

# Solving a 19th Century Challenge with a 21st Century Solution:

Cascade Water Alliance's Improvements to a  
+100-year-old Reservoir



**JACOBS®**

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Cascade Water Alliance's Improvements to a  
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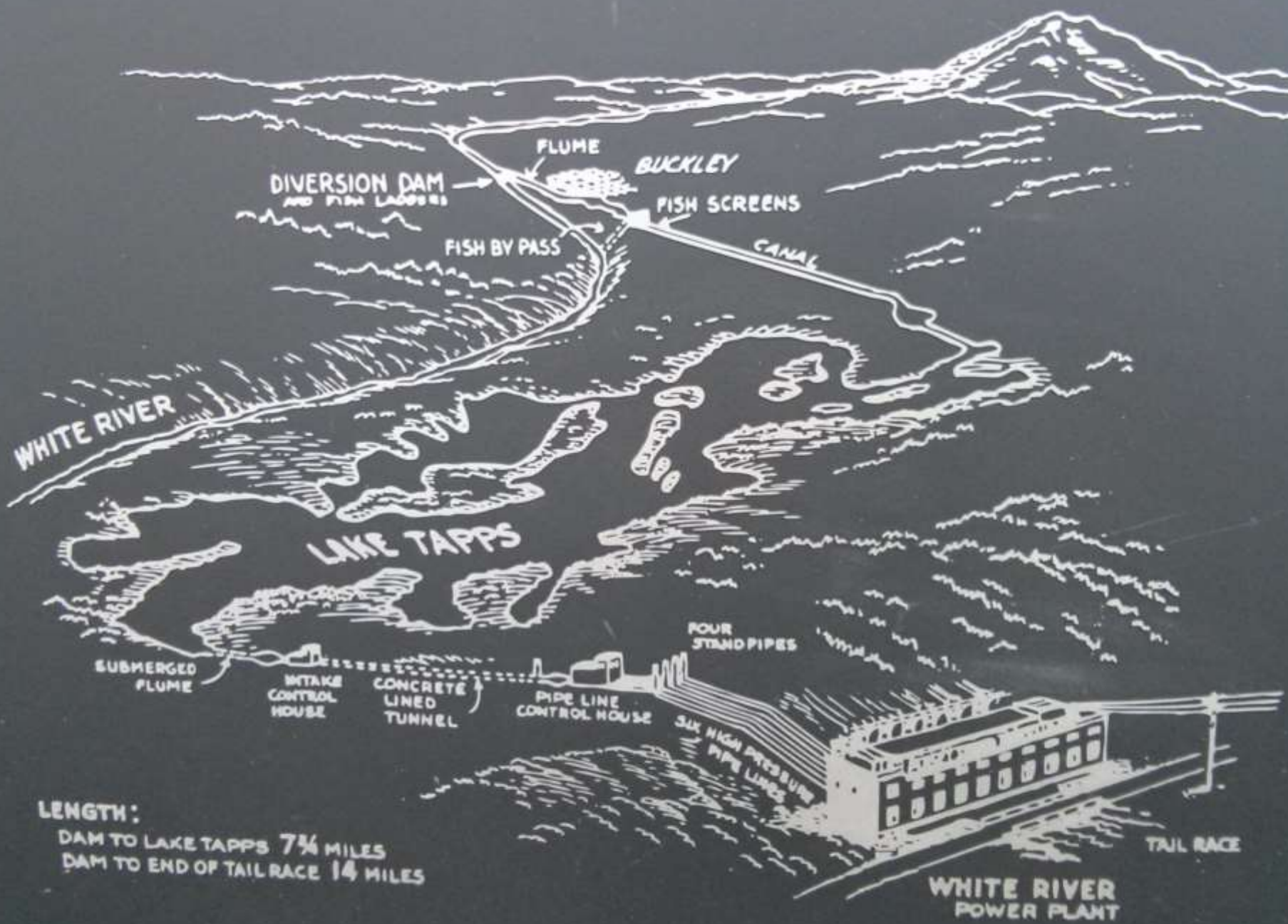
# Agenda

1. Project Background
2. Drivers and Challenges
3. Alternative Solutions
4. Accelerated Construction
5. Commissioning
6. Overall Schedule and Cost



# Project Background

MT. RAINIER



DIVERSION DAM AND FISH LADDERS

FLUME

BUCKLEY

FISH SCREENS

CANAL

FISH BY PASS

WHITE RIVER

LAKE TAPPS

SUBMERGED FLUME

INTAKE CONTROL HOUSE

CONCRETE LINED TUNNEL

PIPE LINE CONTROL HOUSE

FOUR STANDPIPES

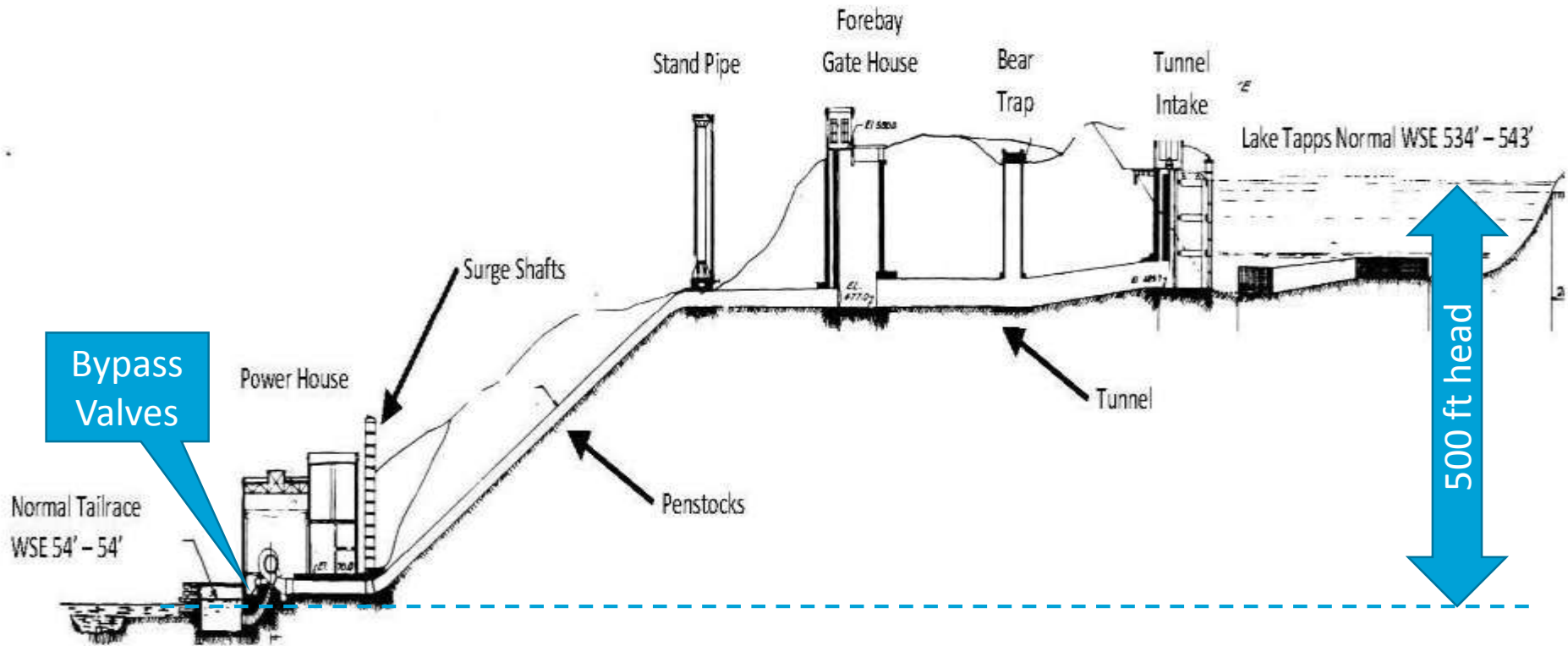
SIX HIGH PRESSURE PIPE LINES

TAIL RACE

WHITE RIVER POWER PLANT

LENGTH:  
DAM TO LAKE TAPPS 7 1/4 MILES  
DAM TO END OF TAIL RACE 14 MILES

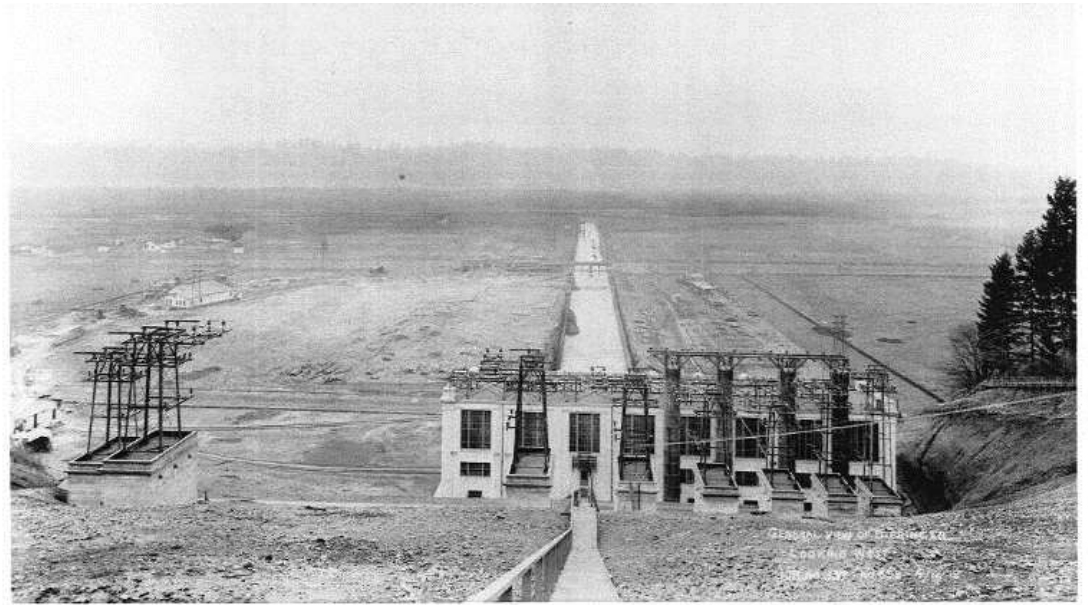
# Lower Conveyance System





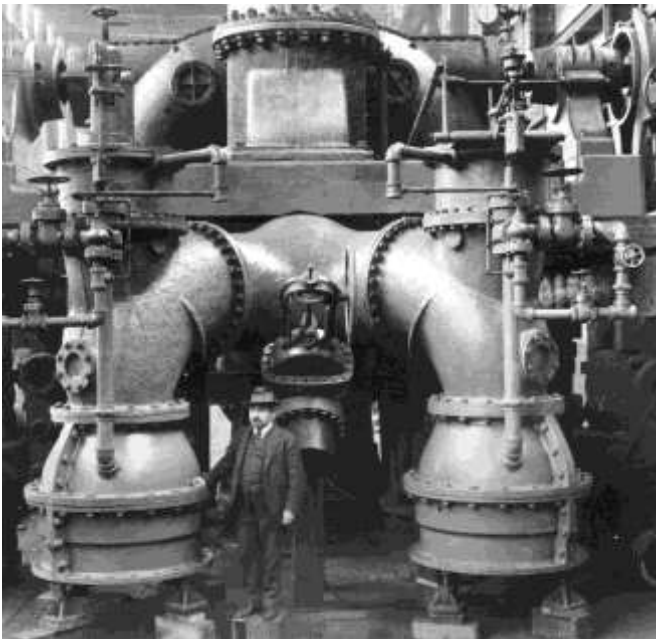
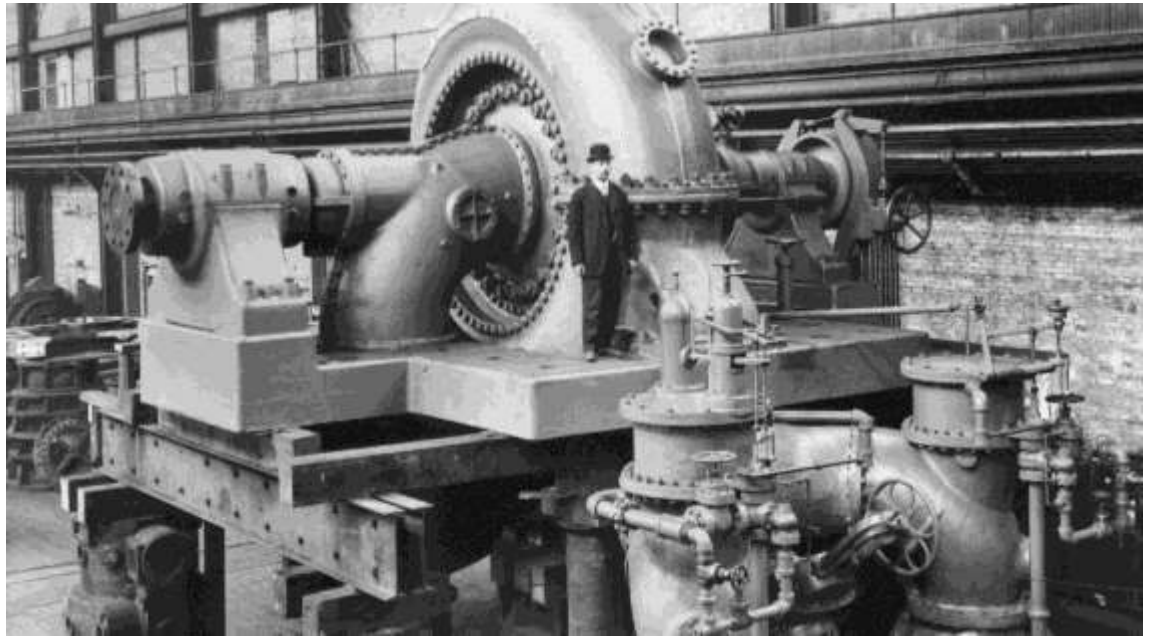
RENOIRIA LINES, LOOKING EAST  
J. H. 337  
NO. 871  
P. 4-11

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# 1910 Construction

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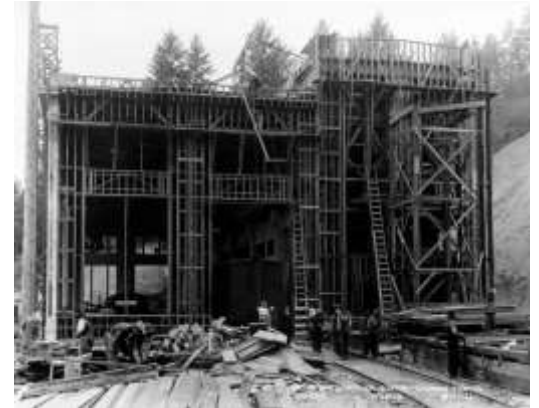
# Original Cast Turbines/Valves

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# Timeline

- 1910 Construction
- 1910-2004 Operation by PSE
  - 2,000 CFS year-round
  - 4 units (penstocks and turbines)
- 2009 Acquisition by Cascade Water Alliance
- 2009-Present Operation by Cascade Water Alliance
  - 50 CFS, March-October
  - Up to 450+ CFS, November-February
  - 2 units (penstocks and bypass valves)



# Drivers and Challenges

# High Flow Range Performance Needed



# Unique, Vintage Construction under Duress



# High Head and Cavitation Potential



# Constrained Site



# The Path for Alternative Delivery

- Cascade required to maintain 900 CFS flow capability, (Charter, 2009)
- Valve starts to leak, Dec 2015
- CH2M and Johansen retained in CM/GC style contract Jan 2016
- Alternatives Eval/Selection Feb 2016



The logo for Jacobs is the word "JACOBS" in a bold, blue, sans-serif font with a registered trademark symbol.



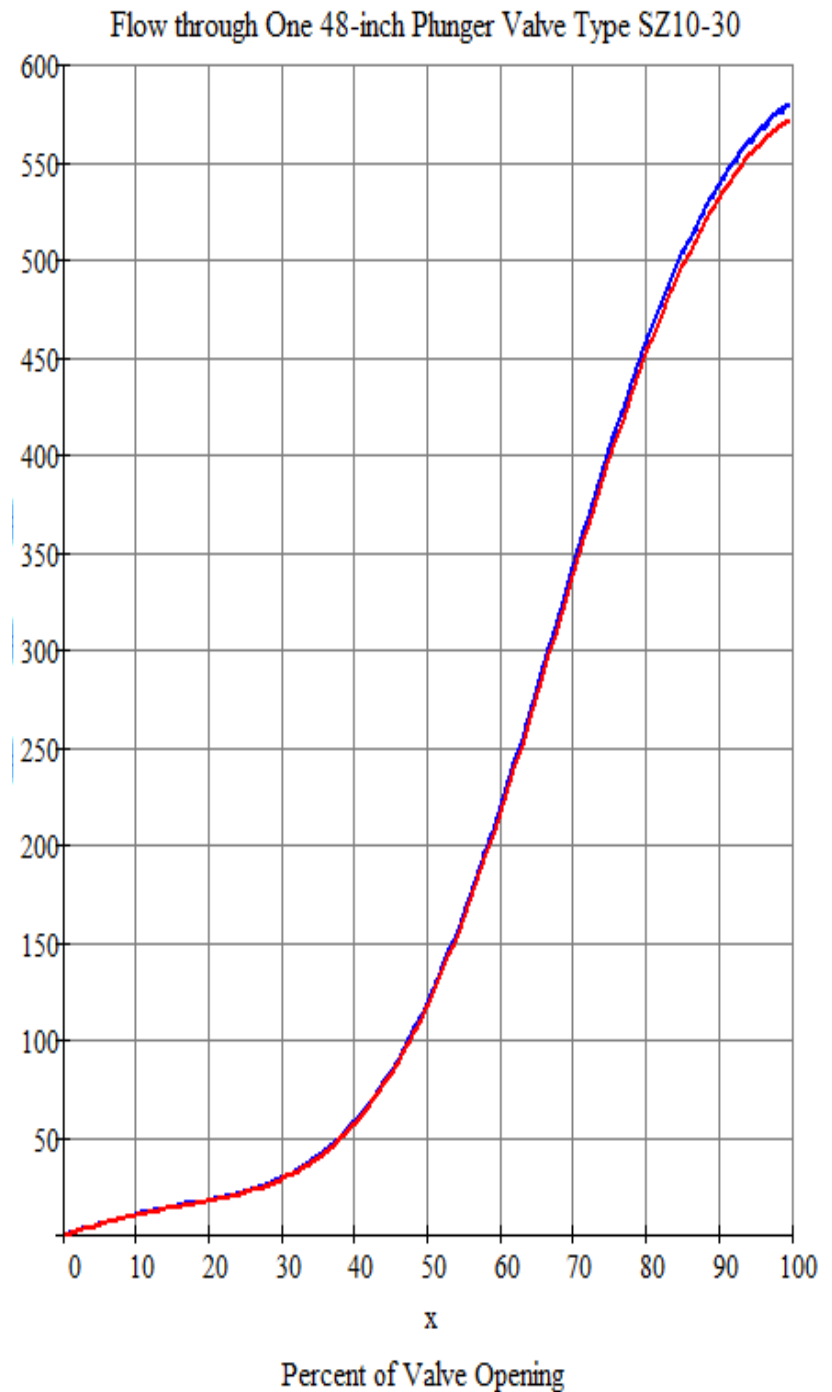
The logo for Johansen Excavating, Inc. features the word "JOHANSEN" in a large, red, stylized font with a white outline. Below it, "EXCAVATING, INC" is written in a smaller, black, sans-serif font, and "CIVIL CONTRACTORS" is written in a red, sans-serif font inside a white rectangular box with a red border.

# Alternative Solutions

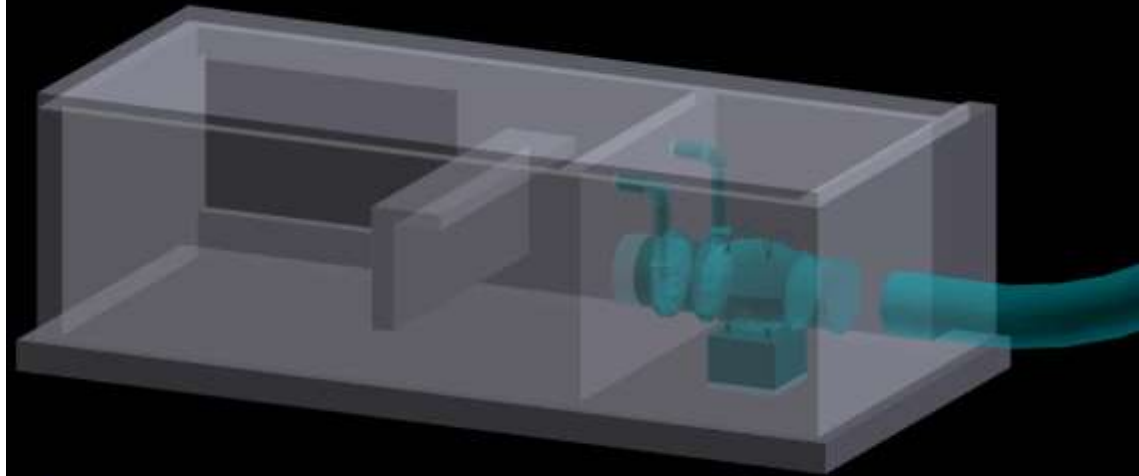
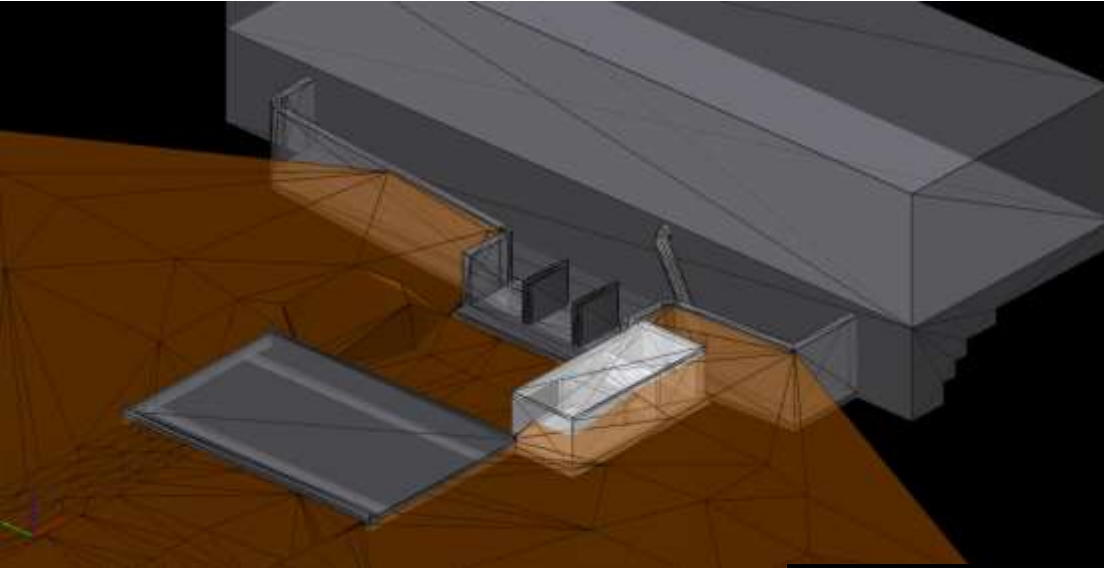


# Requirements

- 50-450 CFS
- 500 FT head
- Operational within the year

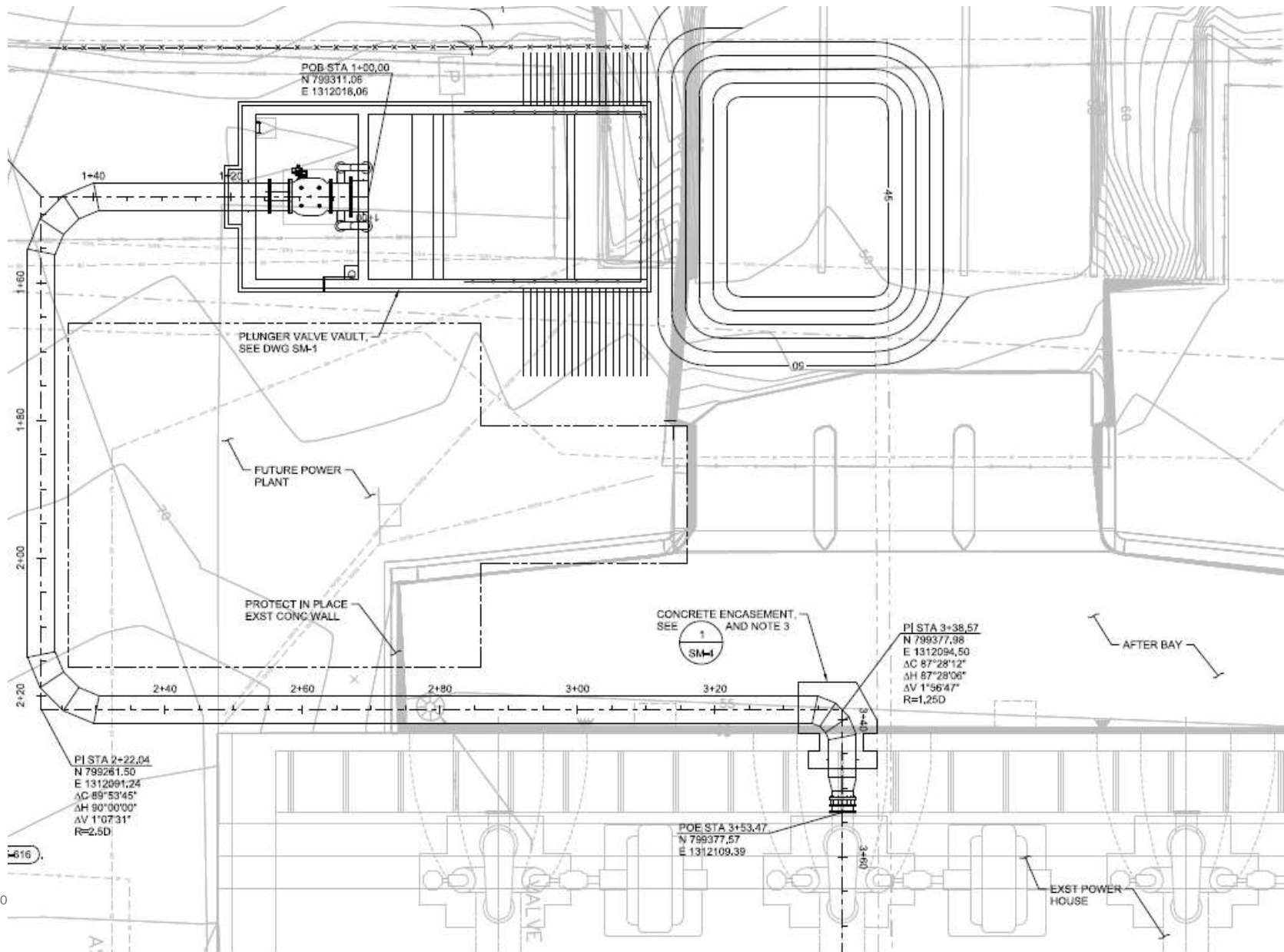


# 1<sup>st</sup> Solution: New Vault Outside the Old Powerhouse





# 2<sup>nd</sup> Solution: Reoriented Vault Outside the Powerhouse

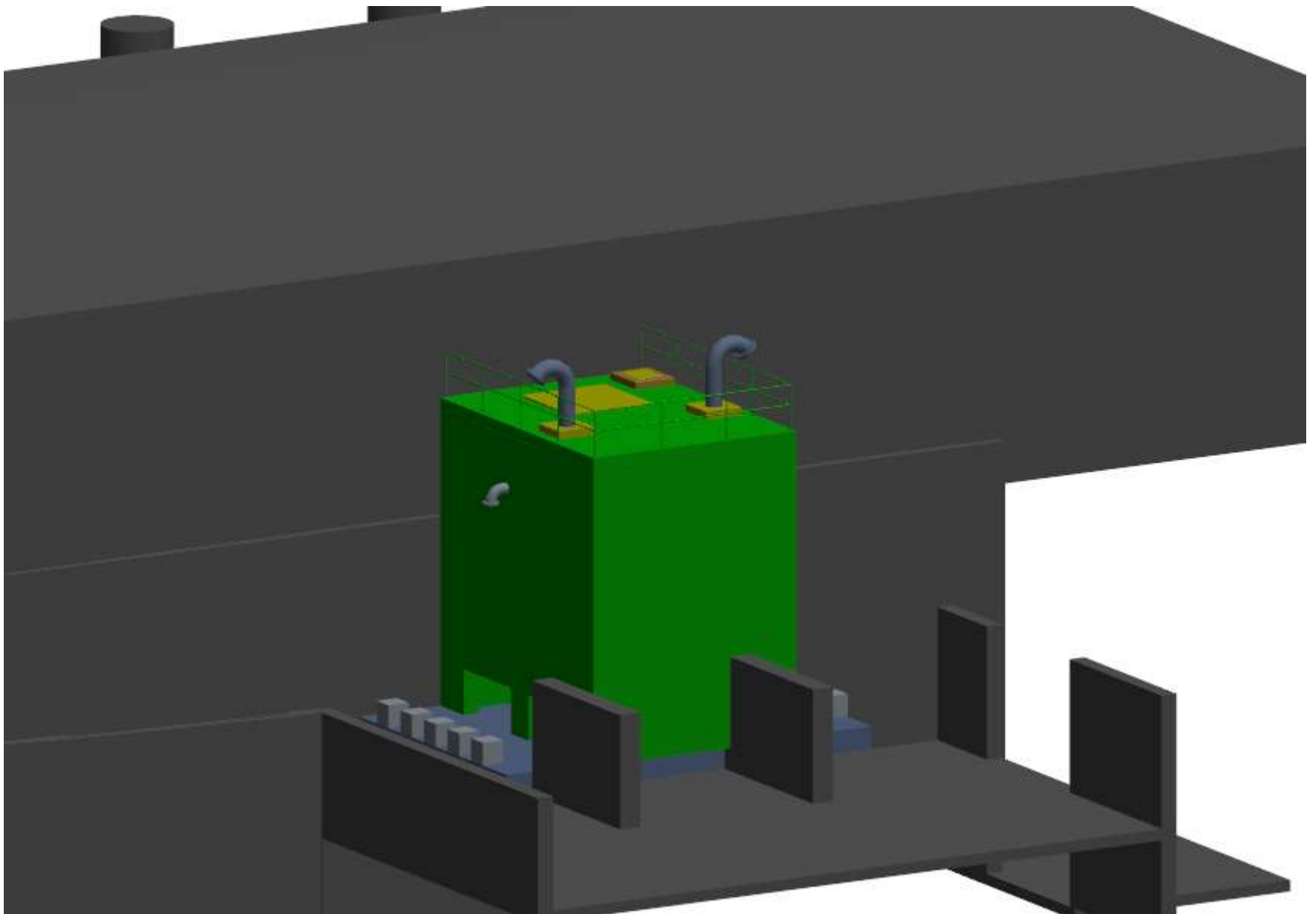


H-Piles?

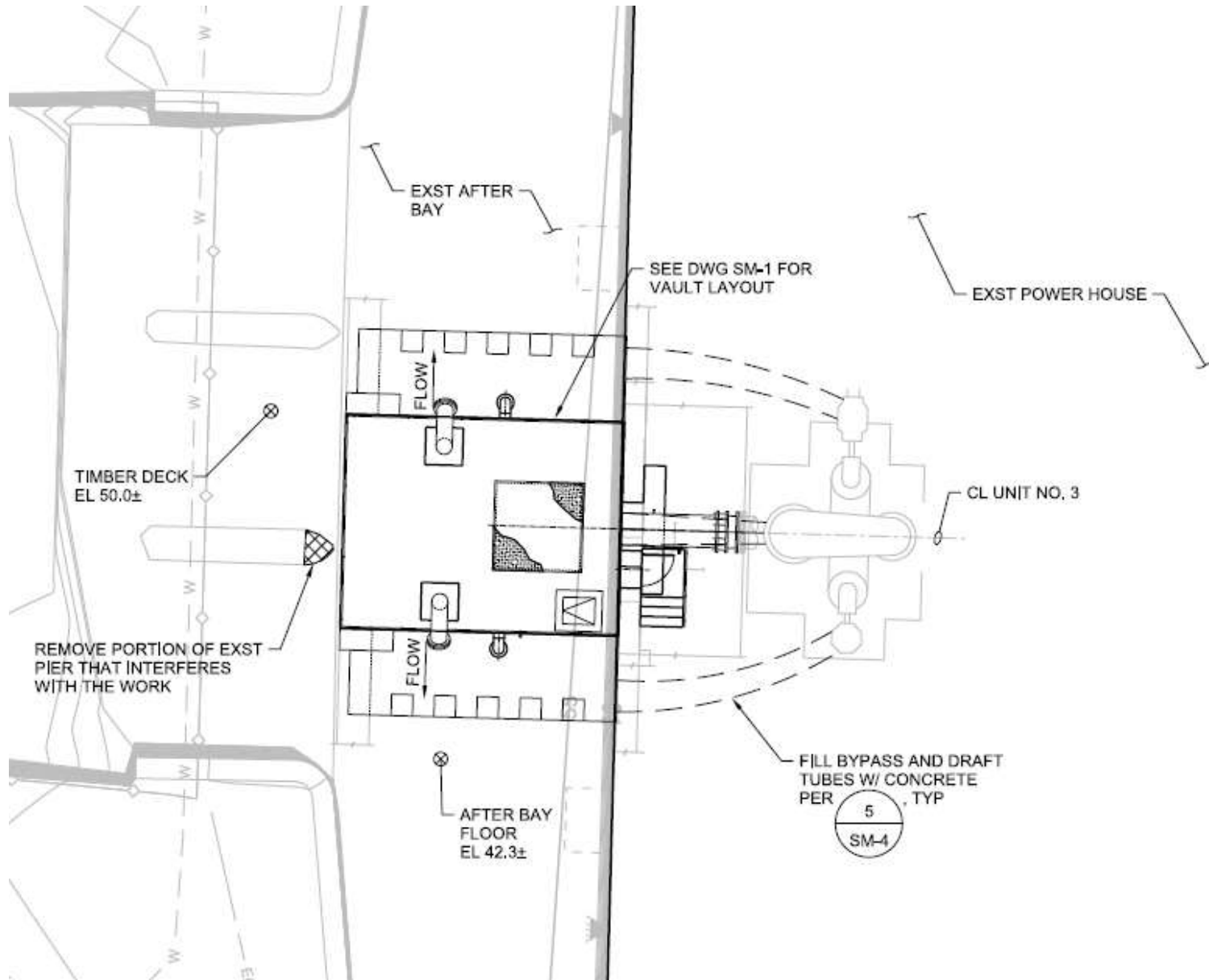
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## 3<sup>rd</sup> Solution: Vertical Standing Vault in Afterbay



# Reduced Overall Footprint and Conveyance Pipe







# Accelerated Construction

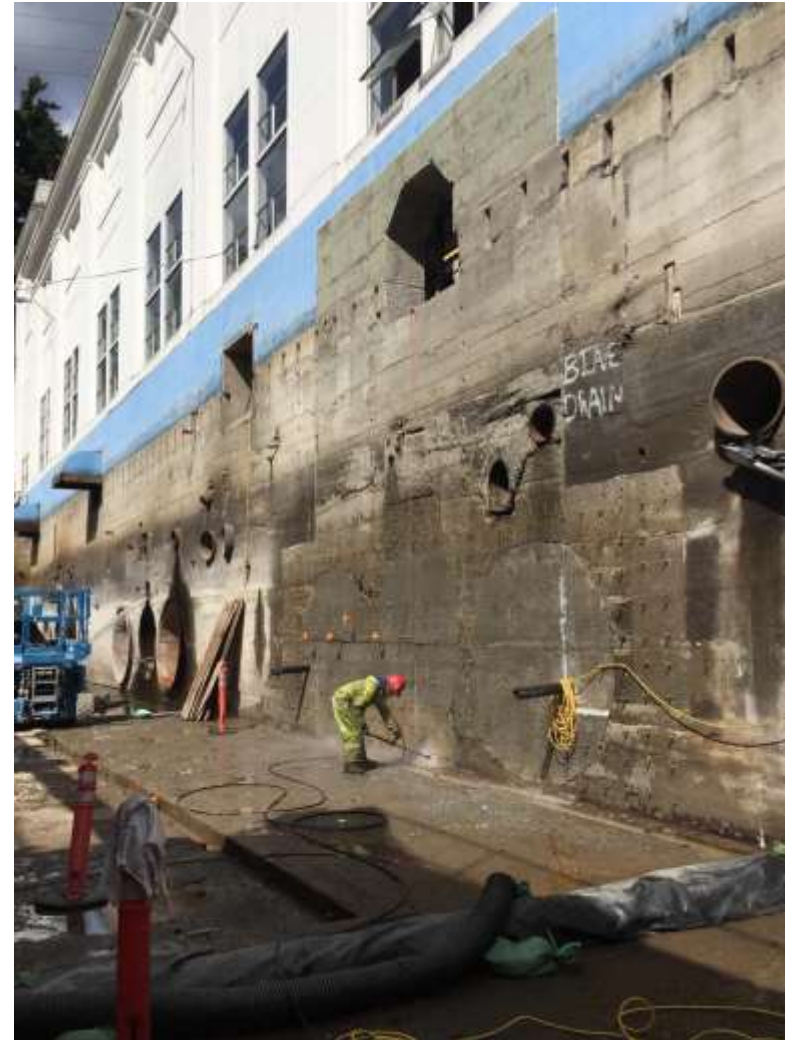
# Erosion Cavity Repairs



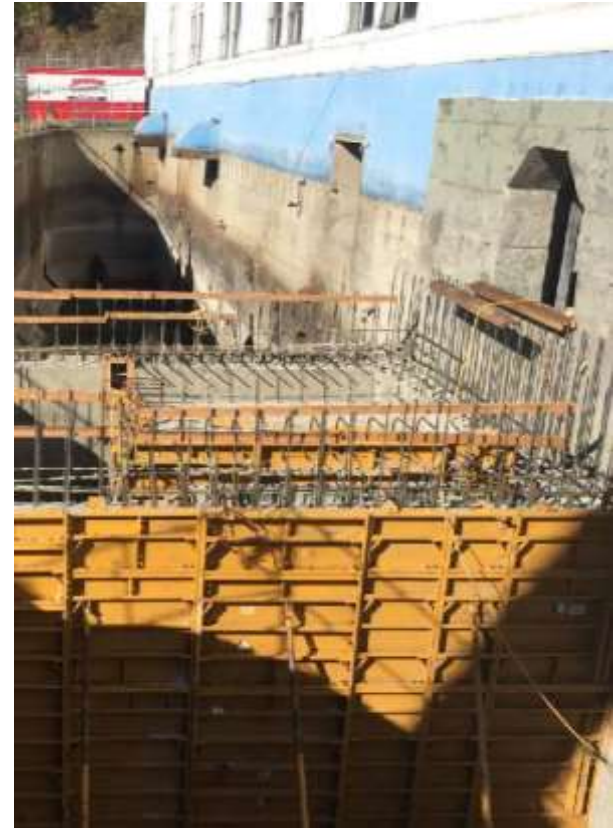
# Failed Valve Removal



# Sawcut Aperture for New Valve Inlet



# Standing Vault Reinforcement, Formwork, and Pour



# Valve Inlet Piping



# Valve Chamber Form and Pour



# New Valve Delivery, Placement, and Installation





# Lessons Learned



# Completed Vault



# Commissioning

# Steady Valve Performance Through Operational Range



# Hydraulic Behavior at High Flow Rates

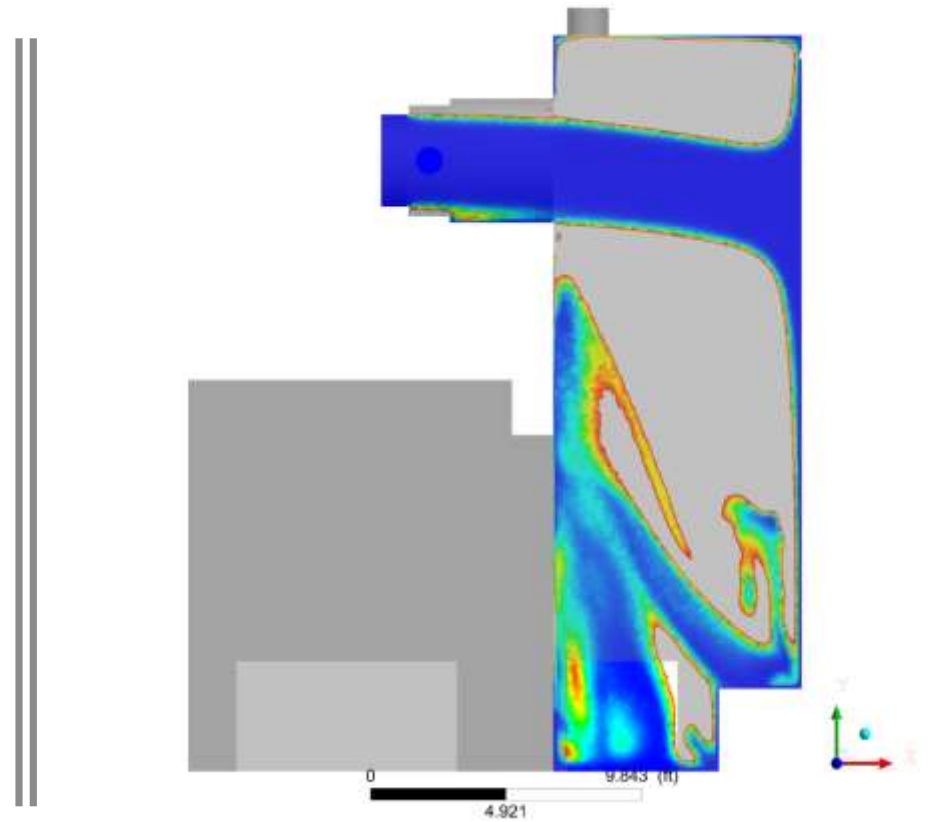


# Post Test Observations



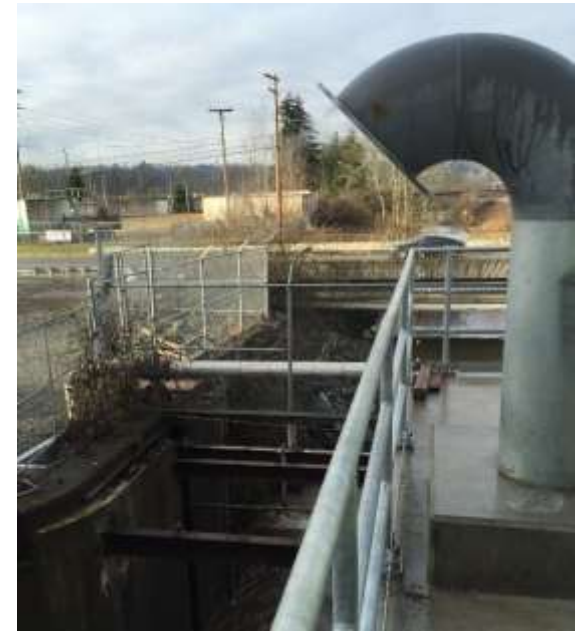
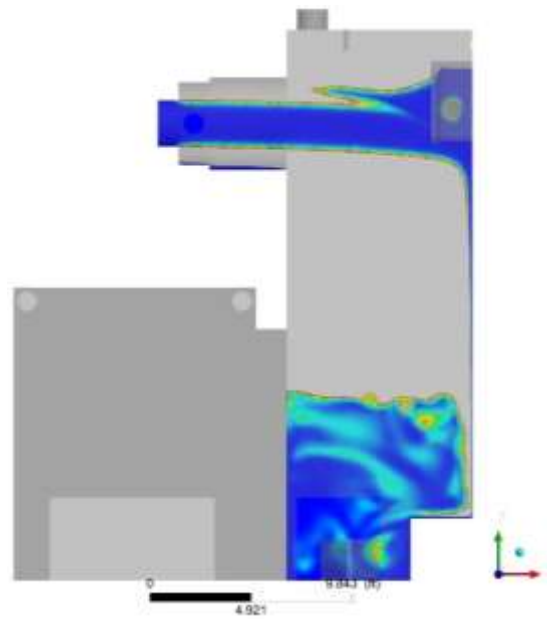
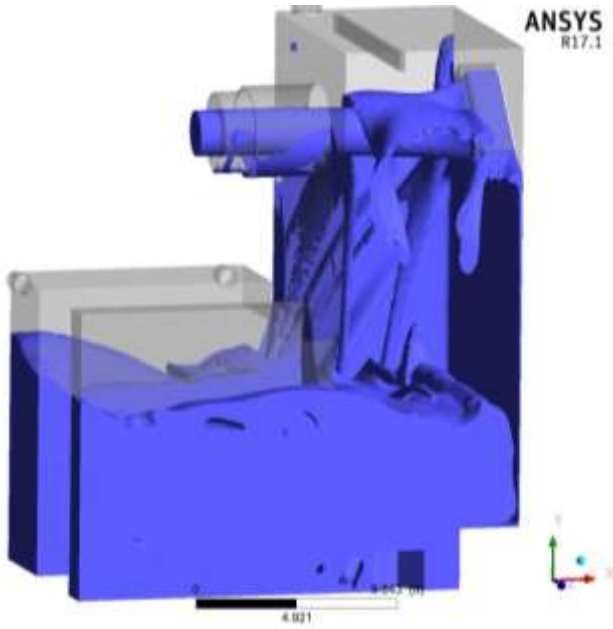
# Post Test Inspection





CFD Modeling Confirmed Vent Spray





Field Modifications to Improve Performance

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# Recommissioning with Deflector Plates Installed



# Overall Schedule and Cost

# Total Project Costs and Schedule

	Jan/ Feb	Mar /Apr	May /Jun	Jul/ Aug	Sep/ Oct	Nov /Dec
Valve Leaks						
CM/GC Contract						
Alternatives Eval.						
Order Valve						
Start Construction						
Valve Arrives						
Install Valve						
Commission						



Valve No. 2 Replacement Cost	
Engr	\$0.19M
Constr	\$1.04M
<b>Total</b>	<b>\$1.23M</b>

Jon Shimada  
Dan Buonadonna  
Dan Murrer

Thank You

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# Timeline

- Valve breaks, Dec 2015
- Feasibility memo, Feb 2016
- Order valve , Mar 2016
- 60% Design, March-May 2016
- Start construction, June 2016
- 100% Design, June-July 2016
- Valve arrives, Dec 9, 2016 (by sea)
- Install the valve, Dec 12, 2016
- Commission, Jan 2017
- Modify, Feb-March 2017
- Recommission, Apr 2017

Get a clip of the valve 1 spray and show side by side

