOD Coordination Project

CA DSOD

Height \geq 25 Feet or
Reservoir Capacity \geq 50 Ac-ft



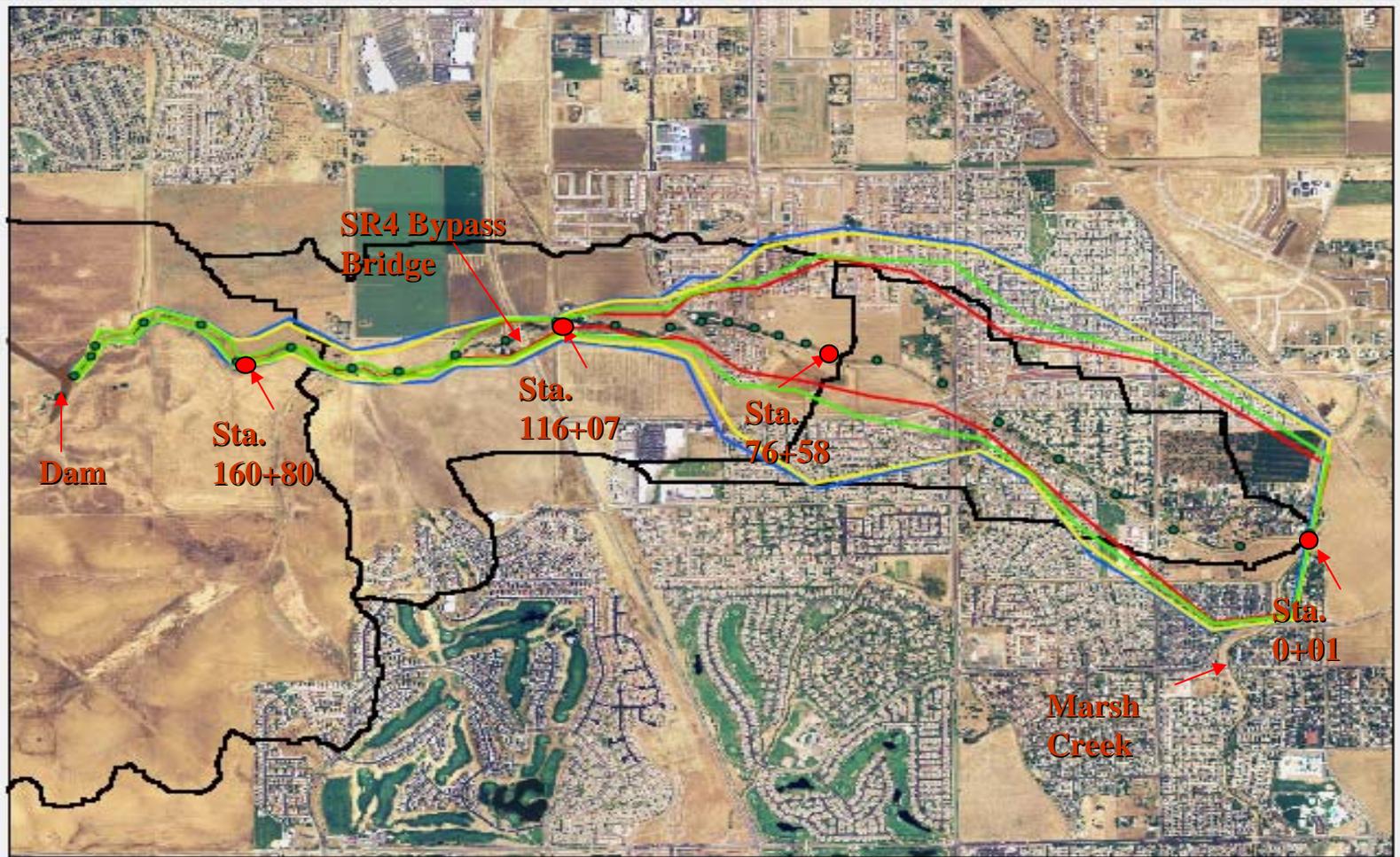
202
Hydropower
Dams



FERC

Hydropower
Dams

Upper Sand Creek Detention Basin (Proposed Flood Control Dam)



0 625 1,250 2,500 3,750 5,000 Feet



10,000 yr without Dam Break

10,000 yr with Dam Break

1,000 yr without Dam Break

1,000 yr with Dam Break

Risk Assessment

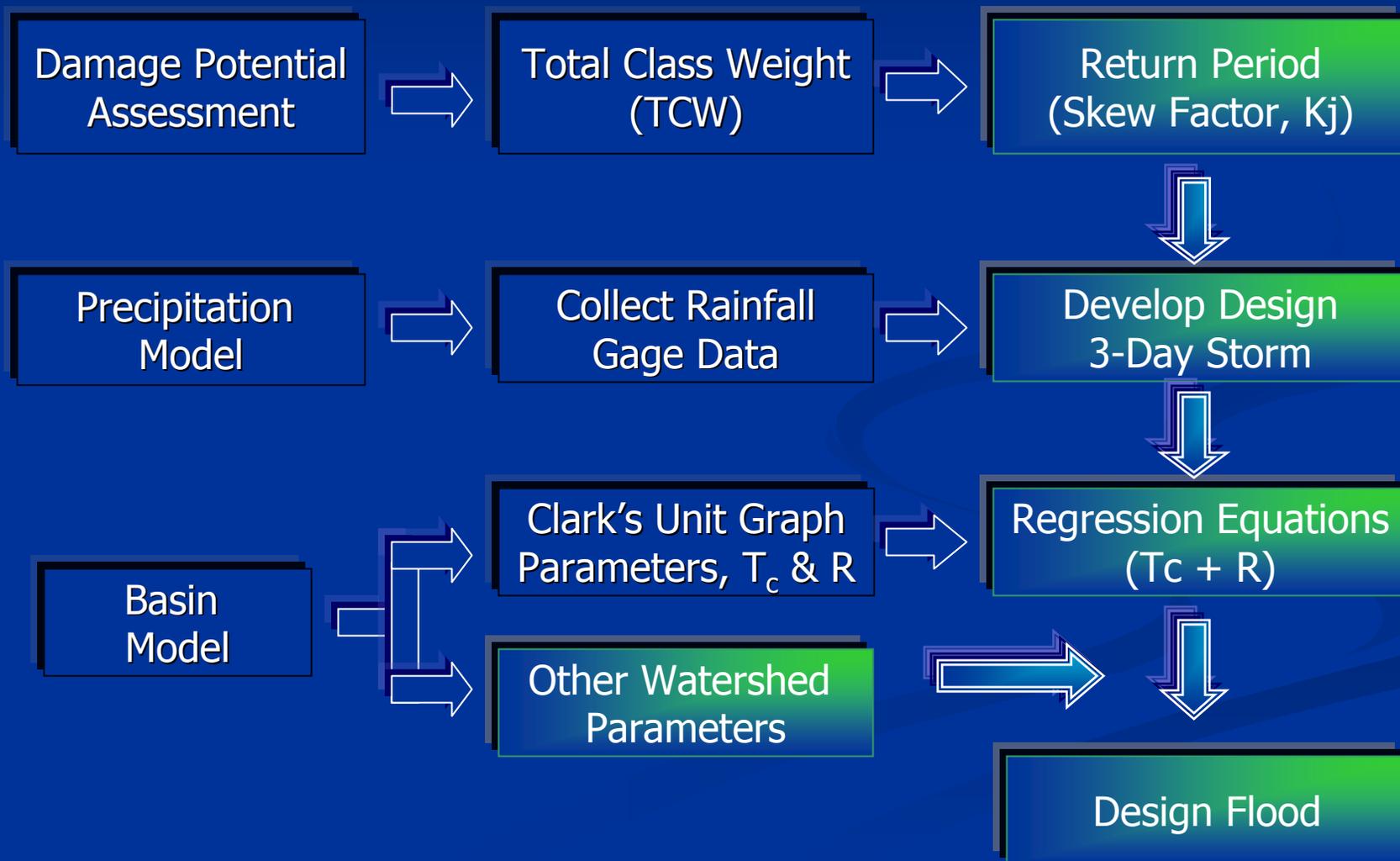
- US Bureau of Reclamation
- ANCOLD – Australian National Committee on Large Dams
- Hydro British Columbia
- United Kingdom
- Hydro Quebec
- Hong Kong
- China



A 2002 Flood



DSOD Hydrology Assessment & Analysis



Present Hazard Classification Form



State of California

Extreme

High

Moderate

Low

CLASSIFICATION OF DAM AS TO DAMAGE POTENTIAL AND CONDITION

Region	Name	DAMAGE POTENTIAL				Dam No.
		Extreme	High	Moderate	Low	
Capacity (A.F.) (circle weight)	100,000 & Over 6	1,000-99,999 4	100-999 2	15-99 0		
Height (Ft.) (circle weight)	150 & Over 6	100-149 4	50-99 2	6-49 0		
Estimated Evacuation (circle weight)	1,000 & Over 12	100-999 8	1-99 4	None 0		
Potential D/S Damage (circle weight)	High 12	Moderate 8	Low 4	None 0		
Weight-Range	31-36 19-30 7-18 0-6	Total Class Weight				
Sub-Class 1	IV III II I	Sub-Class 1				

4

6

4

8

TCW = 22

	CONDITION OF DAM			
	Poor	Fair	Good	Excellent
Age of Dam _____ Years (circle weight)	35 or Over 3	20 - 34 2	5 - 19 1	Under 5 0
General Condition & Type (circle weight)	12	8	4	0

**Total Class Weight
Less than 30**

**Total Class Weight
Greater than 30**

Condition Weight _____
Sub-Class 2 _____

DAM NUMBER _____ Hazard Class (Sub-Class 1 & 2) _____
Number of Inspections _____

**Statistical Design
Precipitation**

**Probable Maximum
Precipitation**

Rated By: _____ Date: _____ Approved By: _____

Capacity

Height

Estimated Evacuation

Potential D/S Damage

Proposed Hazard Classification Form



State of California DEPARTMENT OF WATER RESOURCES The Resources Agency
DIVISION OF SAFETY OF DAMS

CLASSIFICATION OF DAM AS TO DAMAGE POTENTIAL AND CONDITION

Region _____ Name _____

DAMAGE POTENTIAL

Capacity (A.F.) _____ 100,000
(circle weight)

Height (Ft.) _____ 150
(circle weight)

Estimated Evacuation _____ 1,000
(circle weight)

Potential D/S Damage _____
(circle weight)

High	Moderate	Low	None
12	8	4	0

Weight-Range 31-36 19-30 7-18
Sub-Class 1 IV III II

CONDITION

Age of Dam _____ Years 35
(circle weight)

General Condition & Type _____
(circle weight)

Geologic & Seismic Site Condition _____
(circle weight)

Over 20	13-20	5-12
D	C	B

Sub-Class 2 D C B

Estimated Evacuation

- Population at Risk
- Loss of Life

Potential D/S Damage

- Property/Economic Loss
- Life Line Loss
- Environmental Loss

No Total Class Weight (TCW)

Capacity

Height

Estimated Evacuation

Potential D/S Damage

DAM NUMBER _____ Hazard Class _____

Special conditions and considerations for adjustment _____

Adjusted Number of Inspections _____

Rated By: _____ Date: _____ Approved By: _____



Hazard & Damage Potential Assessment Update

- Revised Classified Damage Potential form
- Envisioned Return Periods for Spillway Analysis:

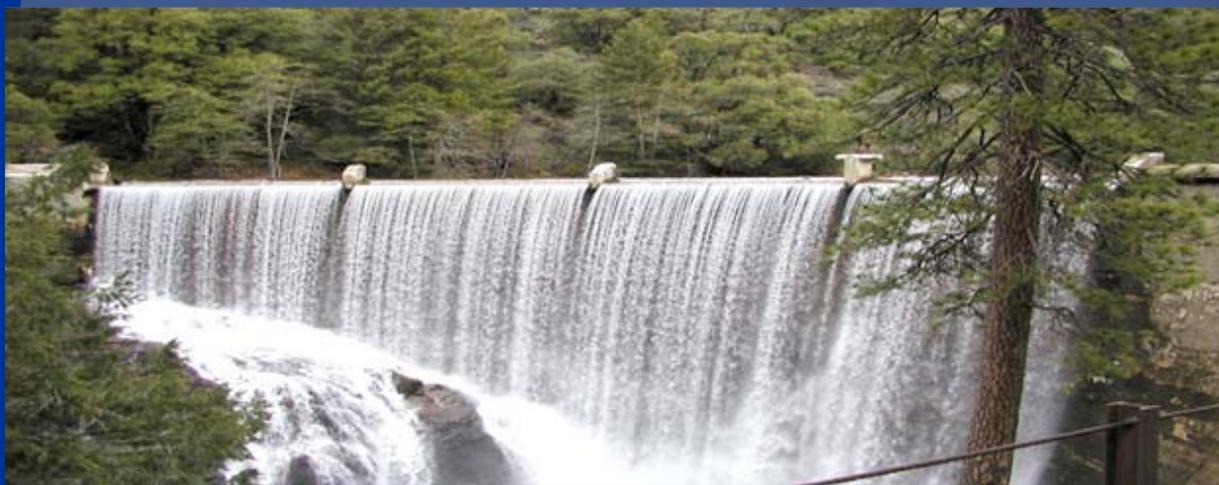
Low	Moderate	High	Extreme
HC I	HC II	HC III	HC IV
1,000	TBA	TBA	PMP



Two Different Approaches

(Proposed Return Periods)

- **Alternative 1** : database of existing return periods for 1250 dams.
- **Alternative 2** : risk approach.



Deer Creek Diversion Dam



Existing Return Periods for Alt. I (Sample)

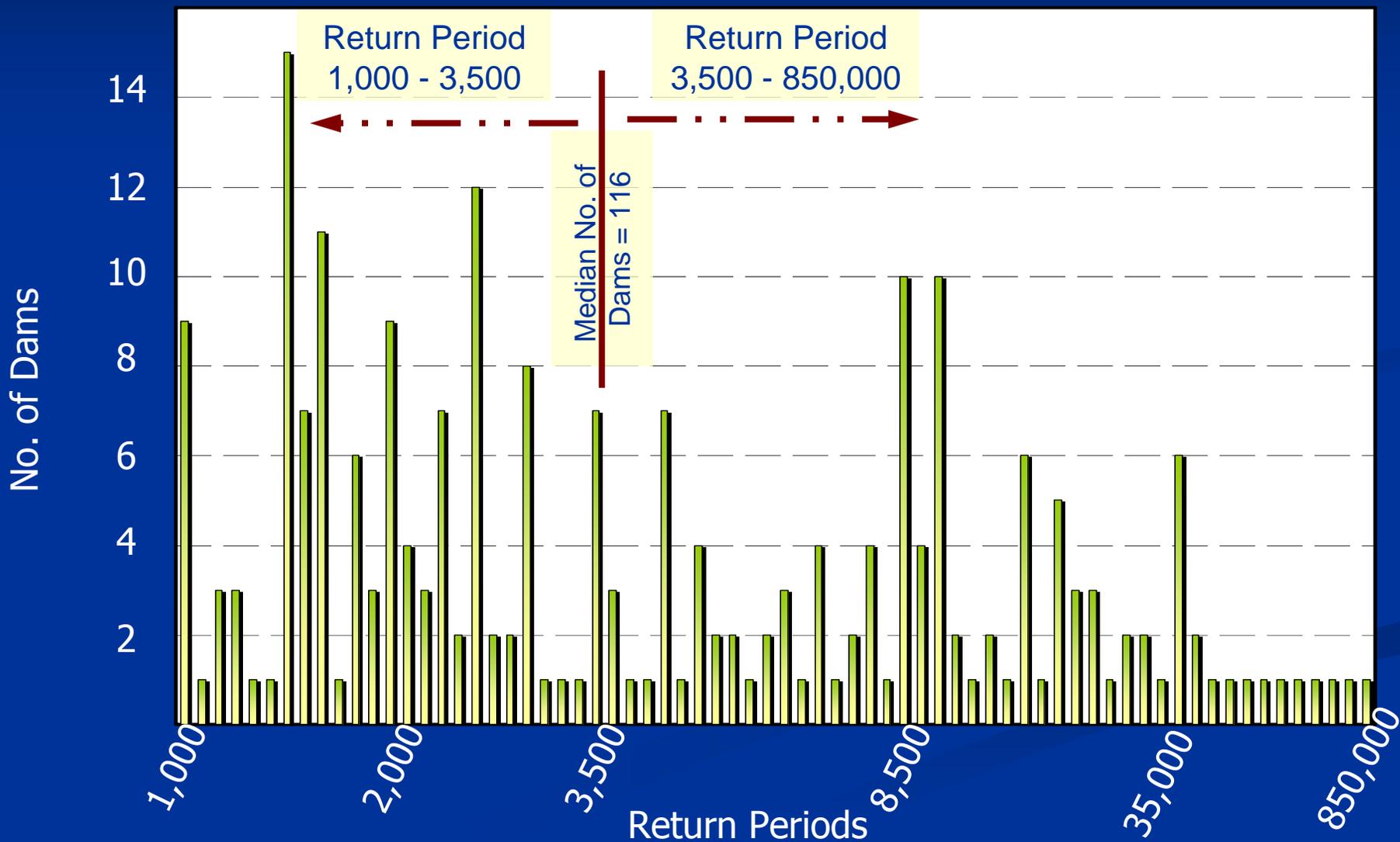
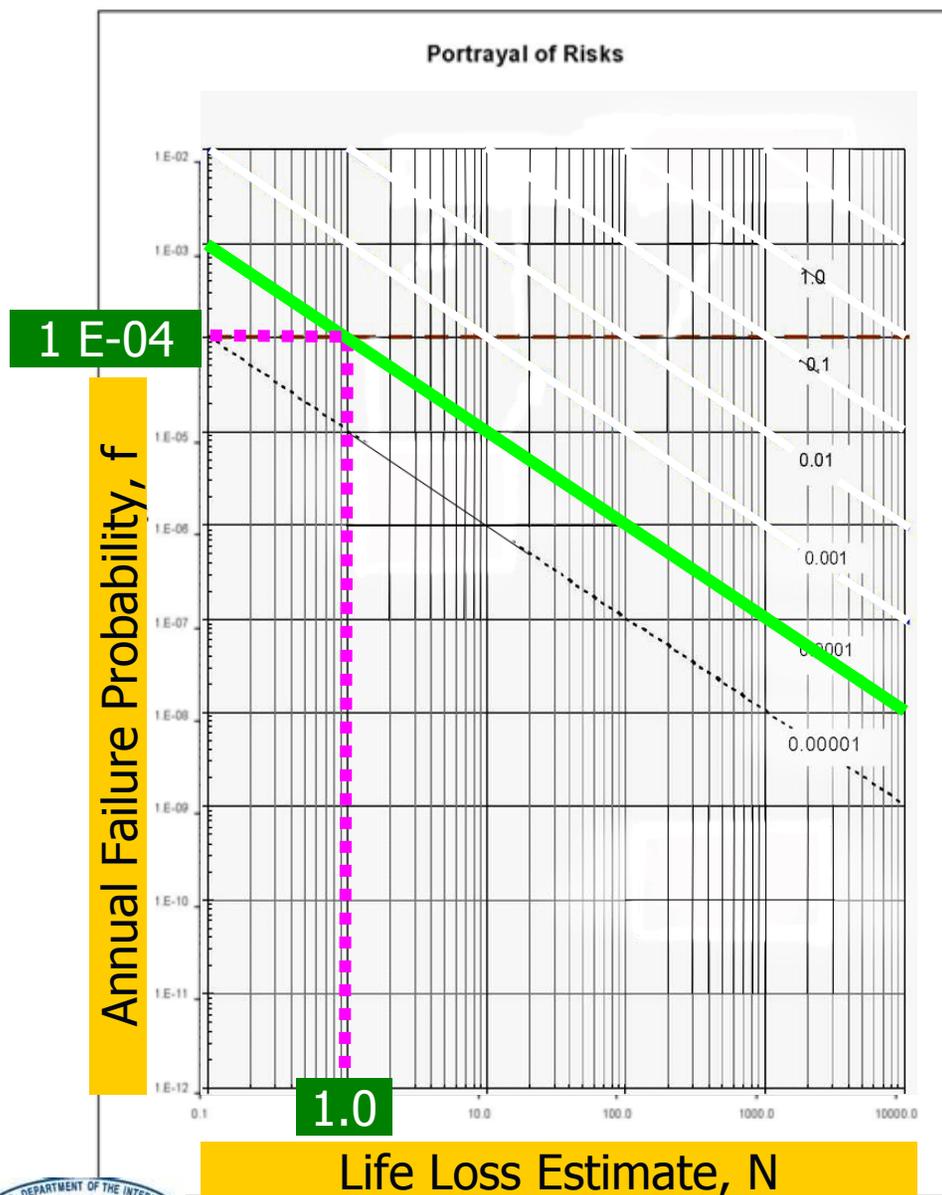




Figure 1. - The f-N Chart for Displaying Probability of Failure, Life Loss, and Risk Estimates



USBR's f-N Chart for Alt. 2



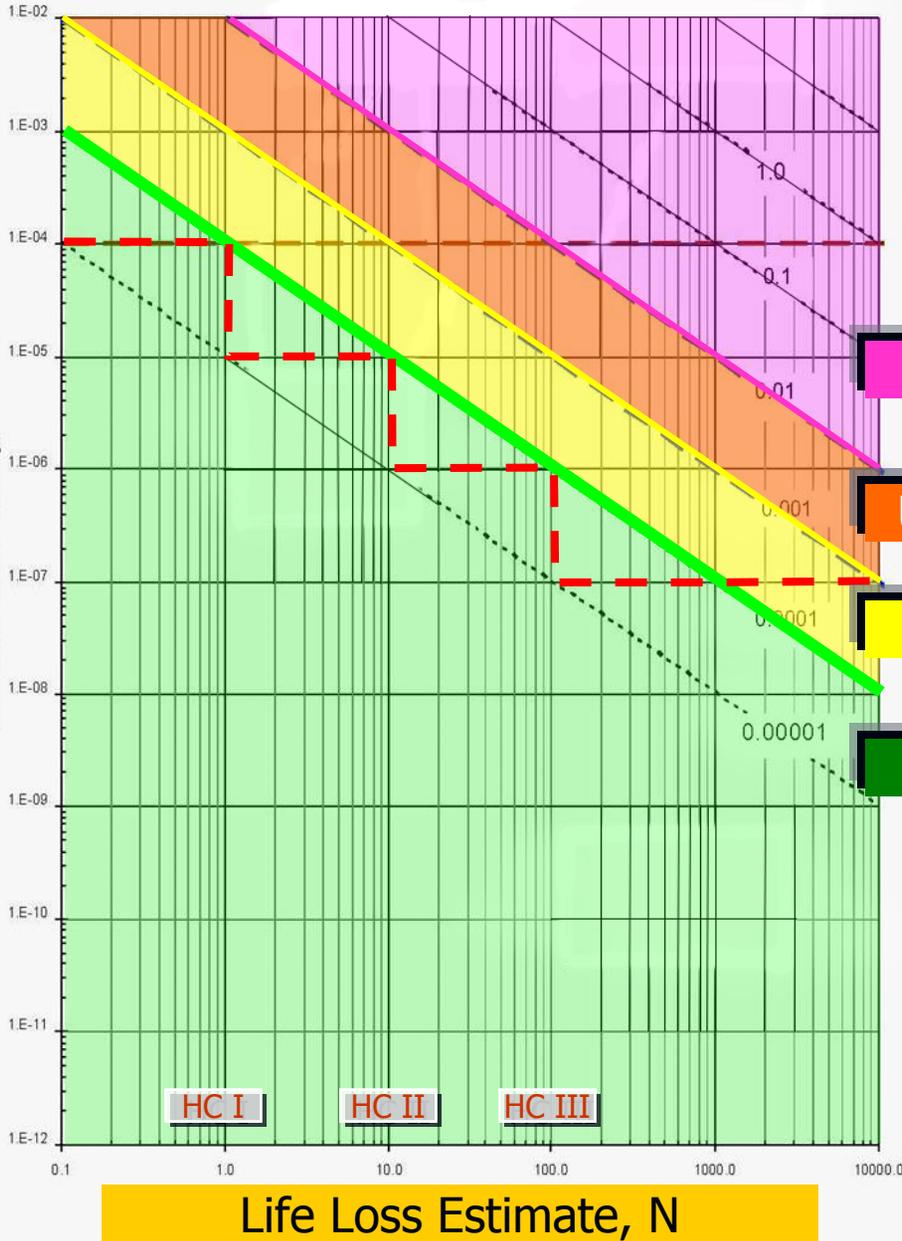


Portrayal of Risks



USBR f-N Chart (Alt. 2)

Annual Failure Probability, f

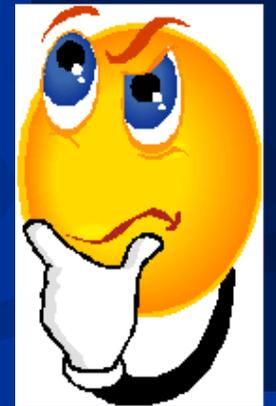


Intolerable

Unacceptable

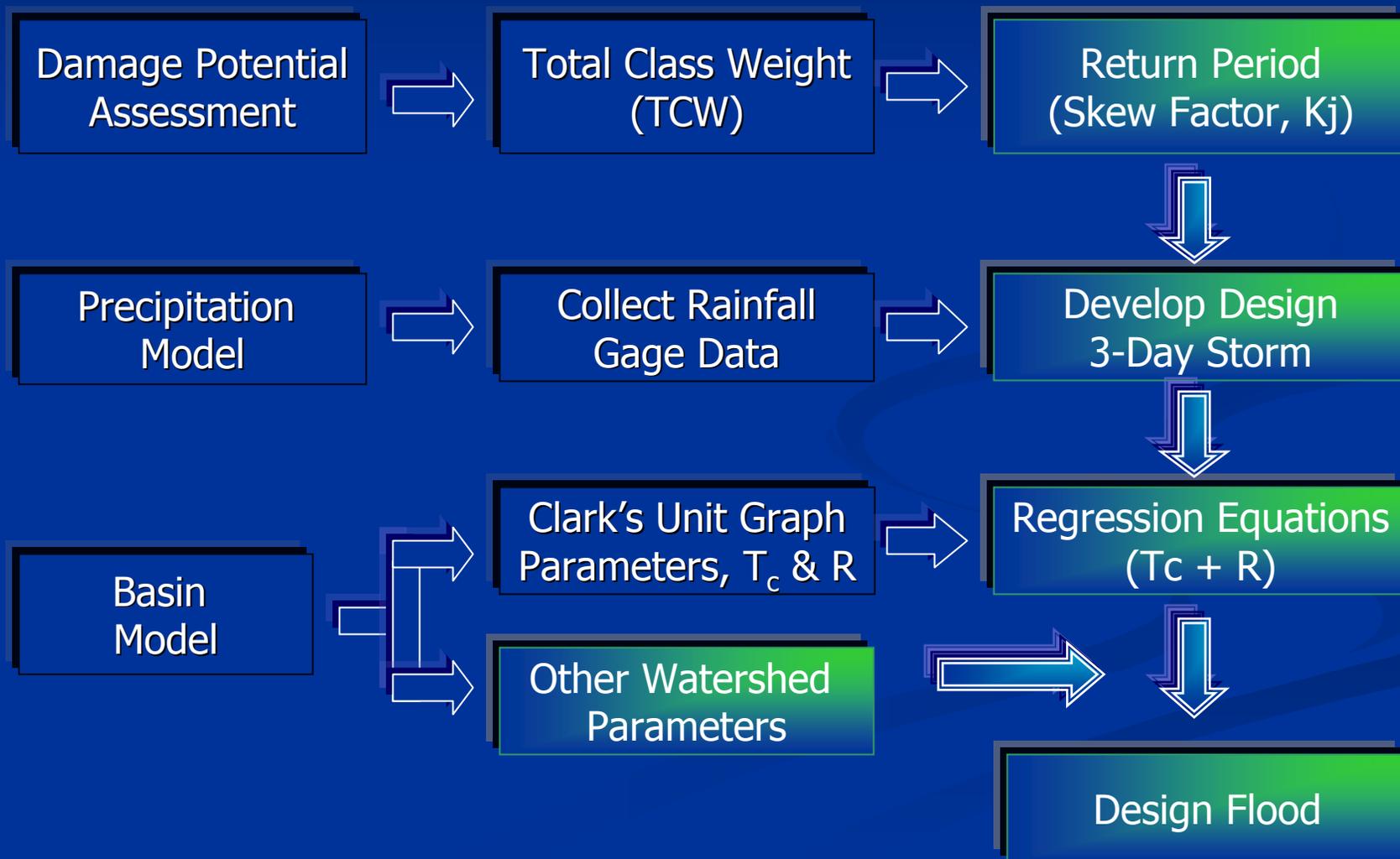
Tolerable

Acceptable





DSOD Hydrology Assessment & Analysis



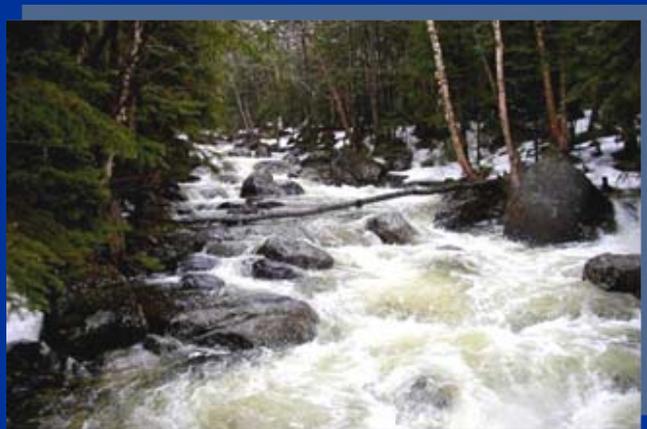
Potential Effects of Climate Change



Air Temperature



Precipitation Amount,
Timing & Type



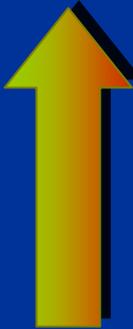
Runoff Timing & Quantity



Sea Level Rise



Climate Change Potential Impacts on Existing Dams

- California Energy Commission/PIER - August 2008:
 -  winter runoff as fraction of total runoff
 - winter flood frequency
 - magnitude & frequency of extreme floods
 - Earlier start of spring snowmelt



Design Precipitation

- Work with State Climatologist to detect trends of increase and change.
- Maintain and enhance existing rainfall stations.
- Transition zone (snow covered and rainfall dominated) needs more stations.



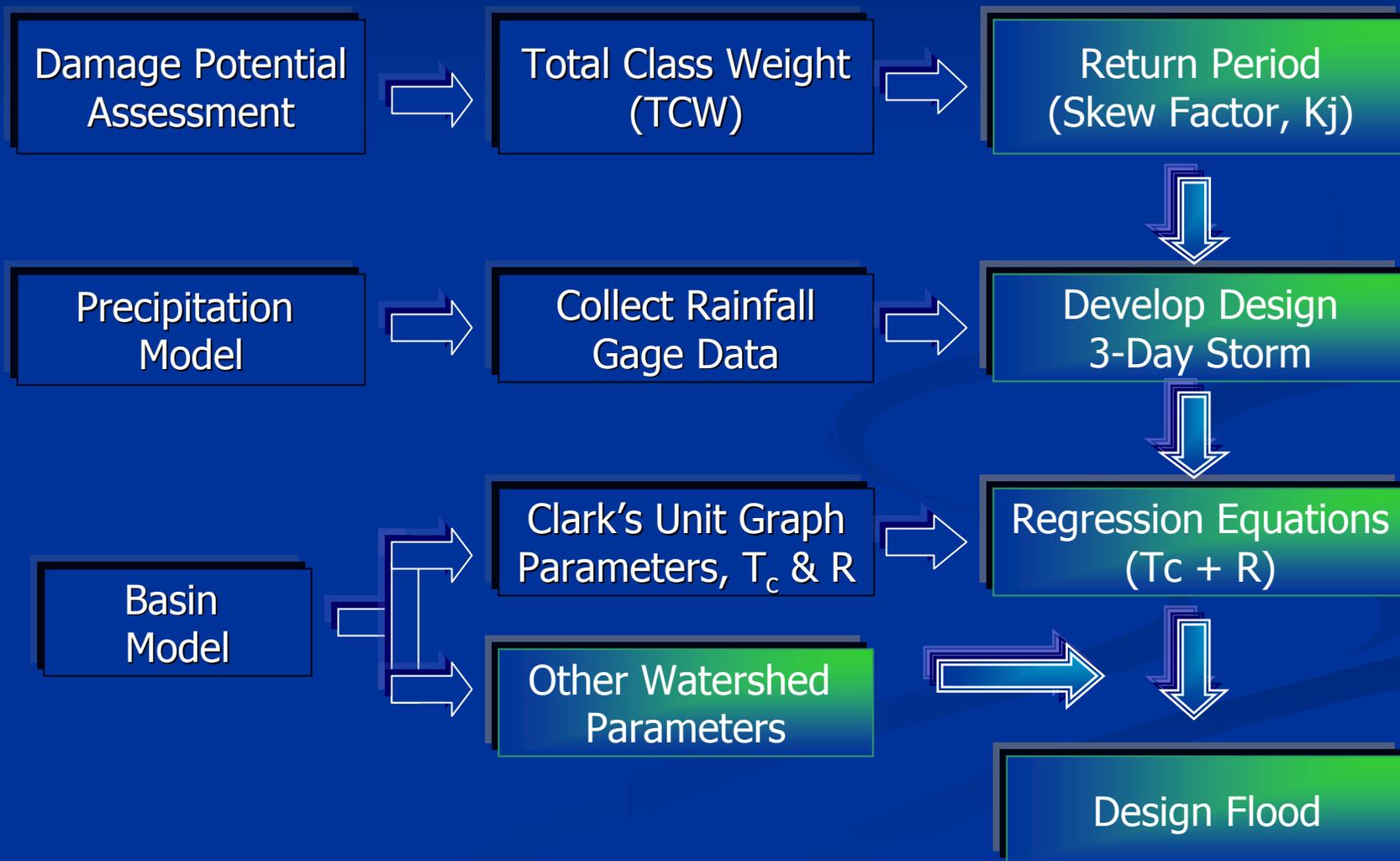
Forbestown Dam



Combie Dam



DSOD Hydrology Assessment & Analysis





Stream Flow Stations

- Use available stream gage data and their projected values as a check.
- Cases applied:
 - Camp Far West Dam
 - Bevans Creek Dam



Impact to Dam Owners

- Revised Hydrology Manual to apply to new dams only.
- Existing spillways evaluated upon proposed major modifications.



Chili Bar Dam



Future Work

- Review Hazard Classifications from other organizations and finalize our own.



Thermalito Diversion Dam



Future Work (Cont.)

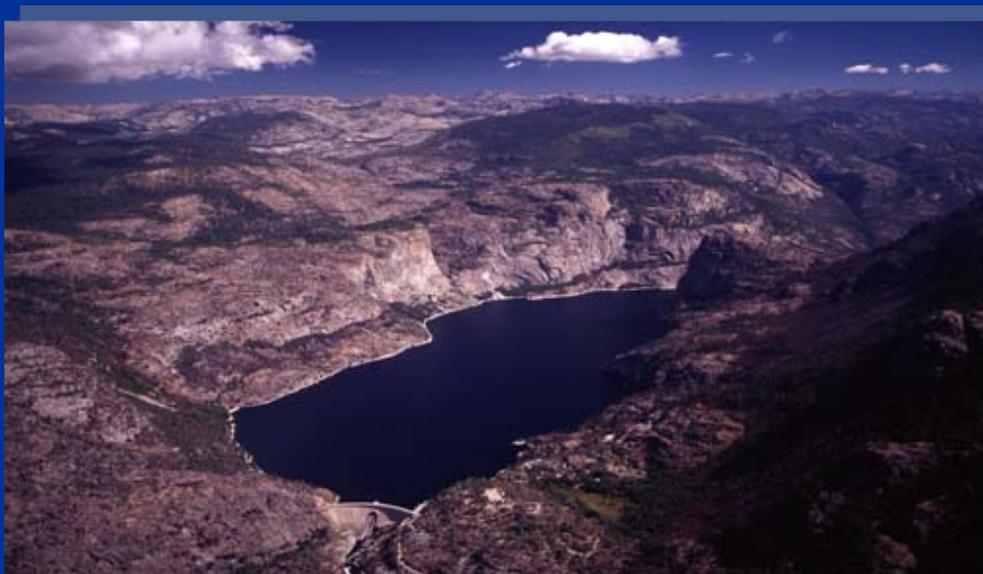
- Increase knowledge/skill of GIS and HEC-HMS.



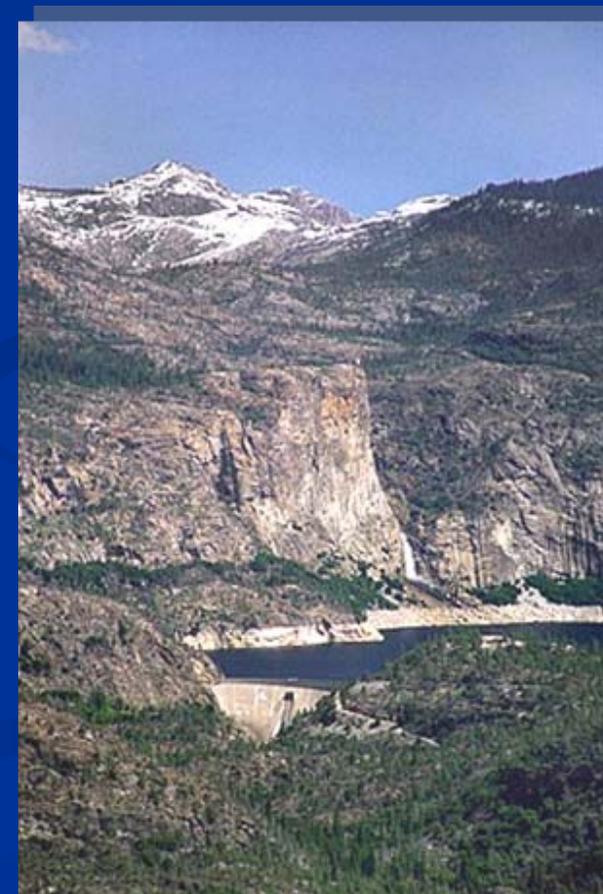
Lake Oroville Dam

Future Work (Cont.)

- Develop snowmelt guidelines.



O'Shaughnessy Dam Snowpack and Runoff





Future Work (Cont.)

- Define return period for small flood detention dams.





Future Work (Cont.)

- Determine rainfall distribution and statistical factors for the 7 hydrologic regions.

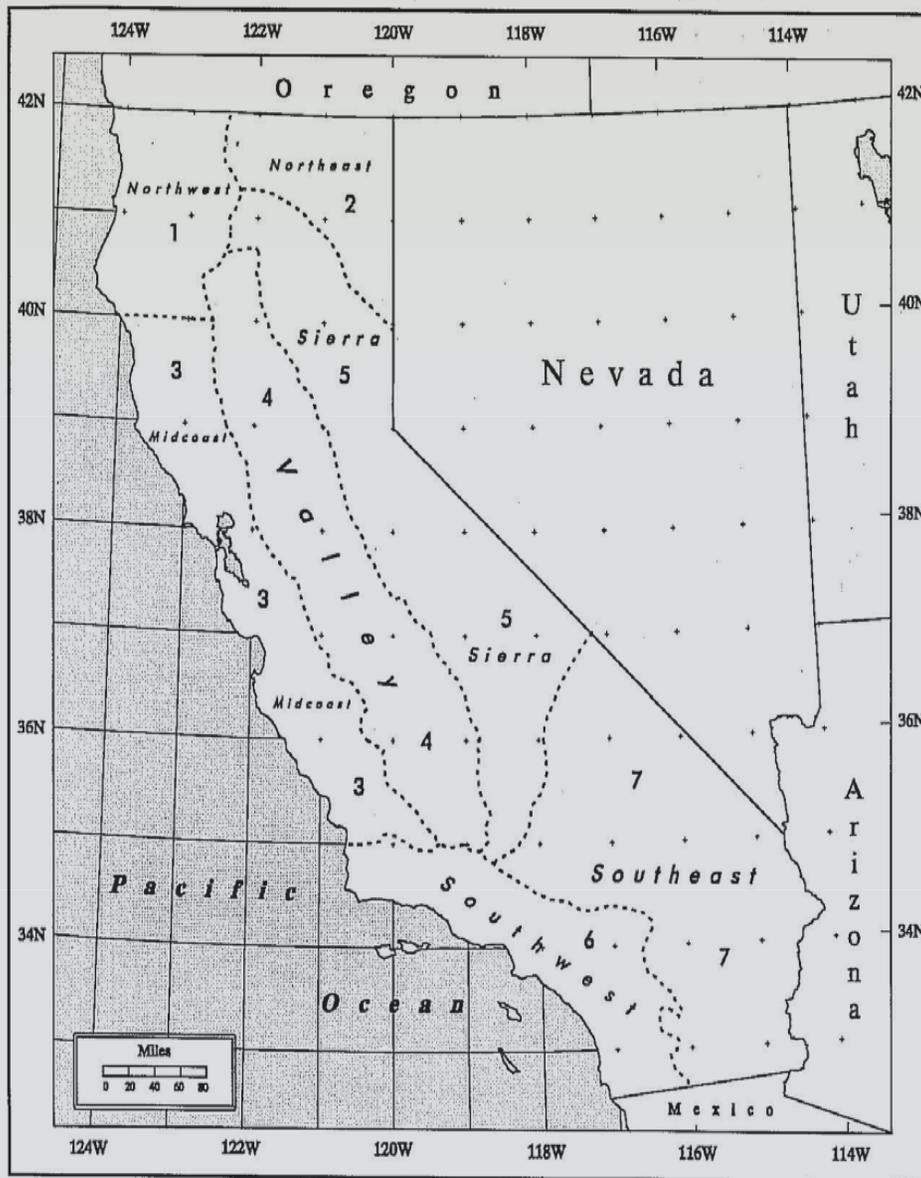


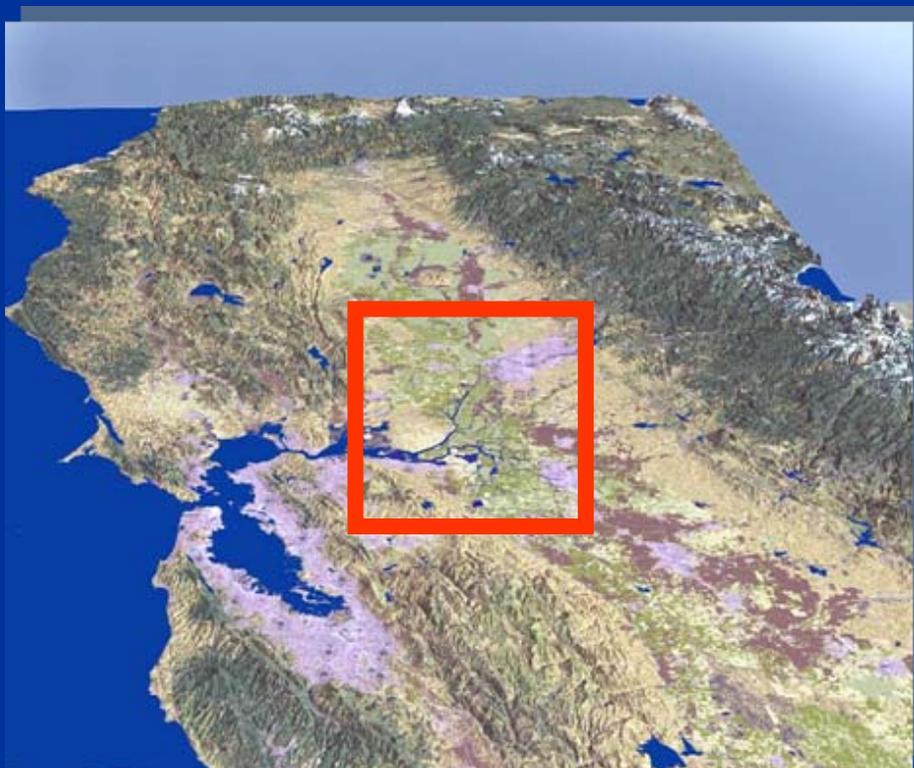
Figure 2.11. Regional boundaries for development of depth-area-duration relations.

Source: HMR 58



Future Work (Cont.)

- Update equations for T_c and R .
- Review HEC's report, "HEC-HMS for the Sacramento and San Joaquin River Basins Comprehensive Study".



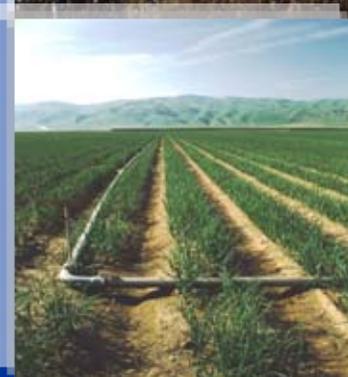
San Joaquin River Basins



Future Work (Cont.)

- Present proposed changes to upper management.
- Peer review by HEC.
- Update the DSOD Hydrology Manual.





Thank You