ALTERNATIVES AND DESIGN OF COUGAR DOWNSTREAM FISH PASSAGE

Scott Fielding, Fisheries Biologist
Jeremy Britton, Technical Lead
Chris Budai, Project Manager

Willamette Fisheries Science Review
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The Willamette River Basin

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Cougar Dam and Reservoir

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COUGAR DAM AND RESERVOIR HISTORY

- Cougar Dam was built in 1963
  - Authorized purposes-flood damage reduction, power generation, water supply, low-flow augmentation, and recreation
- Water Temperature Control Tower constriction began in 2002, completed in 2005
- 2008 Biological Opinion (NMFS & USFWS)
  - The Willamette Valley Project was jeopardizing the sustainability of anadromous fish stocks
  - USFWS reached a no jeopardy determination for bull trout and Oregon Chub

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2008 BIOLOGICAL OPINION-REASONABLE AND PRUDENT ALTERNATIVE

- RPA 4.12 -Based on the best available scientific information at the time of development of this RPA, additional structural and operational modifications are needed to allow safe passage and access to habitat above and below Willamette project dams (NMFS 2008)

- RPA 4.12.1 – Cougar Dam Downstream Passage: Investigate the feasibility of improving downstream fish passage at Cougar Dam through structural modifications as well as operational alternatives

- USACE forms a Product Delivery Team (PDT) in 2010 to work on downstream passage solutions at Cougar Dam

  - PDT consists of multiple disciplines: engineers, environmental specialists, biologists, and Project Manager

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ENGINEERING DOCUMENTATION REPORT (EDR) FOR COUGAR DOWNSTREAM PASSAGE

- PDT began working on the EDR in 2010 to evaluate the feasibility of structural and operational alternatives for downstream passage

- Supporting technical studies completed and documented in the EDR:

  - Reservoir operations modeling with HEC-ResSim
  - Computational Fluid Dynamics (CFD) modeling
  - Structural analysis
  - RM&E biological testing
  - Development of a Fish Benefits Workbook

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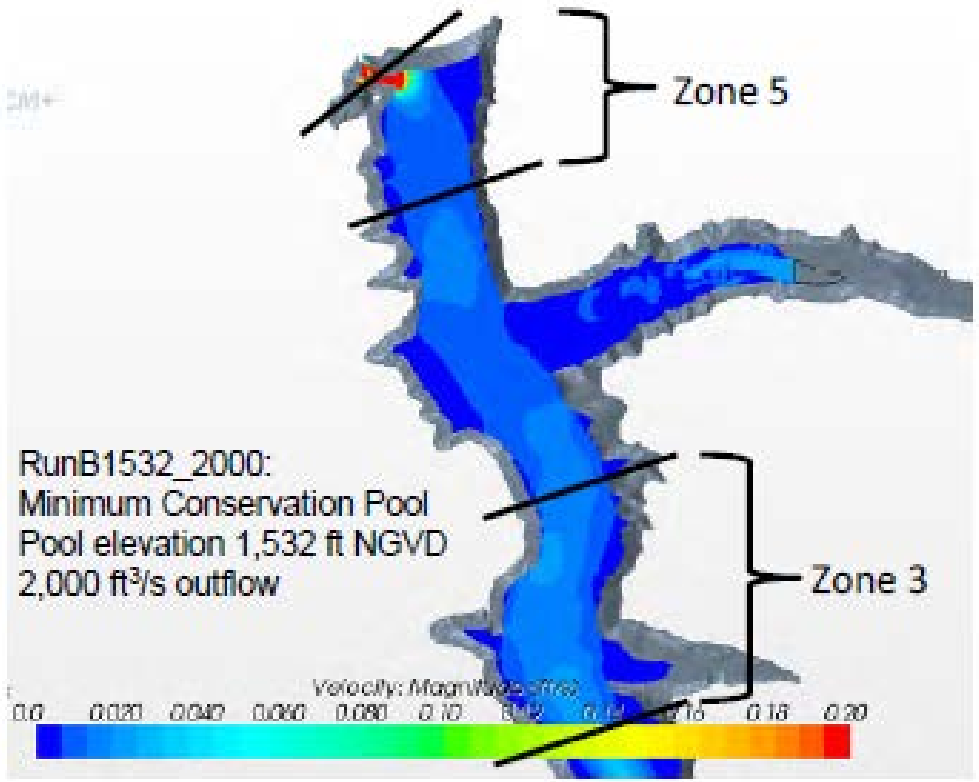
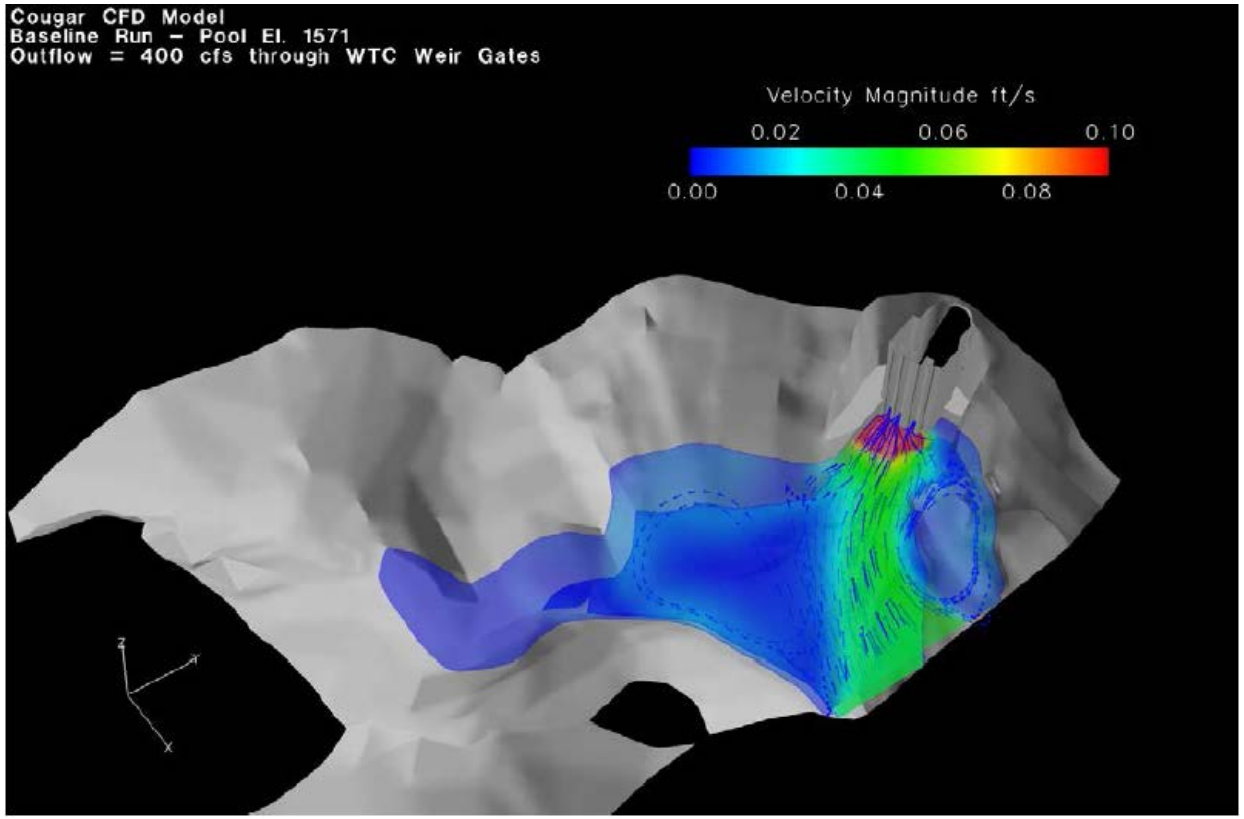
COMPUTATIONAL FLUID DYNAMICS



Surface water velocities from CFD model of Cougar Reservoir (Beeman, 2012). Provided by Liza Wells USACE 2012.



Baseline CFD model run, pool elevation 1571 ft., total outflow 400 cfs (Cougar Downstream Passage EDR, 2015)

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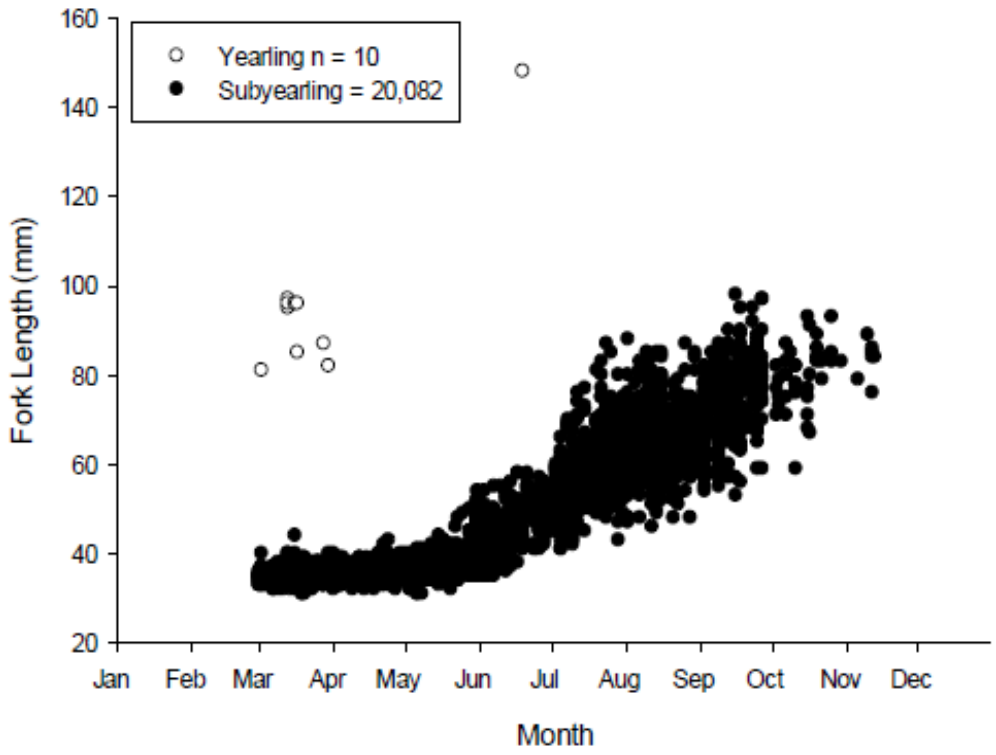
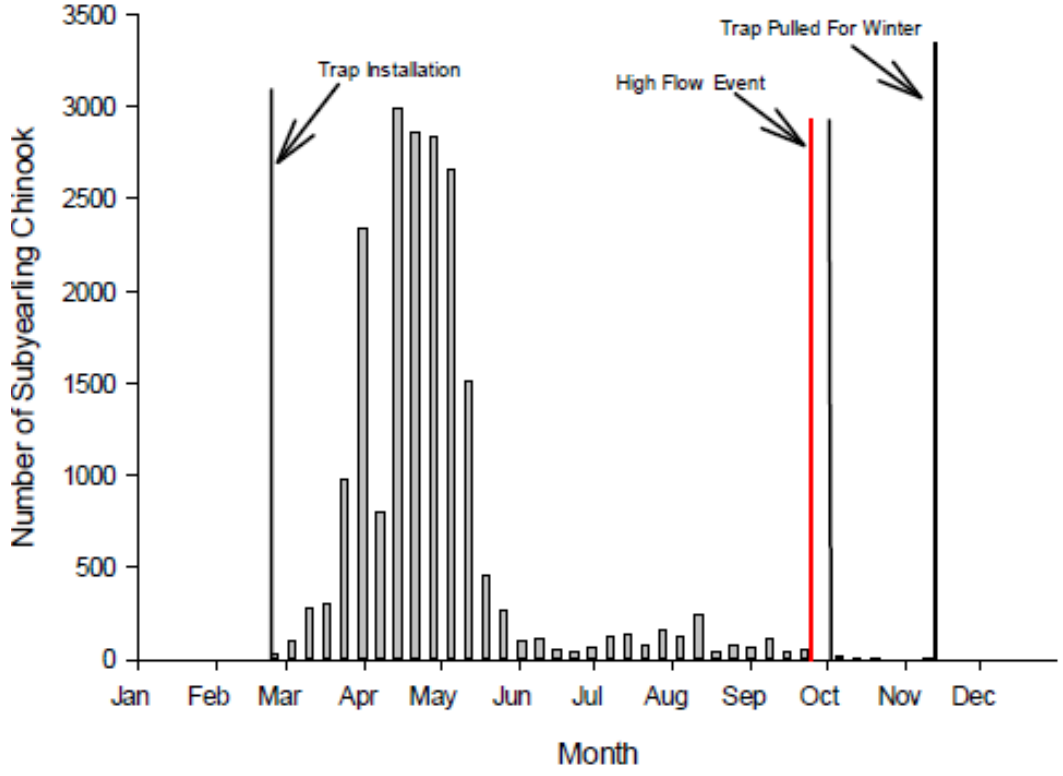
DOWNSTREAM MIGRATION TIMING



Fork length of subyearling and yearling Chinook salmon collected in the South Fork McKenzie trap above Cougar Reservoir, 2013 (Romer et al. 2013)



Weekly catch of subyearling spring Chinook salmon captured in the South Fork McKenzie River trap above Cougar Reservoir, 2013 (Romer et al. 2013)

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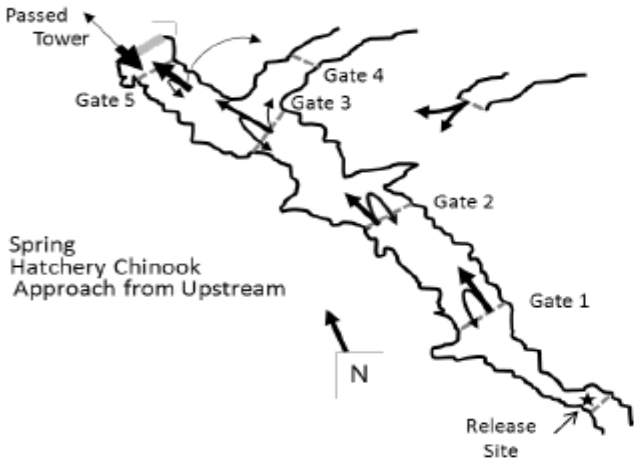
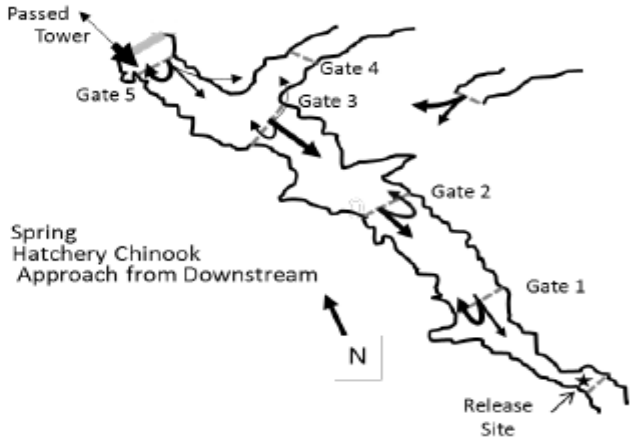
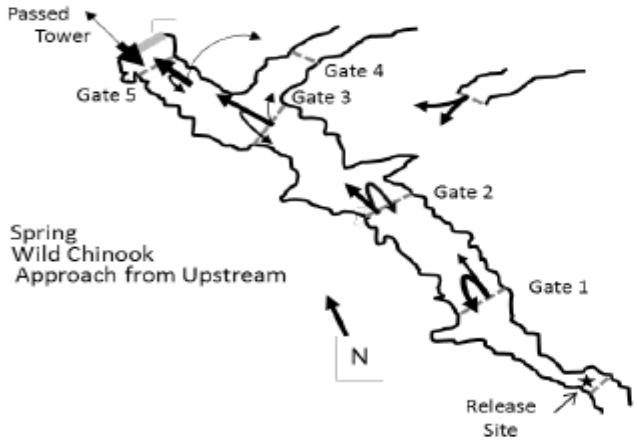
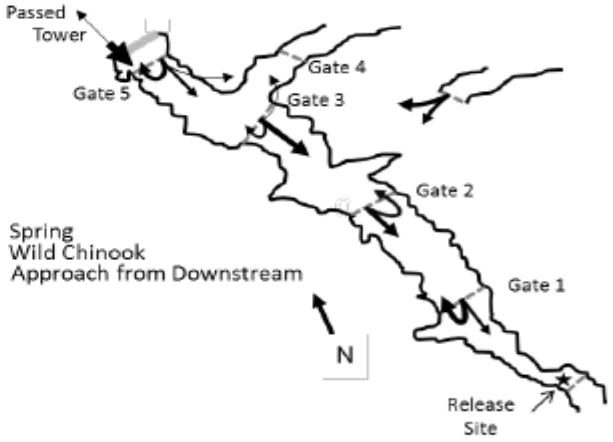
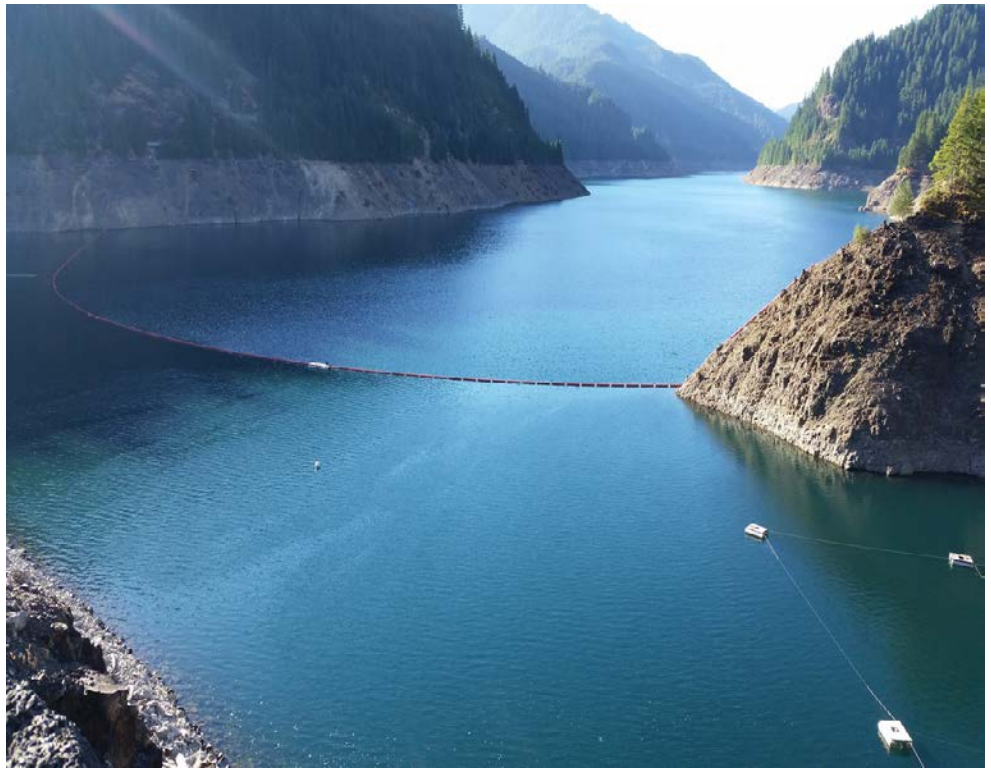
RESERVOIR MOVEMENT











Transition probabilities of hatchery and wild fish released in Cougar Reservoir, Oregon, spring 2011. (Beeman et al. 2013)

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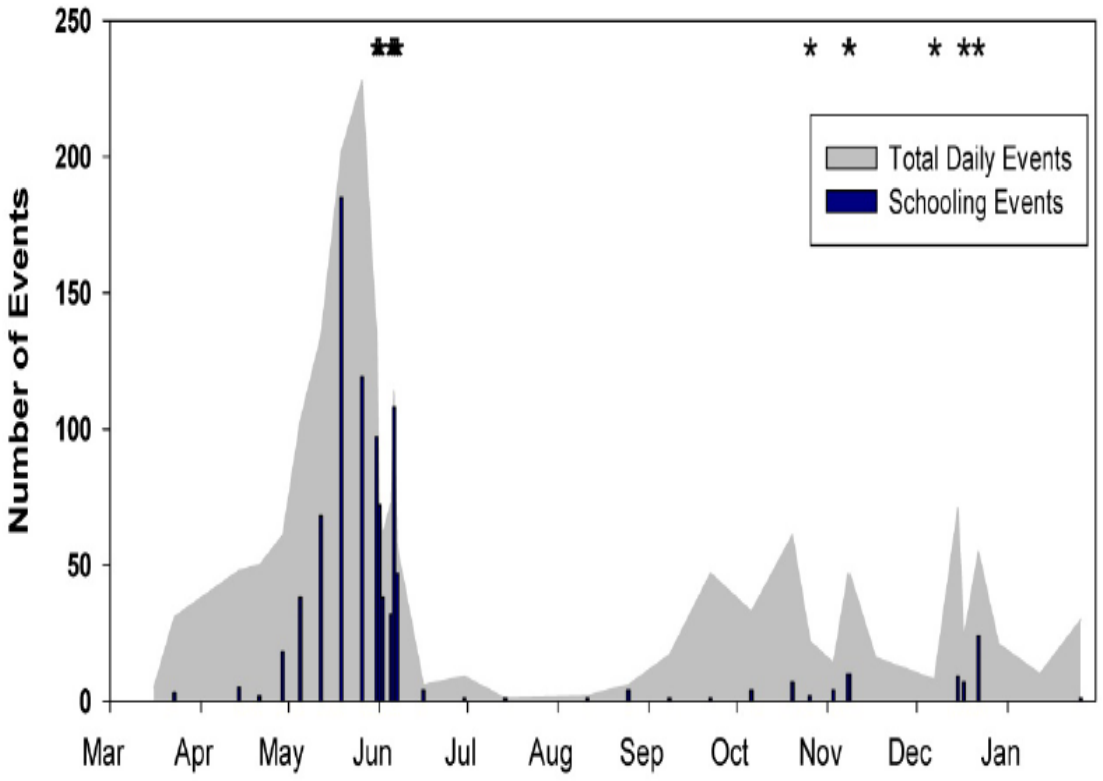
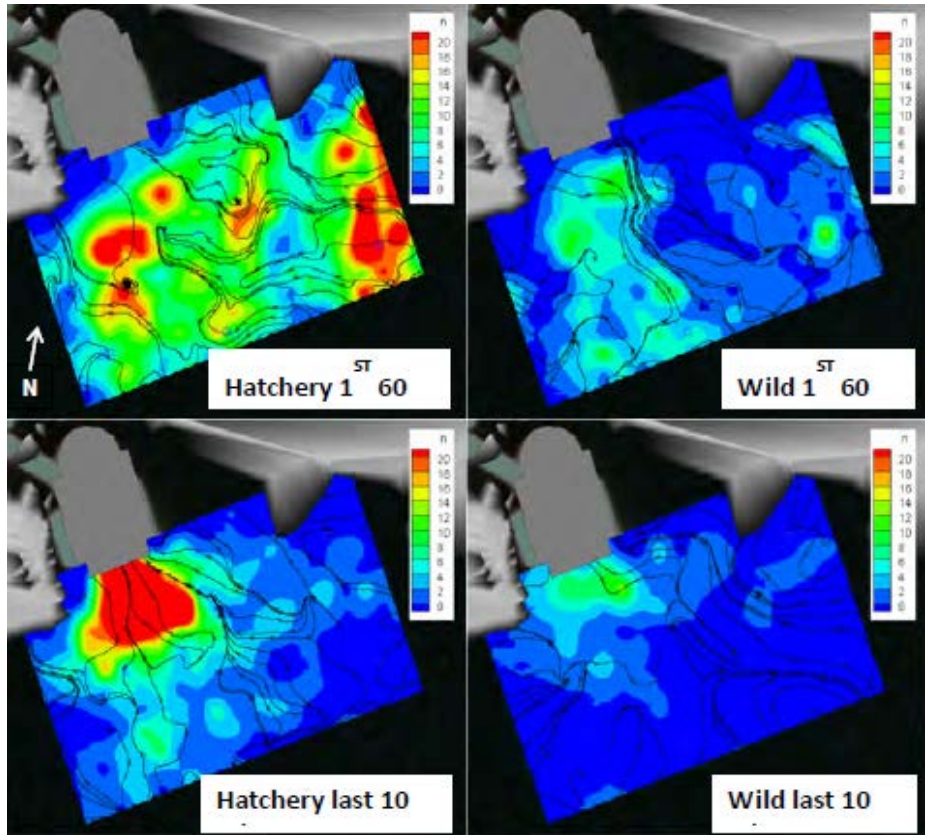
CUL-DE-SAC ABUNDANCE AND BEHAVIOR



Nearfield behavior and relative abundance of fish in the immediate forebay (Khan 2010)



Flood plots and movement vectors of subyearling Chinook released into Cougar Reservoir 2011. (Beeman et al. 2011)

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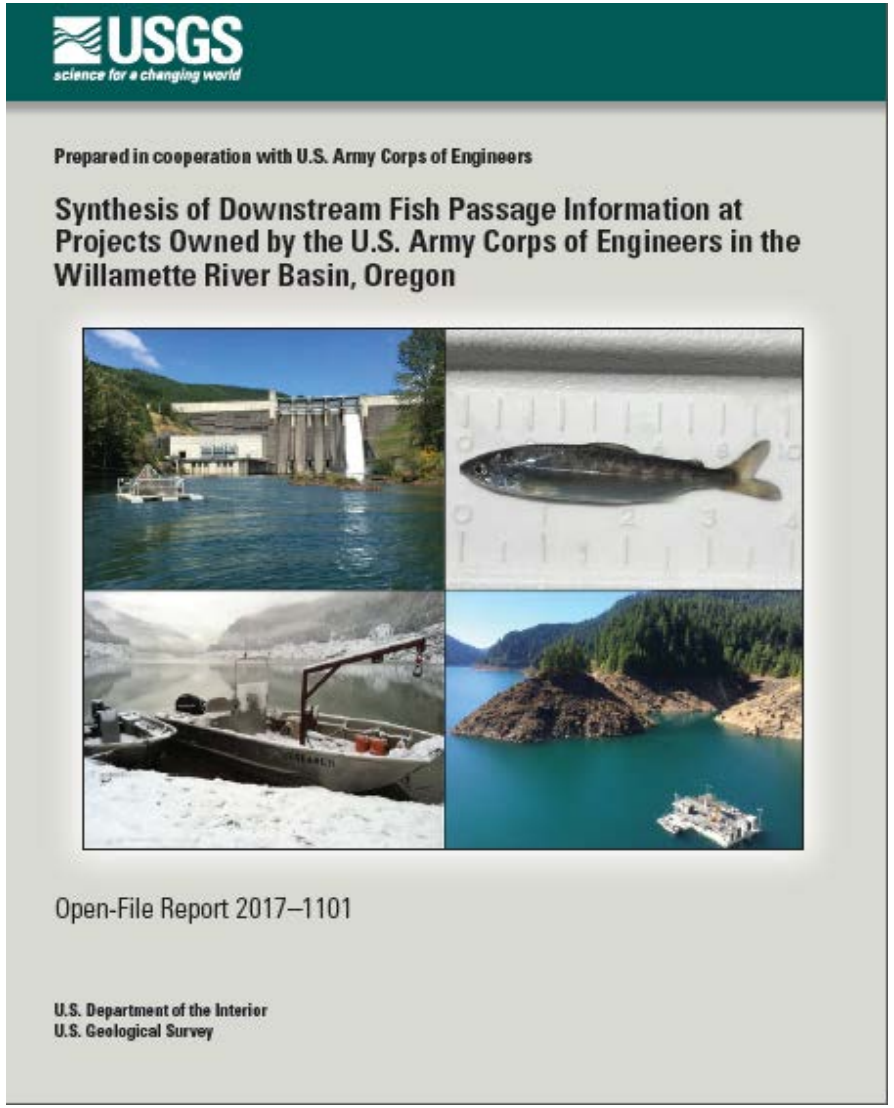
COMPLETE LIST OF STUDIES AT COUGAR DAM



Hansen, A.C., Kock, T.J., and Hansen, G.S., 2017. Synthesis of downstream passage information at projects owned by the U.S. Army Corps of Engineers in the Willamette River Basin, Oregon: U.S. Geological Survey Open File Report 2017-1101, 118p,. https://doi.org/10.333/orf20171101

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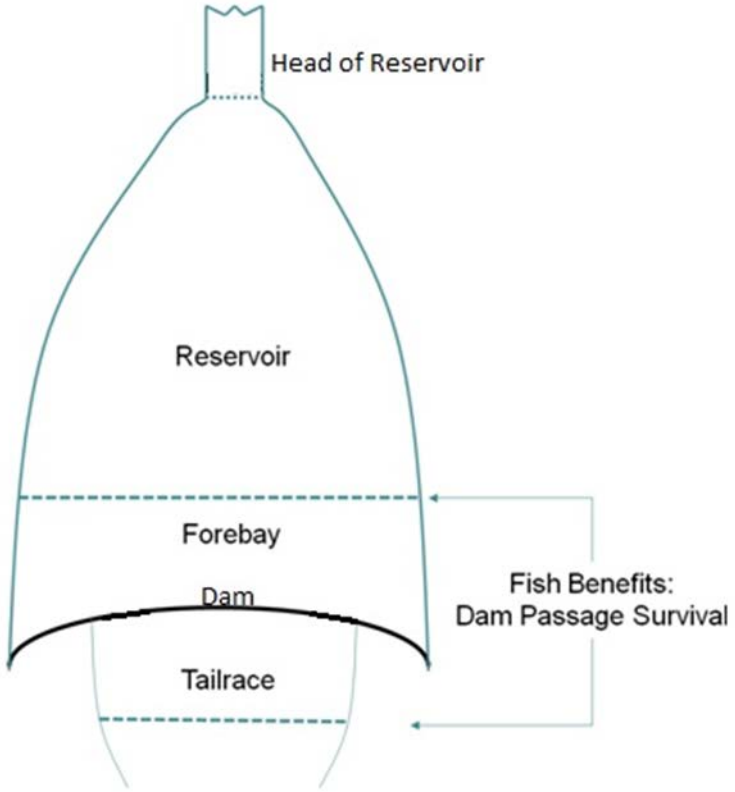
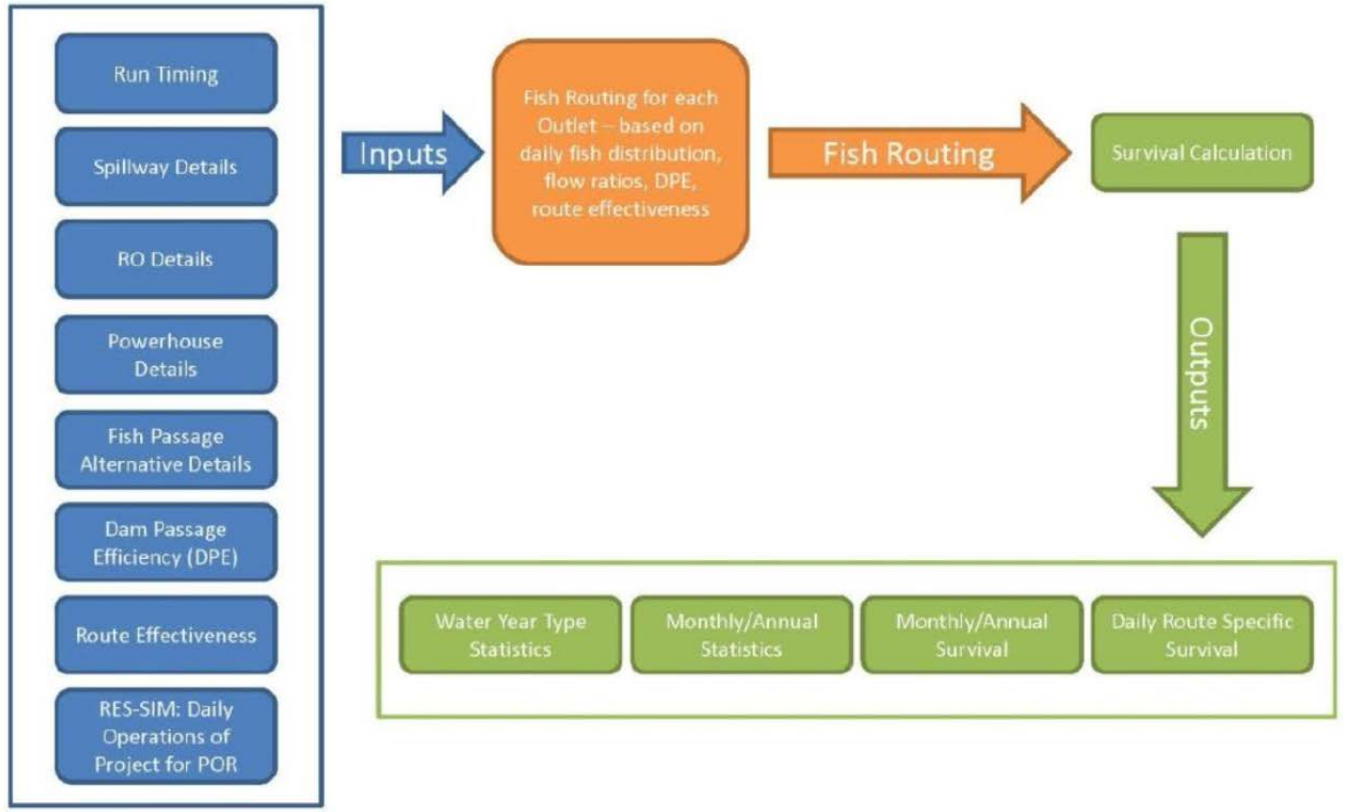
FISH BENEFIT WORKBOOK





Dam Passage Survival =
(Dam passage efficiency) x (Concrete survival)

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EDR COMPLETION AND PREFERRED ALTERNATIVE

- The PDT recommends a Floating Screen Structure (FSS) with truck transport to be carried forward to design
- The FSS provides a surface-oriented outlet for fish passage
- The at tower location takes advantage of existing flow provided by surface withdrawal through the tower for regular operations
- The FSS lends itself to potential modifications towards meeting collections efficiencies and survival goals
- EDR completed in 2016

DESIGN DOCUMENTATION REPORT (DDR)-COUGAR DOWNSTREAM PASSAGE

- The PDT began working on the DDR in 2016
- The main elements of the proposed FSS at Cougar Dam will be comprised of the following;
  - Fish collection and transport
  - Mooring system
  - Debris management plan
  - Operations and maintenance plan
- The 60% review was just completed in December 2017

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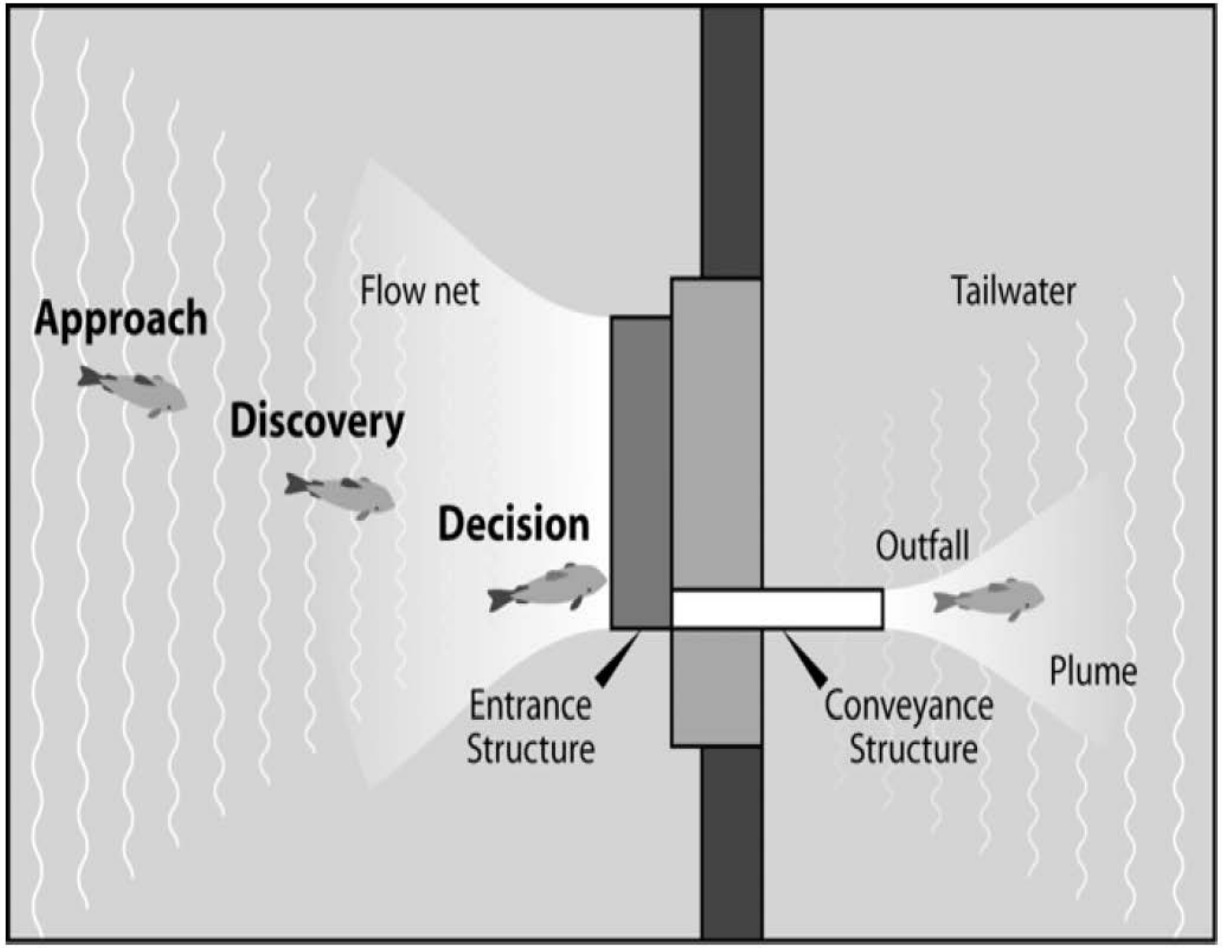
FACTORS DRIVING DESIGN

- Location
  - Locate the FSS near the WTCT in the cul-de-sac
  - Locate the FSS near known fish locations
- Pool Fluctuation
  - The FSS will need to fish over the entire reservoir range of elevations (1,532 ft. to 1,690 ft.)
- Flow
  - The FSS is designed to a maximum capacity of 1,000 cfs and a minimum flow of 350 cfs
  - Competing flow
- Entrance
  - Location, shape, and configuration



Source: ENSR, 2007

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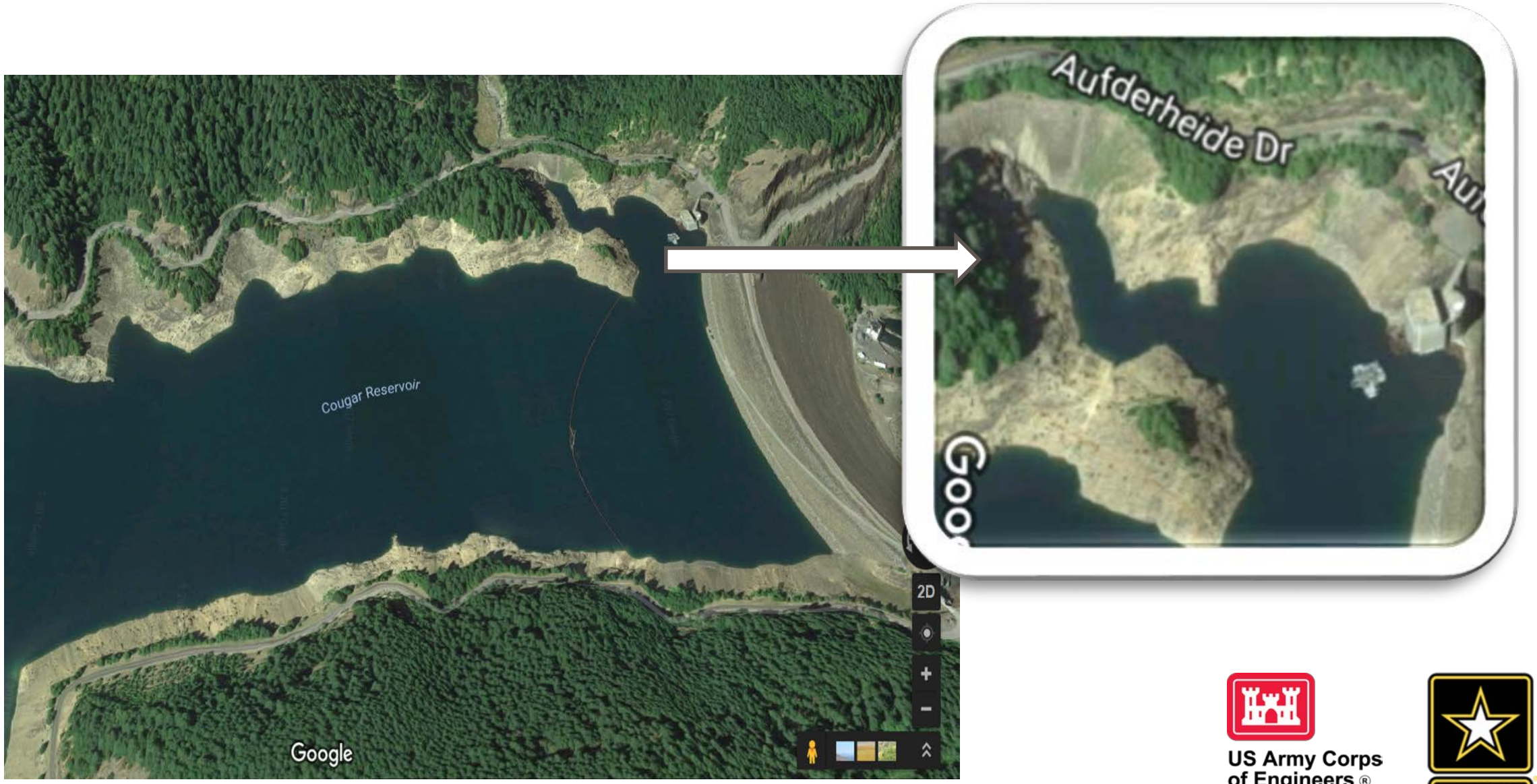
LOCATION INSIDE THE CUL-DE-SAC



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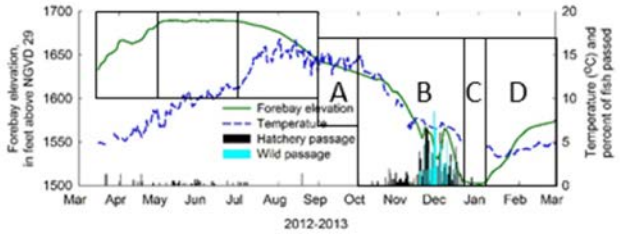
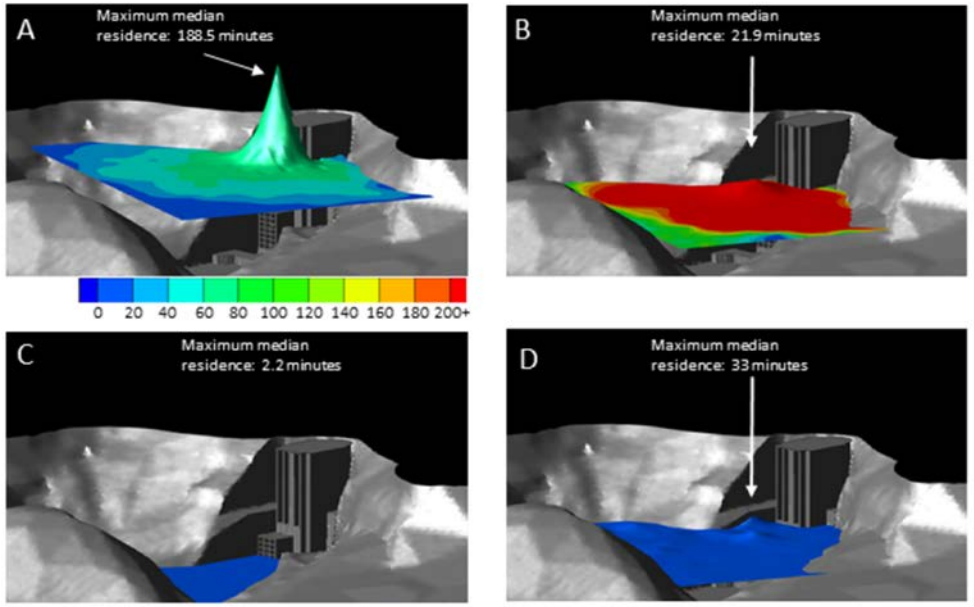
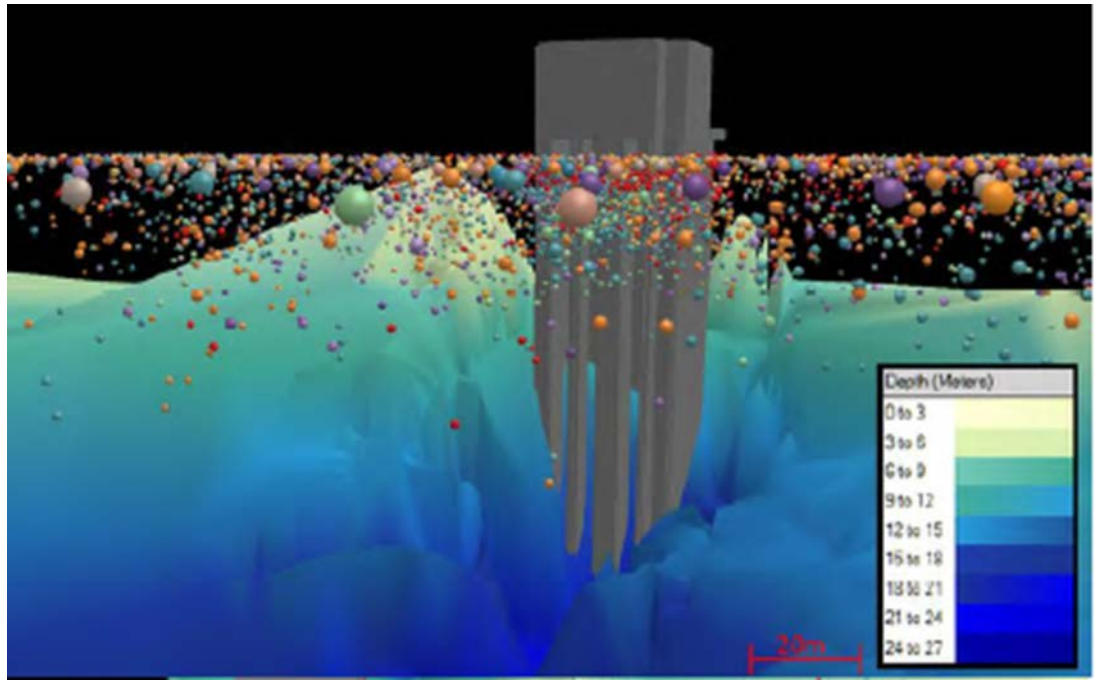
JUVENILE CHINOOK DISTRIBUTION





Spatiotemporal density graph of juvenile hatchery and wild (B only) Chinook salmon released into Cougar Reservoir and positioned within 200 meters of the temperature control tower, fall 2012 (Beeman et al.)



Three-dimensional fish position estimates near the temperature control tower for yearling Chinook salmon released into Cougar Reservoir, spring, 2011 (Beeman et al.)

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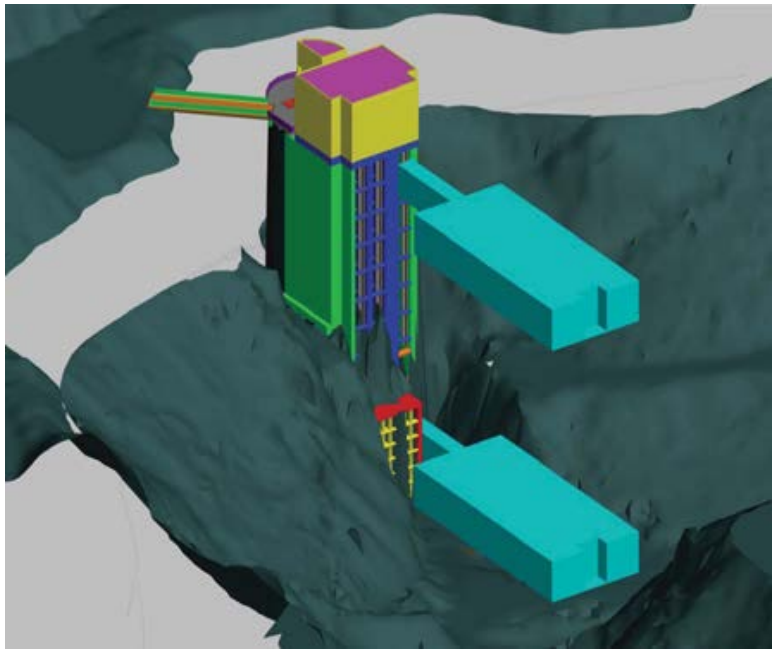
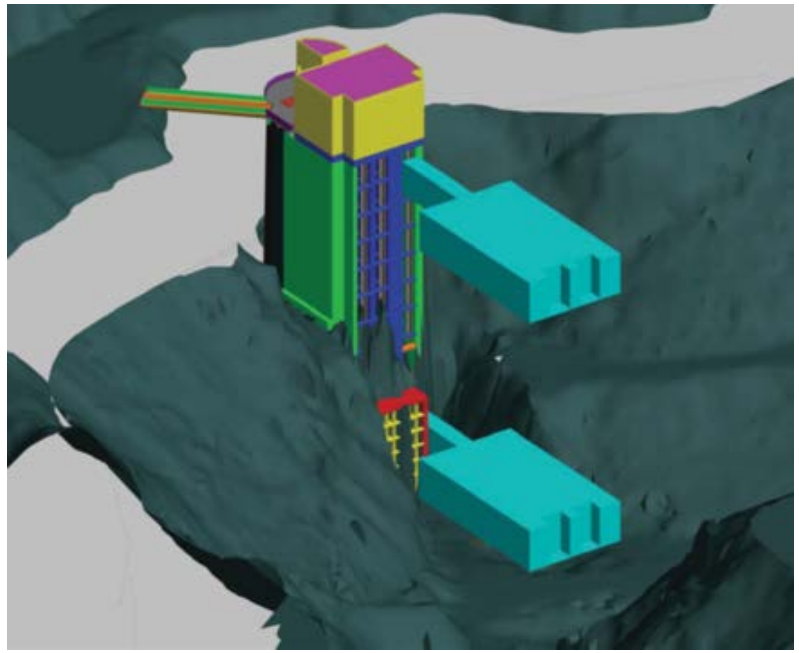
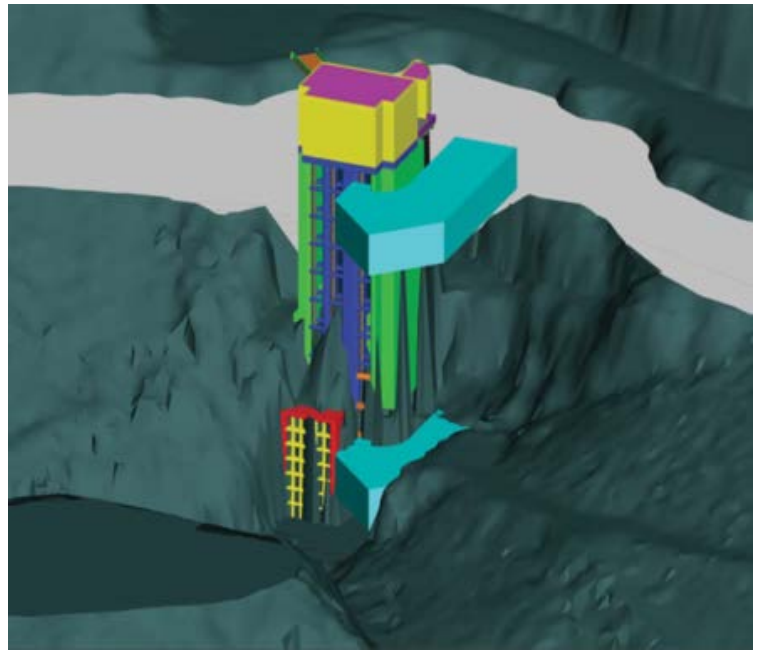
ENTRANCE LOCATION



Single entrance



Dual entrance



Dual entrance angled

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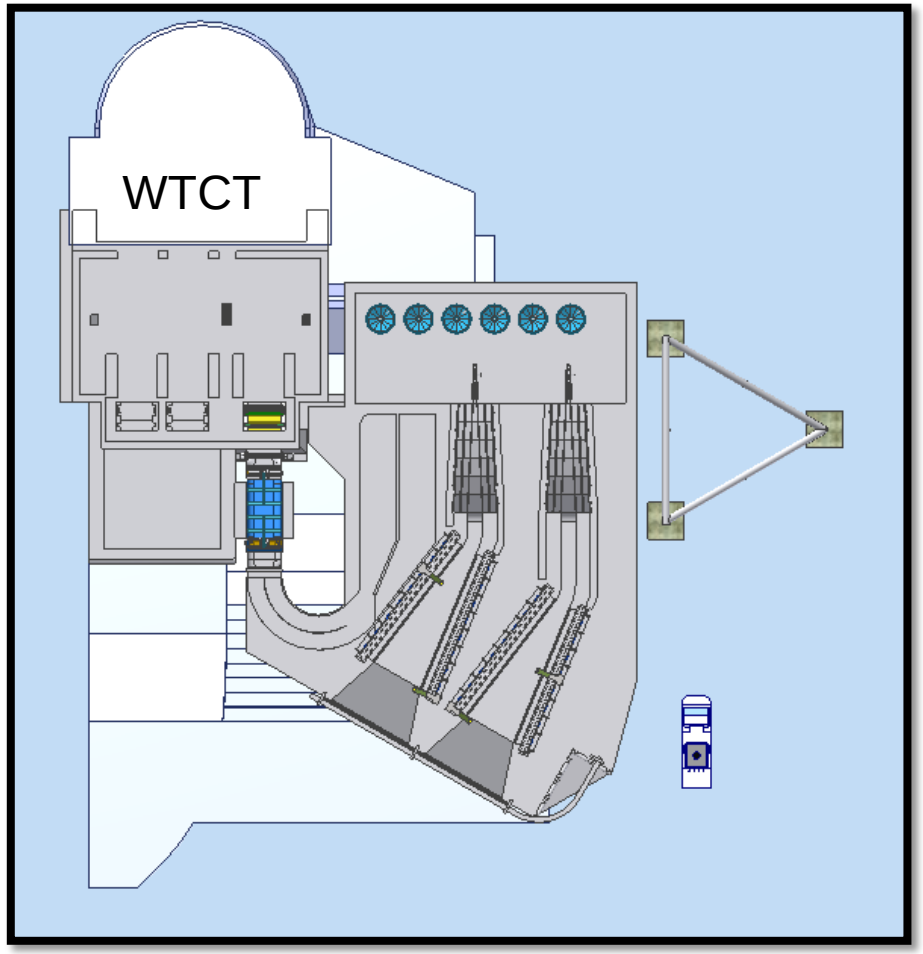
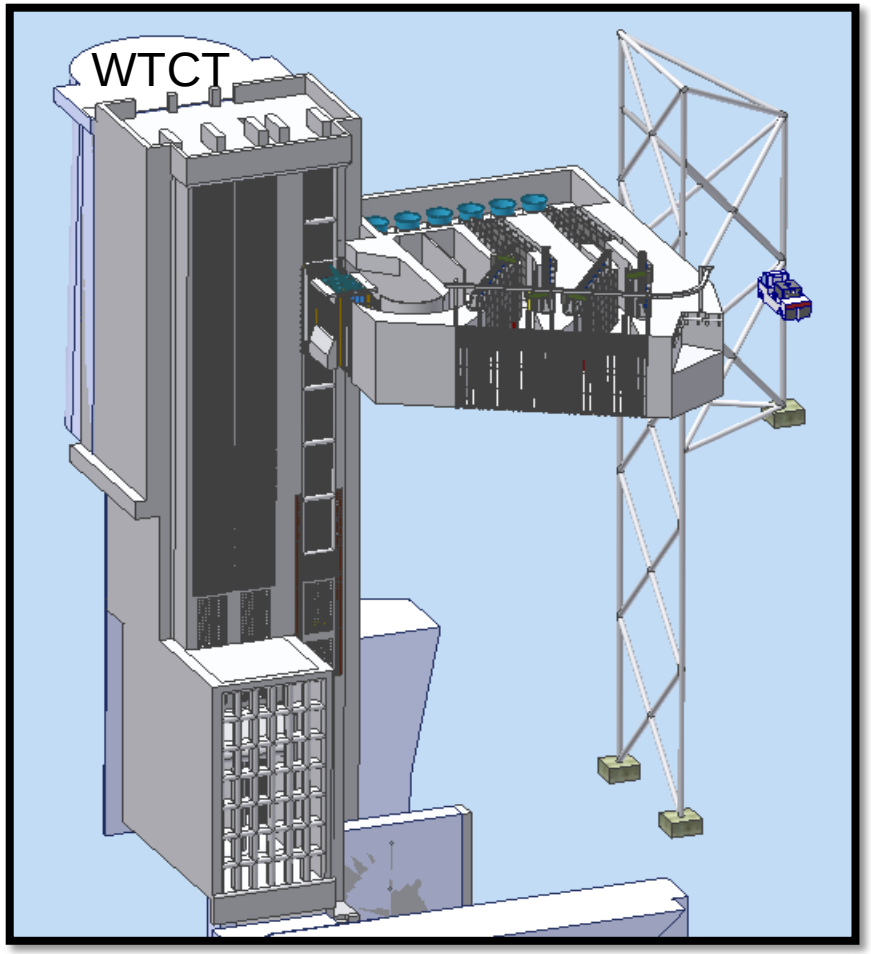
LOCATION – NEAR WATER TEMPERATURE CONTROL TOWER





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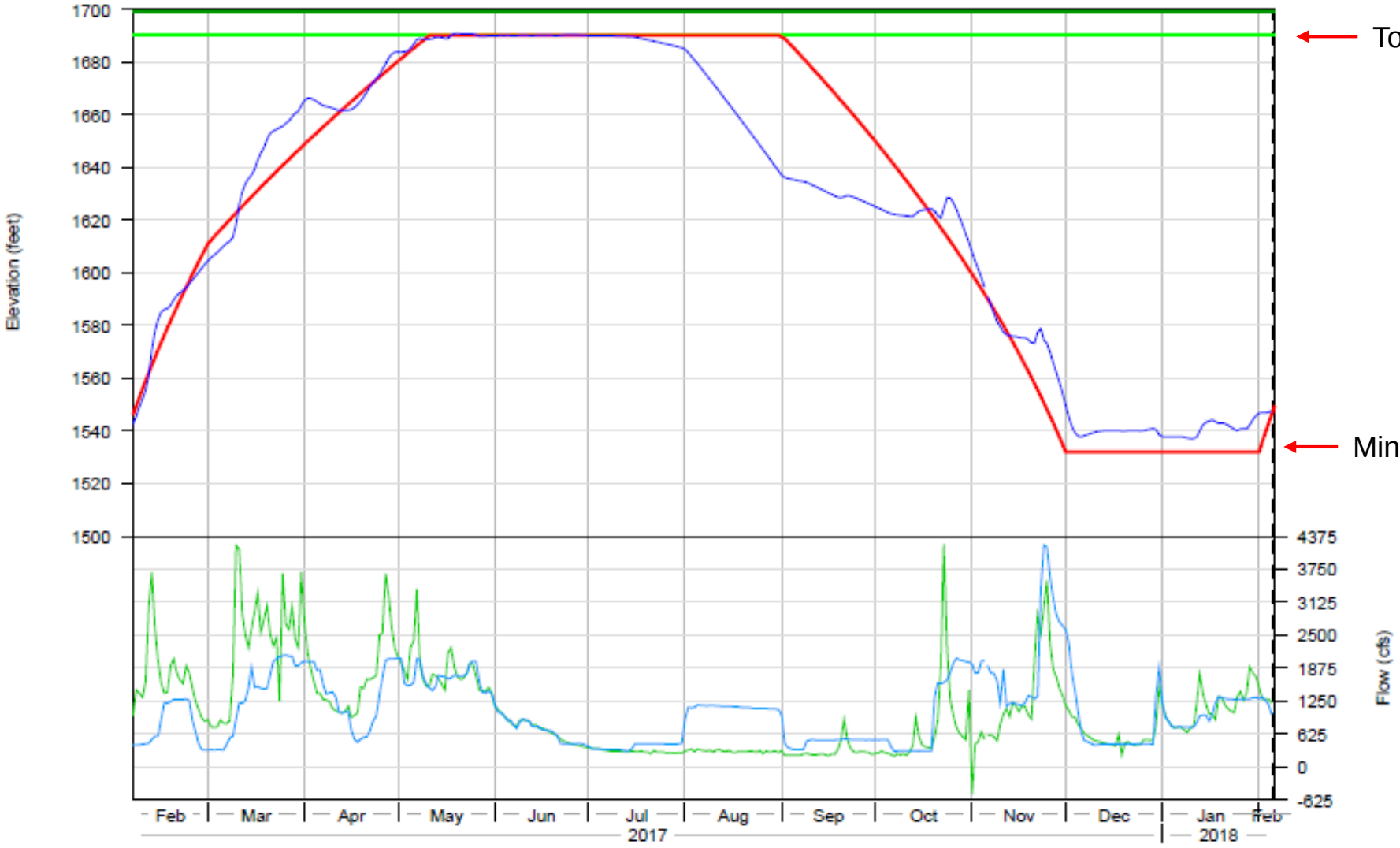
RESERVOIR FLUCTUATIONS-RULE CURVE



Top of conservation pool 1,690 ft.

Minimum conservation pool 1,532 ft.

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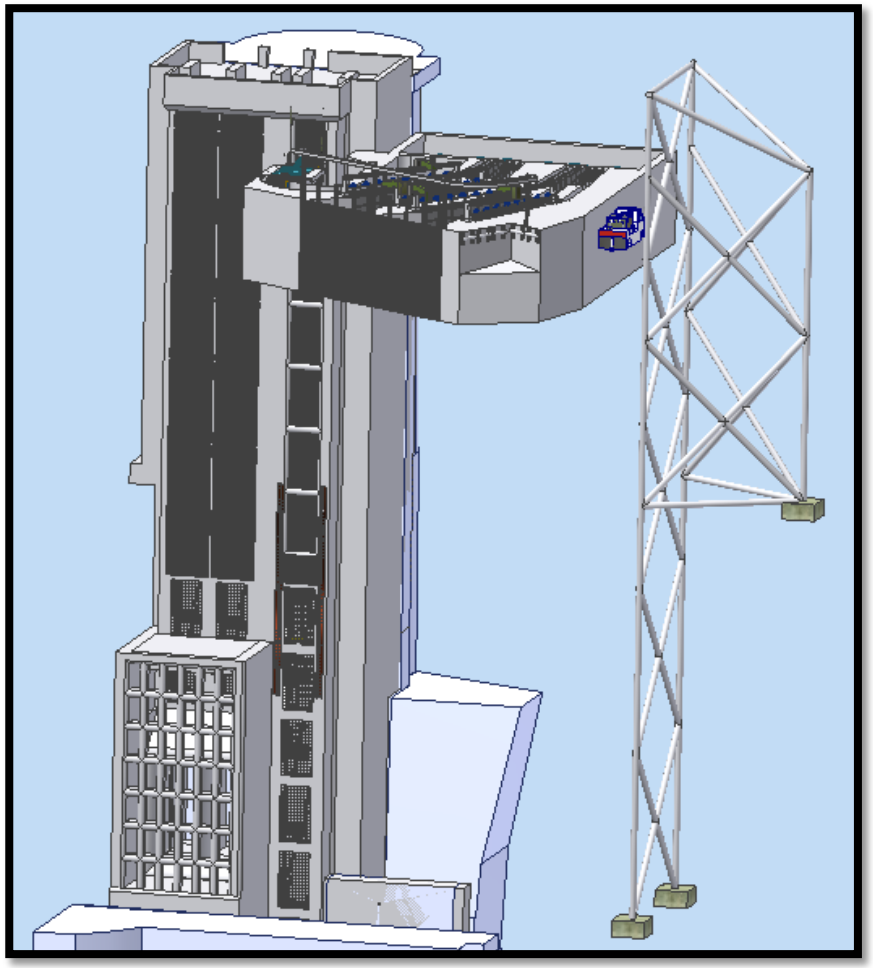
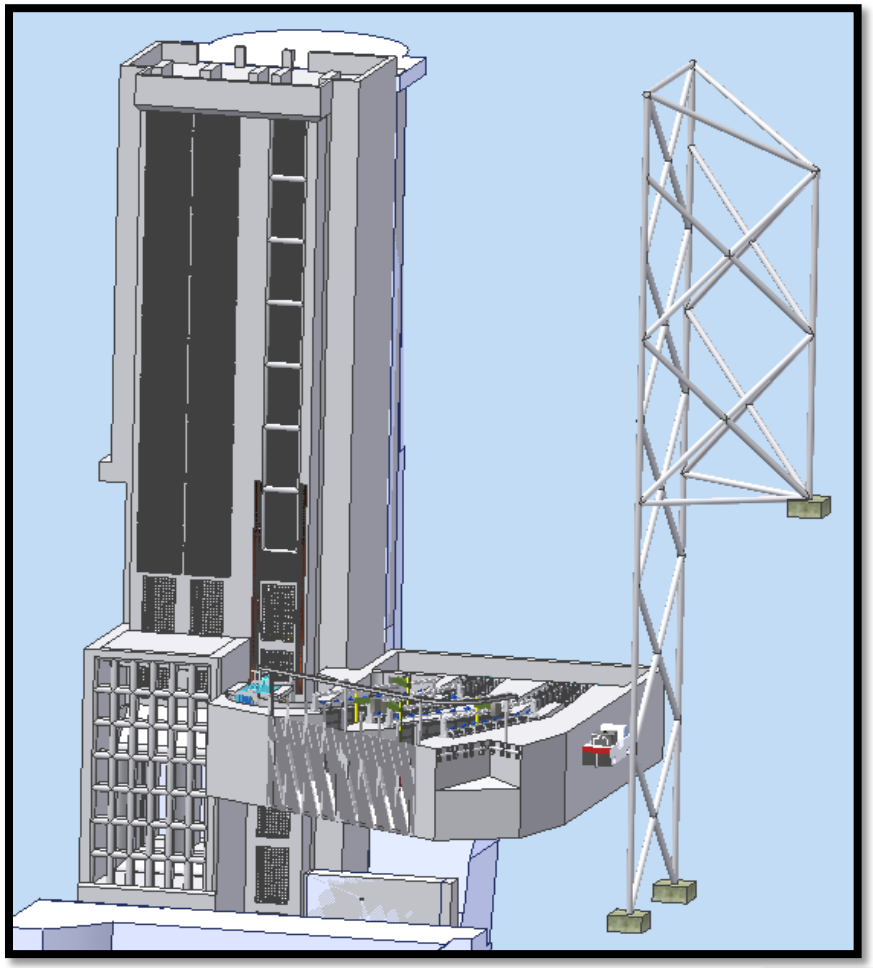
POOL FLUCTUATIONS



Elevation ~1,690

158 Ft.

Elevation ~1,532



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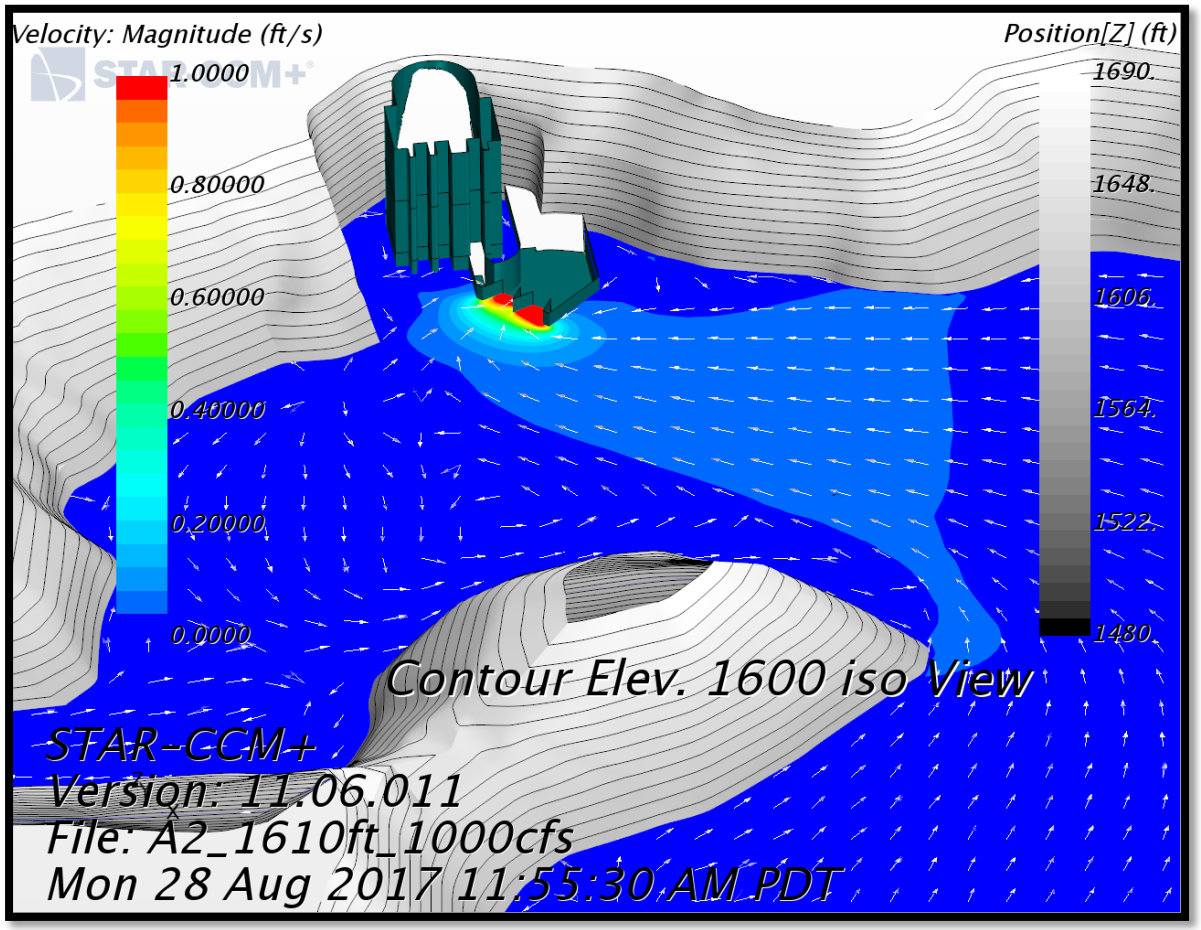
ENTRANCE FOCUS AREAS-SHAPE AND CONFIGURATION

Entrance hydraulics

- Proper hydraulic conditions are important
- Uncertainty in optimal entrance conditions for juvenile spring Chinook
- Design will be informed by CFD and considering physical modeling



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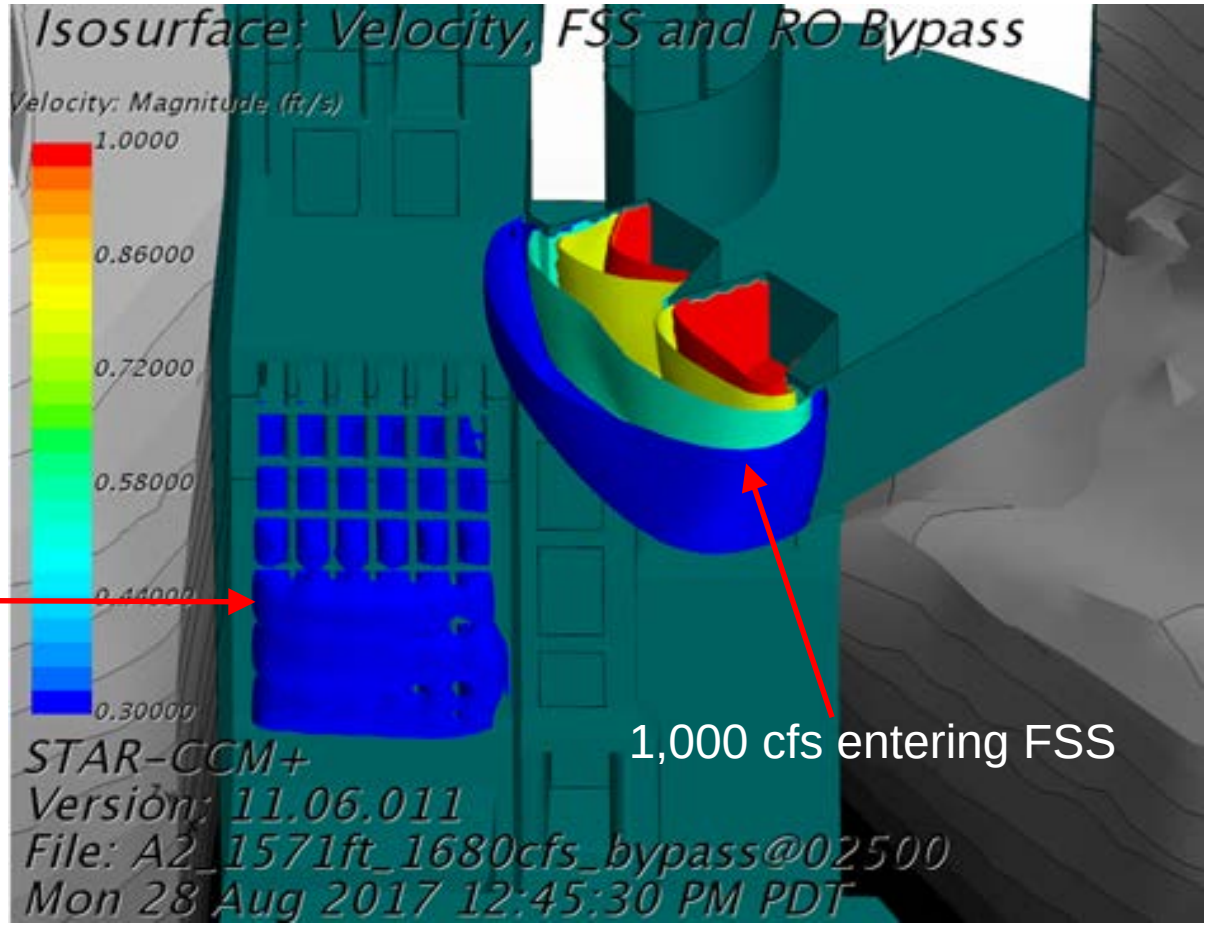
ENTRANCE FOCUS AREAS-COMPETING FLOWS

- Competing flows – high flow issue
- Maximum FSS design flow = 1,000 cfs
- Flow increments above 1,000 cfs will pass over the WTCT weirs and/or through the RO bypass gate

680 cfs entering RO bypass



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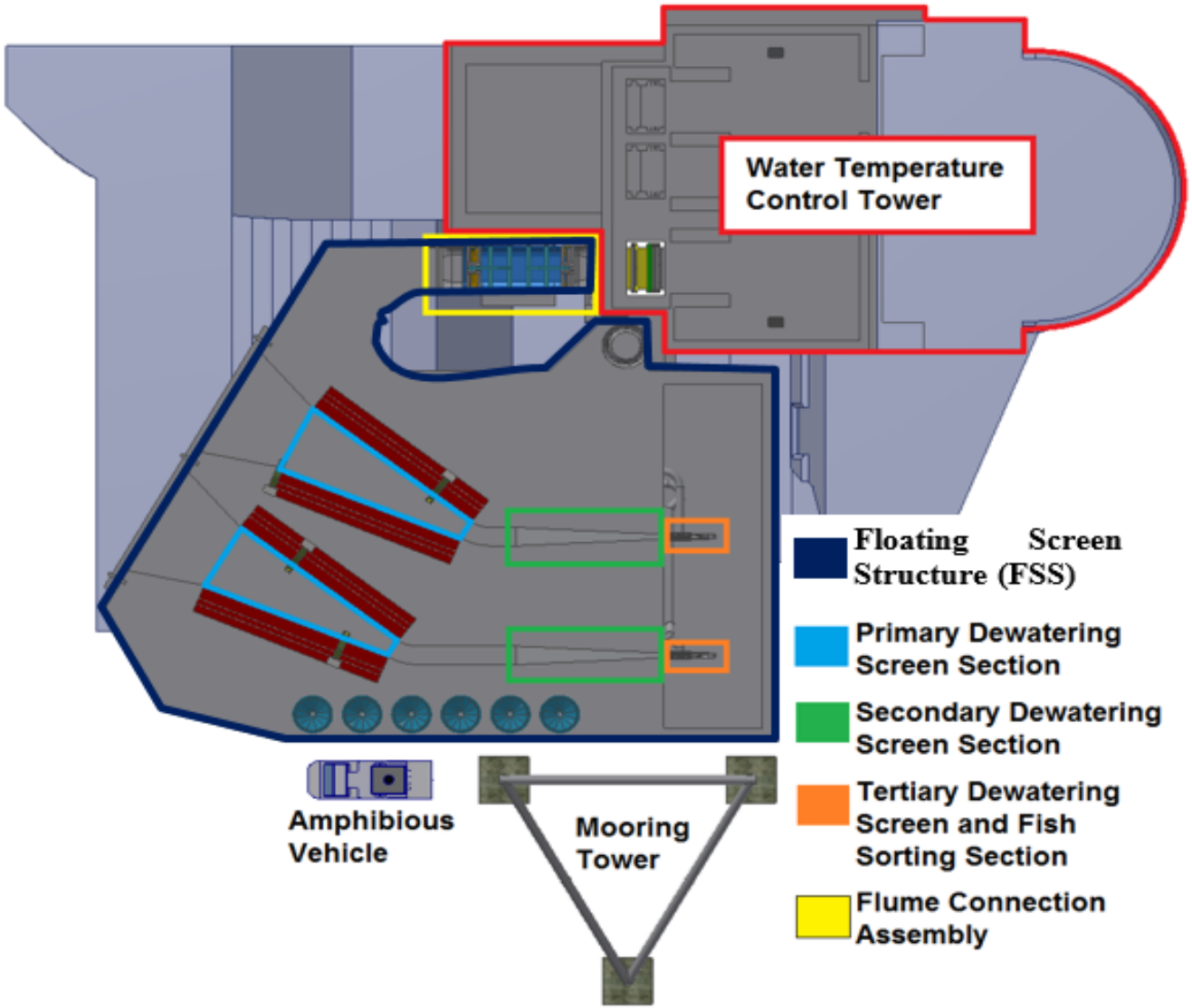
FLOATING SCREEN STRUCTURE OVERALL PLAN (60% DDR)



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DEBRIS MANAGEMENT SYSTEM

- Multiple debris booms
- Trash racks at the FSS

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QUESTIONS?

Photo courtesy of USGS