Jun 26th, 2:30 PM - 2:50 PM

Concurrent Sessions A: Emerging Engineering Solutions for Downstream Fish Passage at Big Dams - Downstream Fish Passage For Cle Elum Dam

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Managing Water in the West

Cle Elum Dam
Downstream Fish Passage
(a progression of studies and lessons learned)

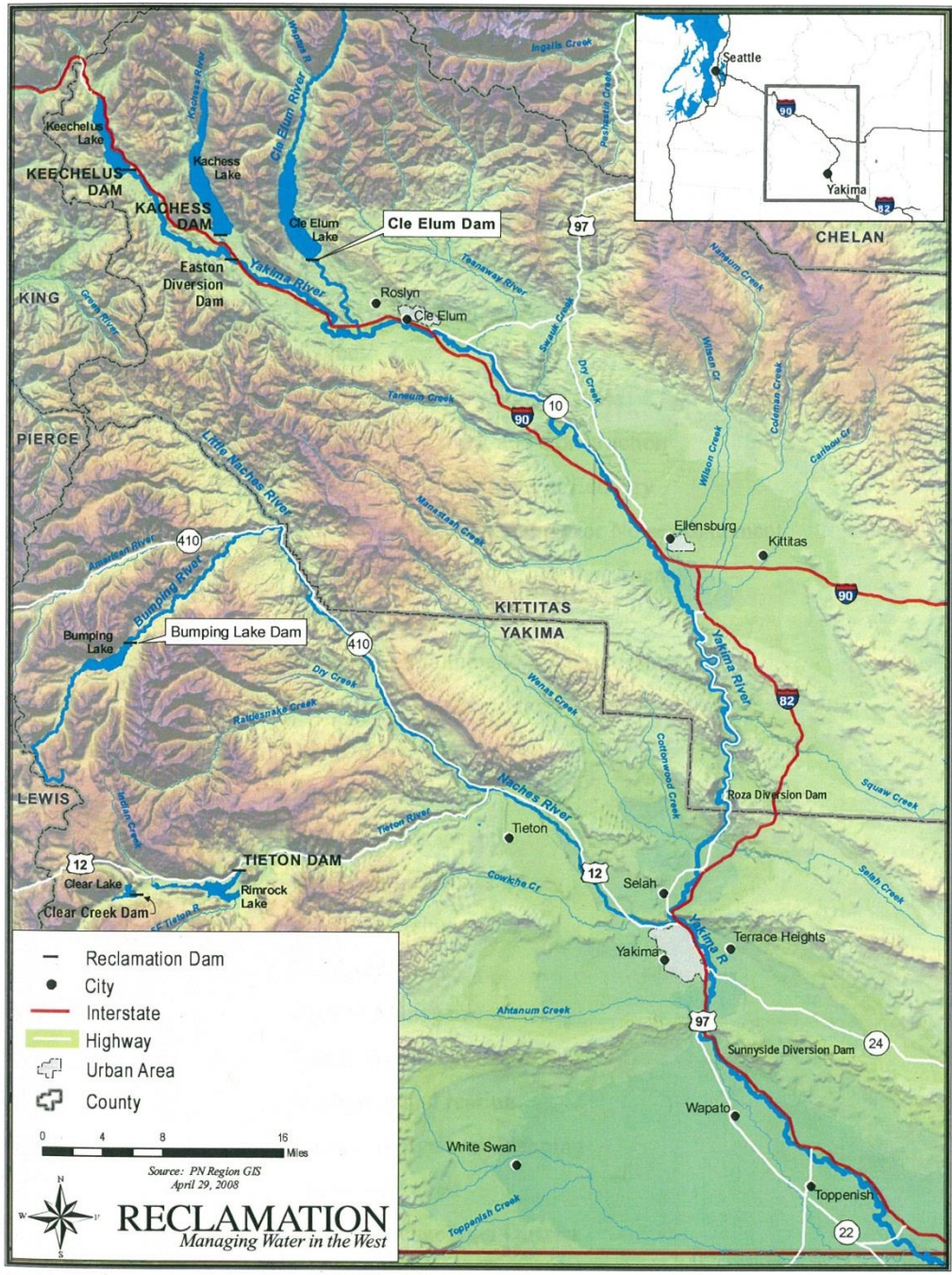
U.S. Department of the Interior
Bureau of Reclamation

Leslie Hanna
Hydraulic Investigations &
Research Laboratory

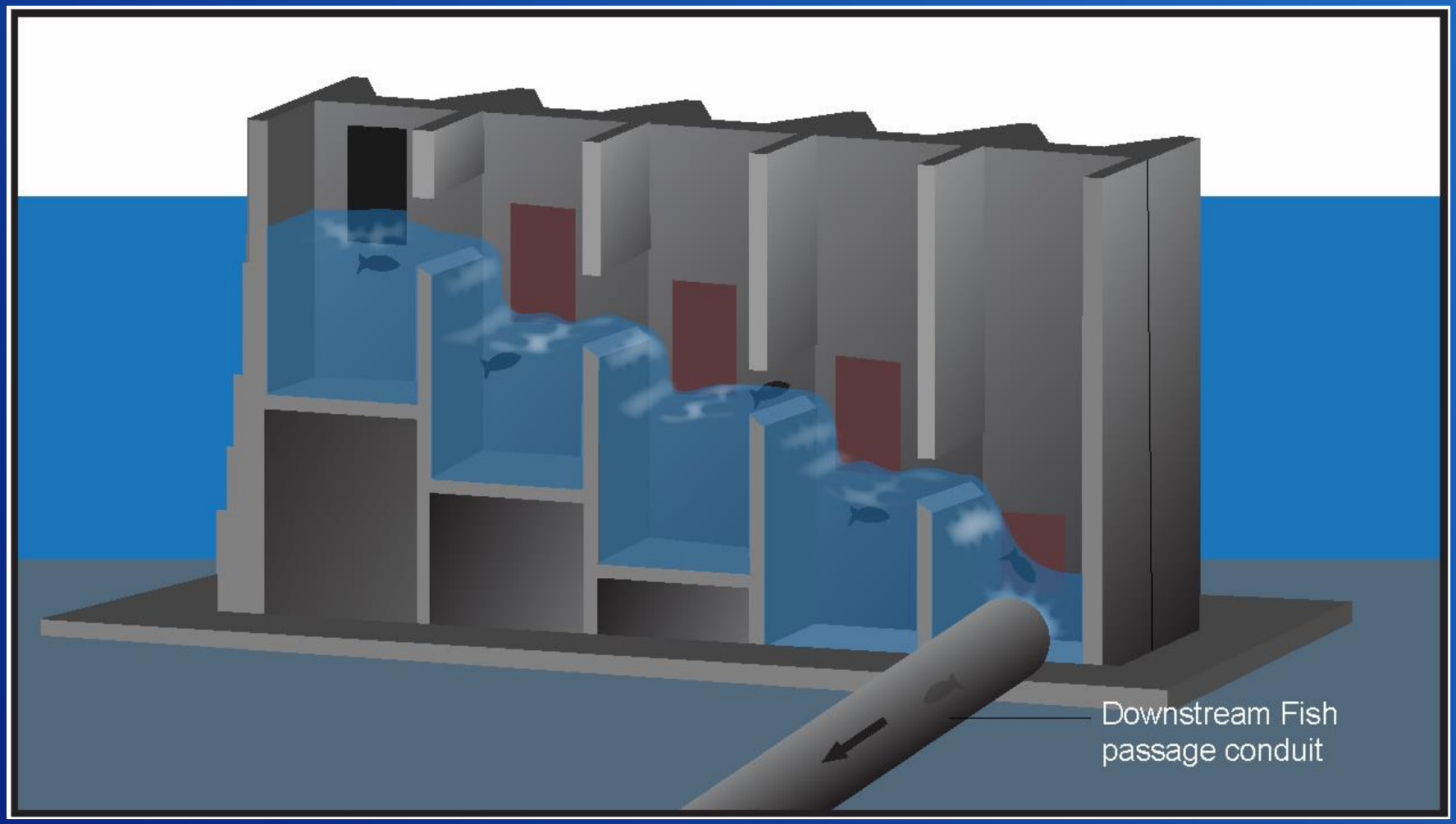
Yakima Projects Dams

Large Storage Reservoir Challenges

- Reduce Operation and Maintenance costs
- Dam Height
- Large water surface fluctuations due to seasonal releases.



Interior View of Multi-level Gated Intake Structure



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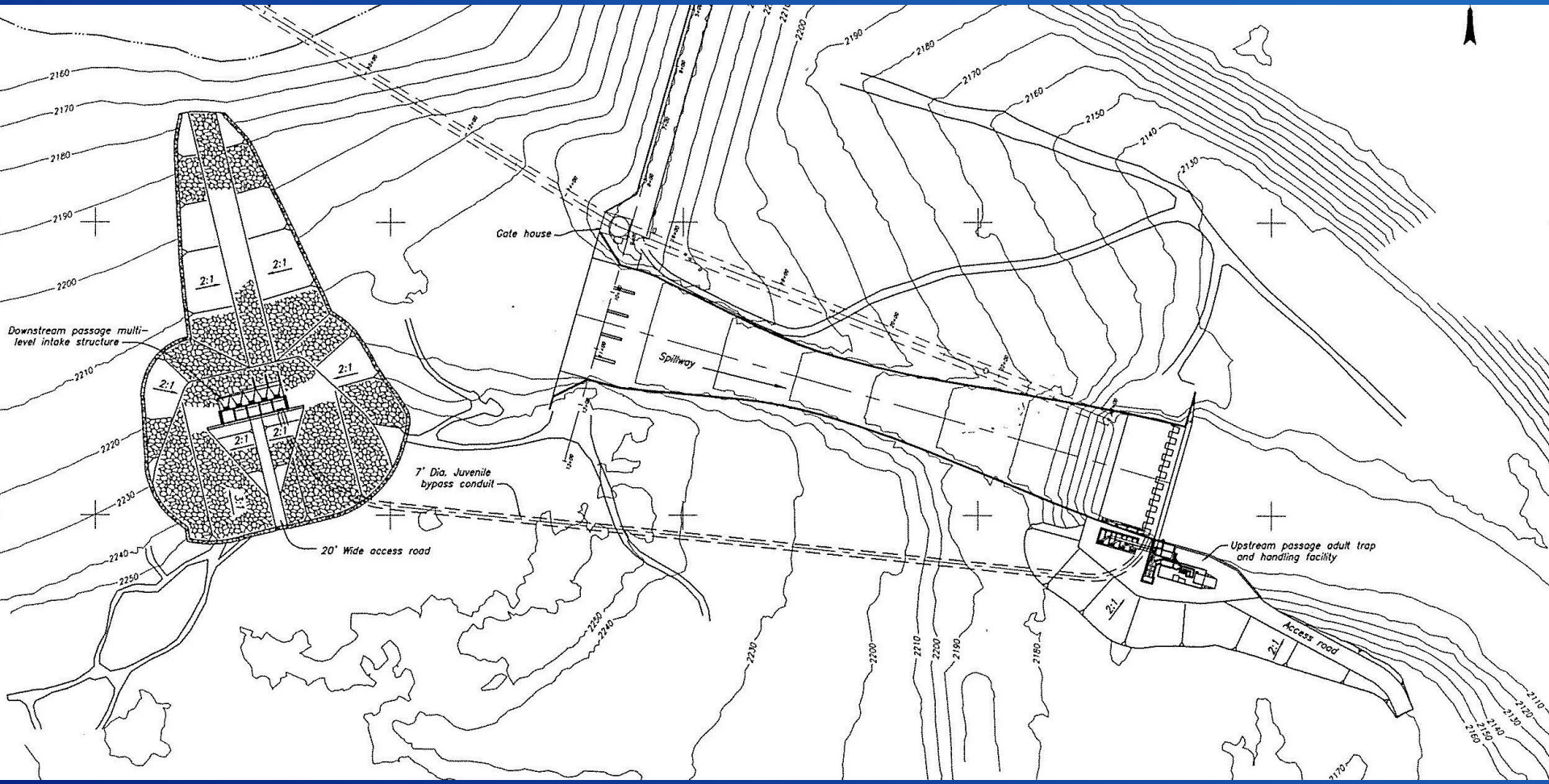

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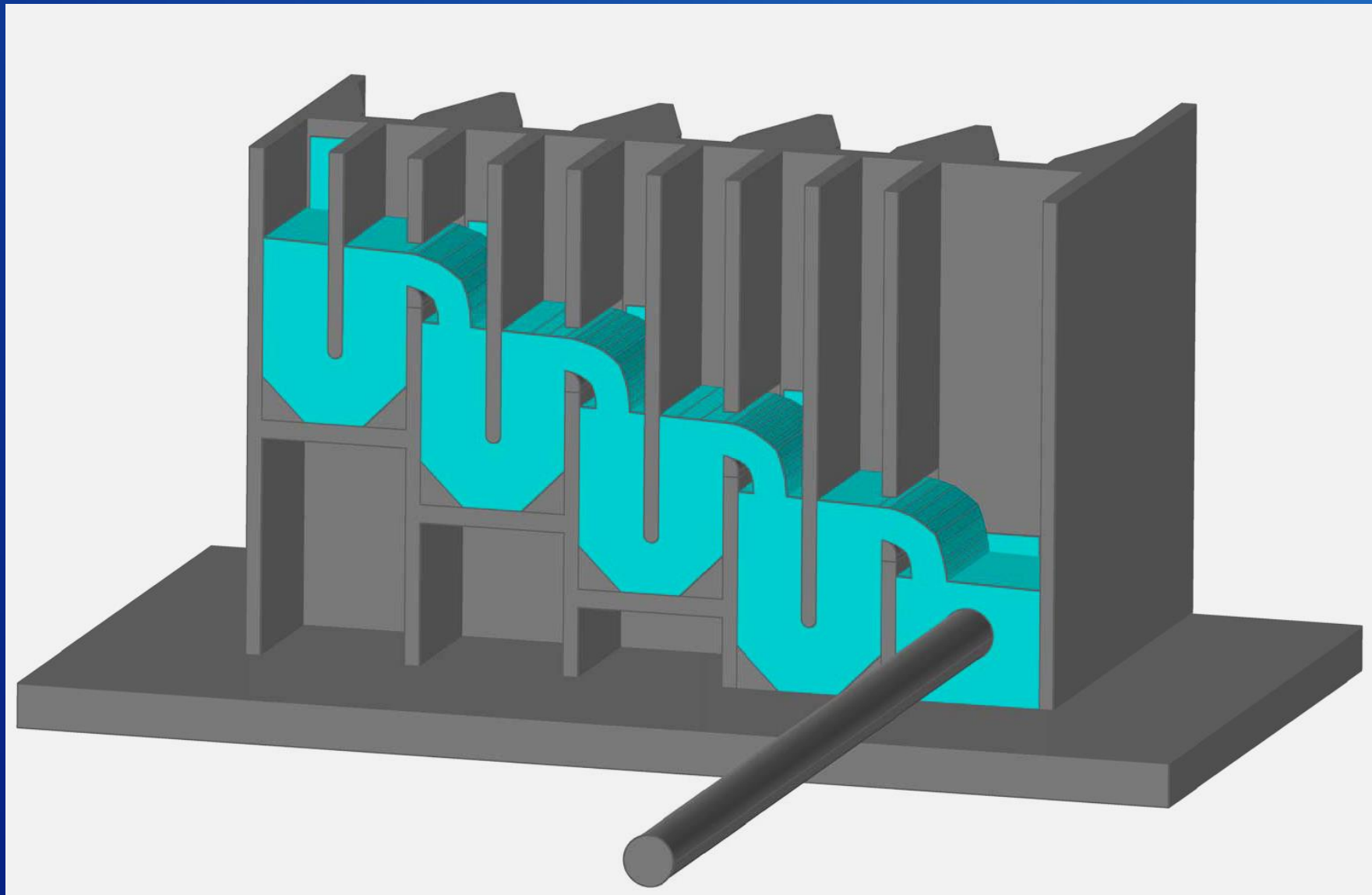
Cle Elum Intake Tower , Q = 400 cfs

Cle Elum Intake Tower with Orifices
Q = 200 cfs

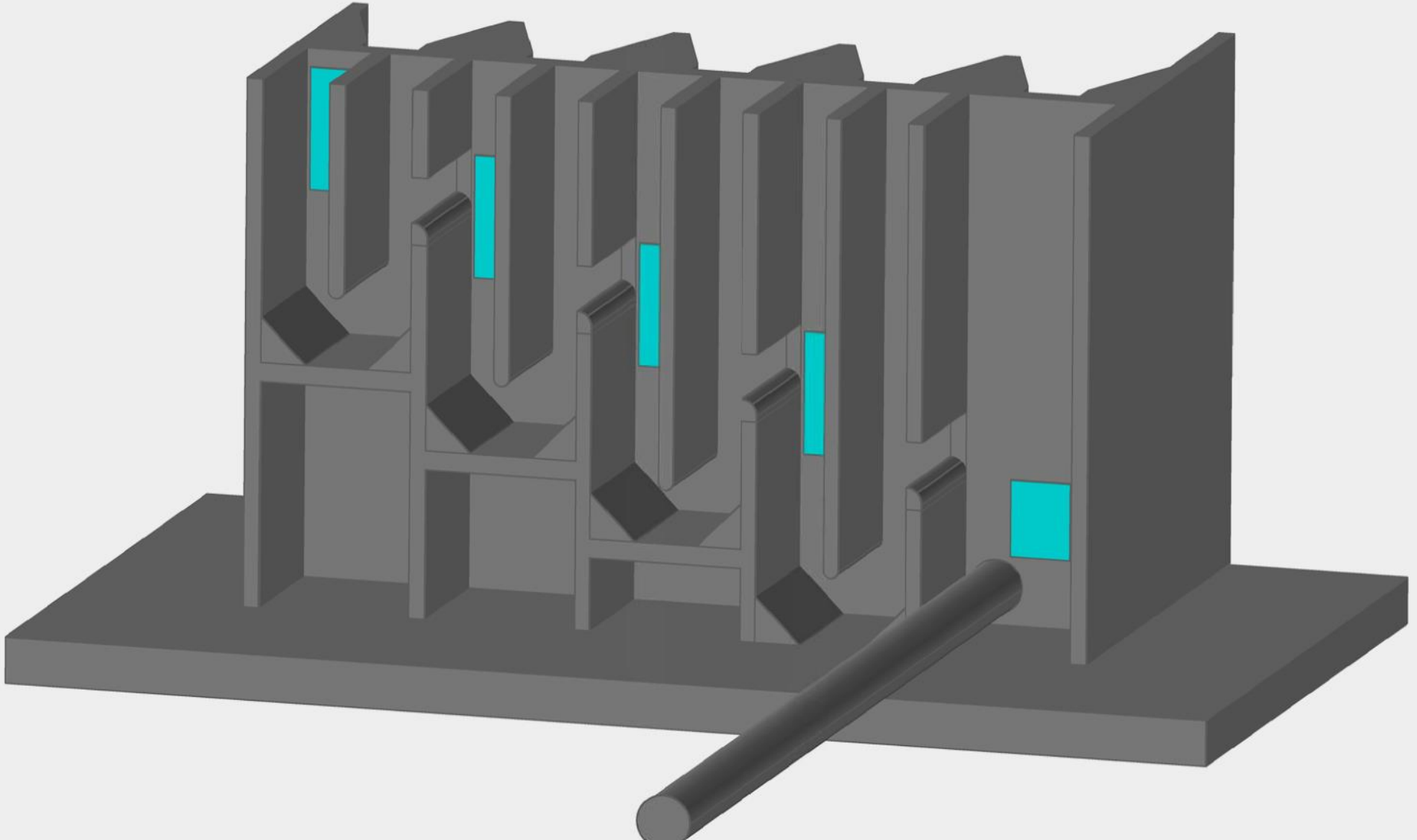
Back to the drawing board!!!

Brain storming new concepts

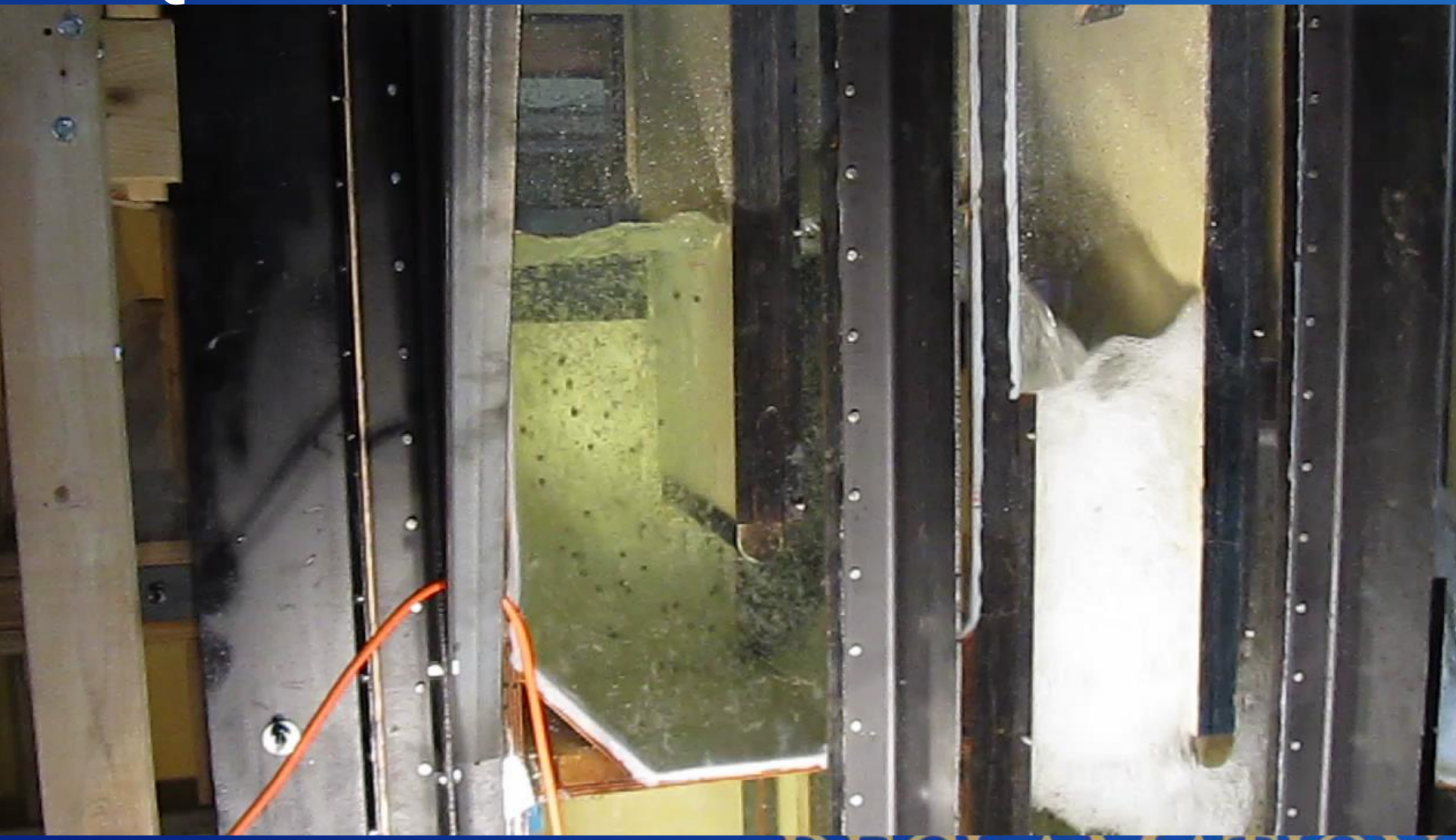
Upwelling Concept



Upwelling Model Layout
1:10 geometric Scale



Cle Elum Upwelling Model
Q = 400 cfs Reservoir El 2236.6 ft



Model discharge to produce average prototype velocity in model

Prototype Discharge Q_p (ft^3/s)	Prototype Cross Section Area below Center Wall A_p (ft^2)	Prototype Average Velocity V_p (ft/s)	Model Cross Section Area below Center Wall A_m (ft^2)	Model Discharge to achieve V_p $Q_m = Vp * A_m$ (ft^3/s)	Model Scaled Discharge (ft^3/s)
400	180	2.23	1.8	4.0	1.26
300	180	1.67	1.8	3.0	0.95

Cle Elum Upwelling Model Fish Tests
3 Large trout (5-6 in length), 3 small trout (2 in)
Prototype Velocities for Qp = 300 ft^3/s, (Qm=3 ft^3/s)

1:10-2:53)

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Cle Elum Upwelling Model Fish Tests Ramped up to Prototype Velocities for Q = 300 ft^3/s (Qm=3 ft^3/s)

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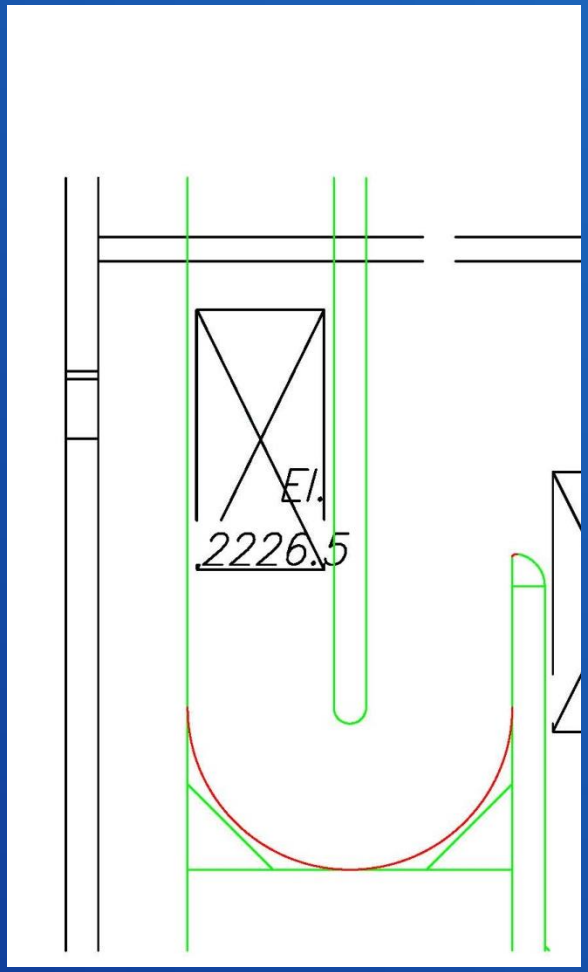
Cle Elum Upwelling Model



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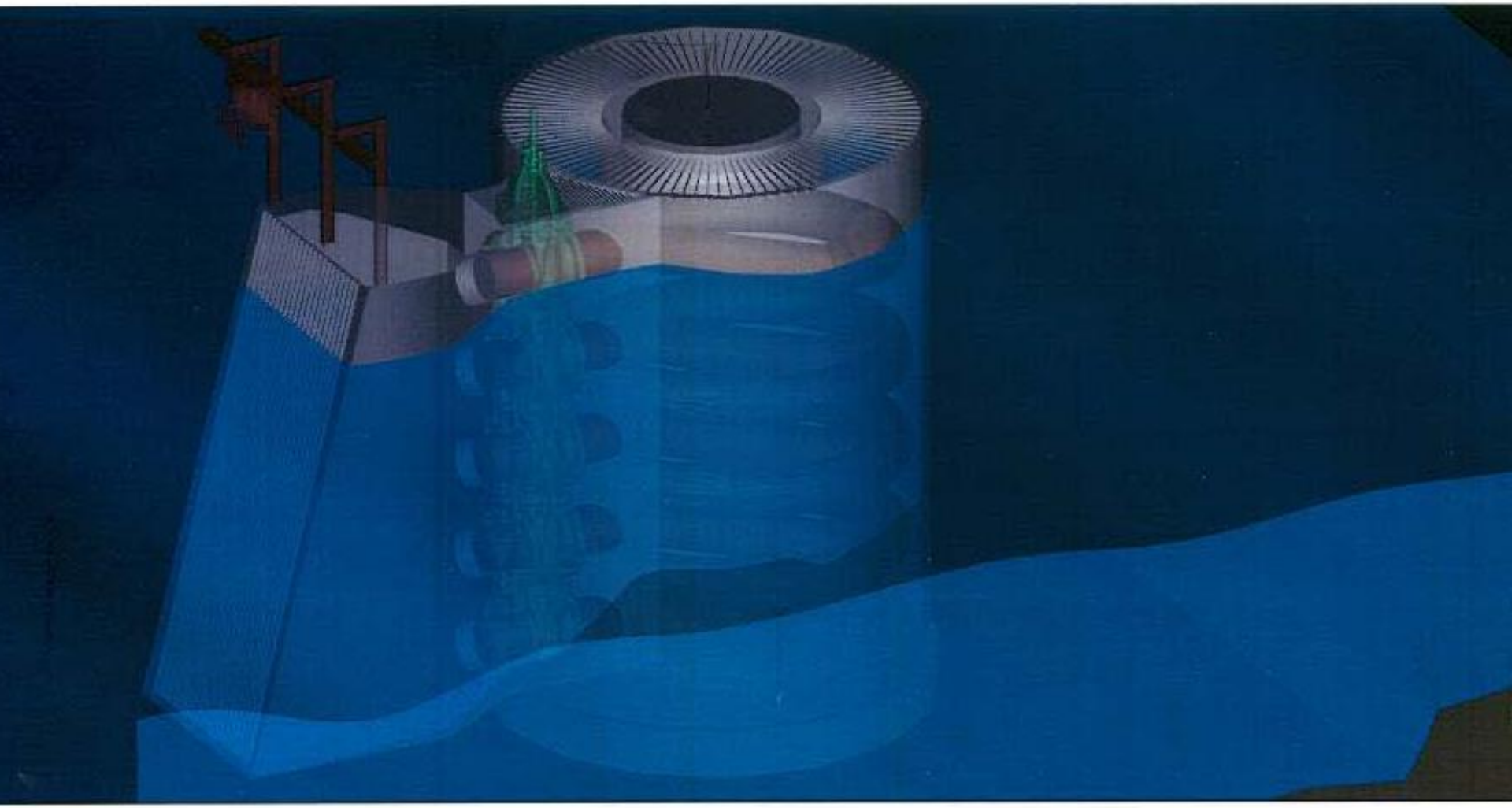
Upwelling Concept Conclusions

- Improved design over drop –pool concept
- Fish should pass through system quickly although within a very turbulent environment
- Sinusoidal design is not considered optimal by fisheries biologists
- Further evaluation with biological testing is recommended if this concept were carried forward

What Next?

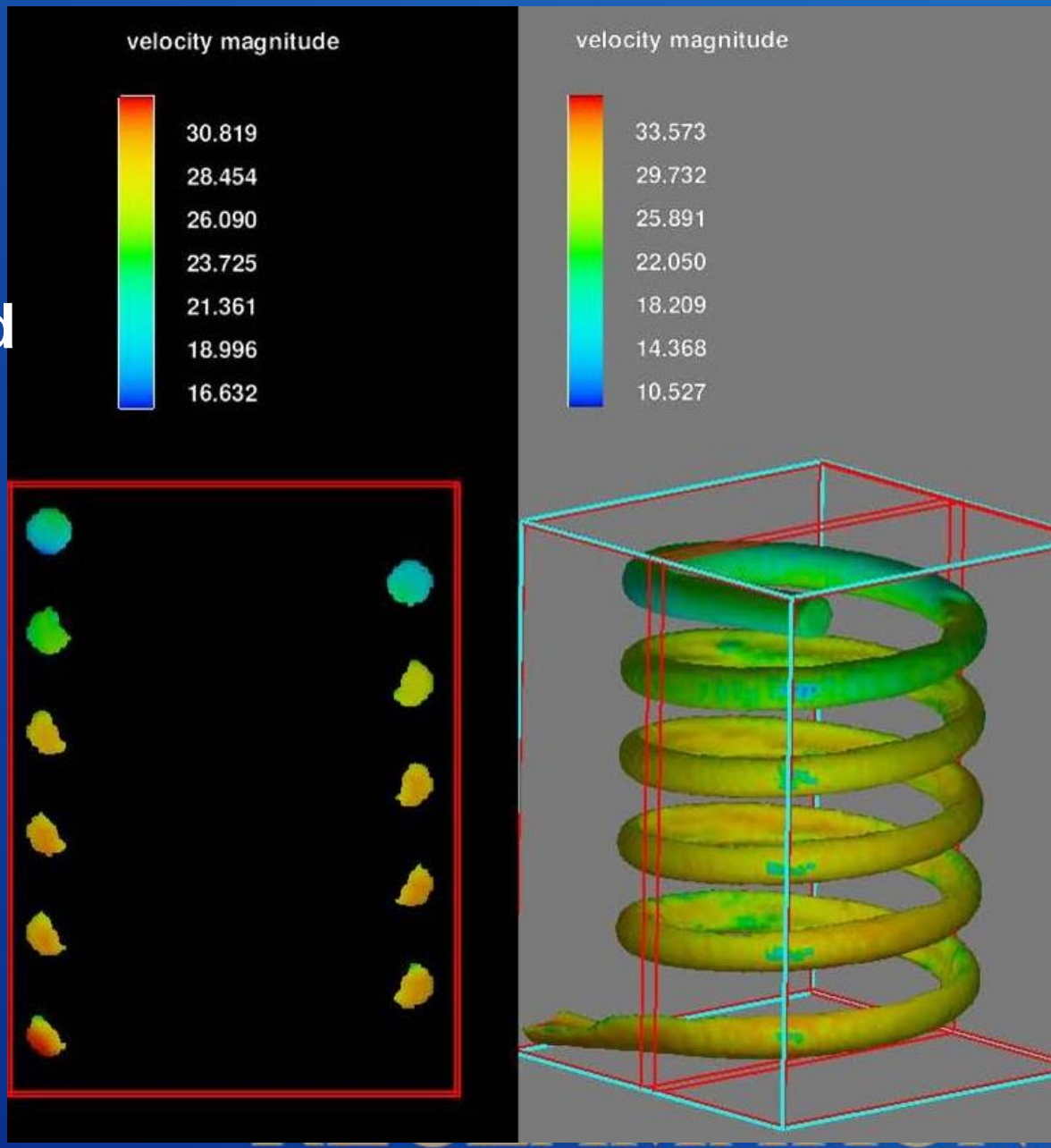
Helix Concept

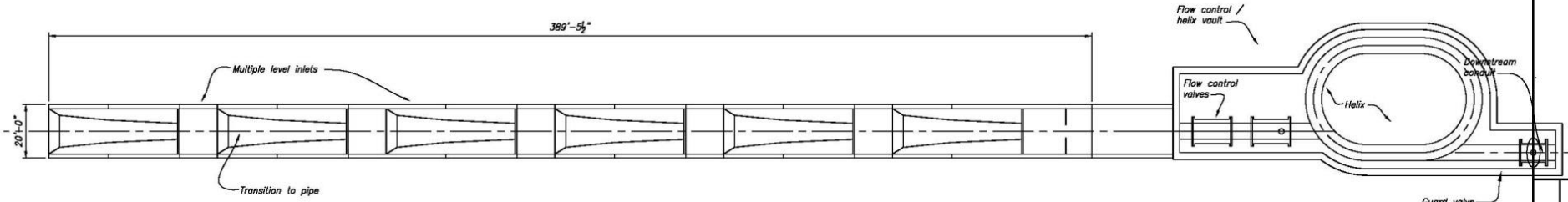


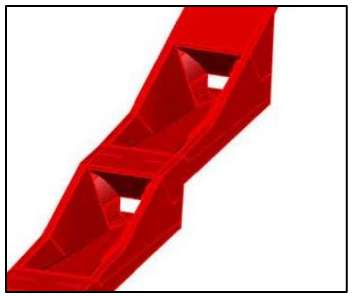
Preliminary (10% slope)

Advantages

- Long, relatively mild slope
- Small footprint
- Smooth transitions

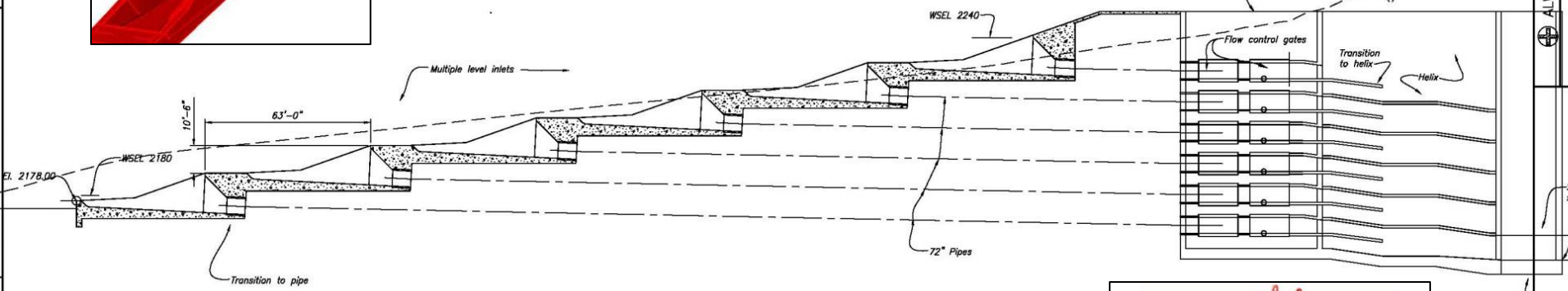


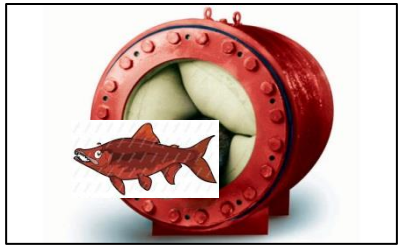




PLAN
MULTIPLE INLET AND HELIX

SCALE OF FEET





PROFILE

SCALE OF FEET

ALWAYS THINK SAFETY

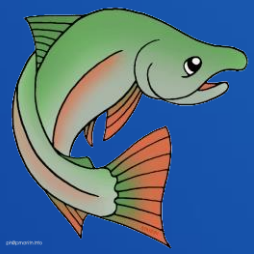
Next Steps

- **Numerical modeling will be used to determine initial shape and configuration for Helix concept.**

- **Physical modeling will be used to refine the intake structure and helix into the final design for Cle Elum downstream passage**

- **Long term restoration plan calls for implementing lessons learned and proven methods rising from the Cle Elum project to other large storage dams on the Yakima project**

Acknowledgments



Special Thanks to:

- Yakama Nation: Mark Johnston, Brian Saluskin, Dave Fast
- NMFS: Bryan Nordlund, Sean Gross
- Yakima Basin Joint Board: David Child (the YBJB represents the major irrigation districts)
- WA State Department of Fish & Wildlife (WDFW): John Easterbrooks
- Bureau of Reclamation: Joel Hubble, Wendy Christensen, Brent Mefford, Jason Wagner, Steve Montague, Walter Larrick, Elizabeth Cohen

Questions?

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End

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Interim Fish Passage at Cle Elum Dam

- **Reclamation agreed to provide interim downstream fish passage at Cle Elum dam until a permanent facility was implemented, as a part of an agreement with the Yakama Nation.**

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