USING DESIGN-BUILD TO MITIGATE RISK TO A MAJOR WATER DELIVERY SYSTEM

ROCKY MOUNTAIN DBIA PRESENTATION
MAY 20, 2016

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PRESENTATION OVERVIEW

- ✓ Utilities / Water System Overview
- ✓ Project Requirements
- ✓ Team Selection
- ✓ Stanley Canyon Tunnel
- ✓ Energy Dissipating Structure (EDS) Facility
- ✓ Risk Mitigation / Lessons Learned

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UTILITIES / WATER SYSTEM OVERVIEW

OVERVIEW

COLORADO SPRINGS UTILITIES

- ✓ Water Service Population – 458,051
- ✓ Peak Year Water Supply Deliveries – 93,900 AF
- ✓ Peak day demand – 182.4 MGD
- ✓ Raw Water Storage Reservoirs – 29
- ✓ Raw Water Pipeline – 254 miles
- ✓ Raw / Potable Pump Stations – 49
- ✓ Water Treatment Plants - 6
- ✓ Potable Pipeline – 2,057 miles
- ✓ Potable Water Storage Tanks – 49
- ✓ Non-Potable Water Pipeline – 27 miles

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OVERVIEW

PROJECT WATER SYSTEM

- ✓ Trans-Mountain Supplies
- ✓ Terminal storage at Rampart Reservoir
- ✓ Primary raw water transmission to WTP
- ✓ Energy Dissipating Structure (EDS)
  - 760 PSI to atmospheric
- ✓ Primary WTP to service area
  - 75% of water supply pass through these facilities

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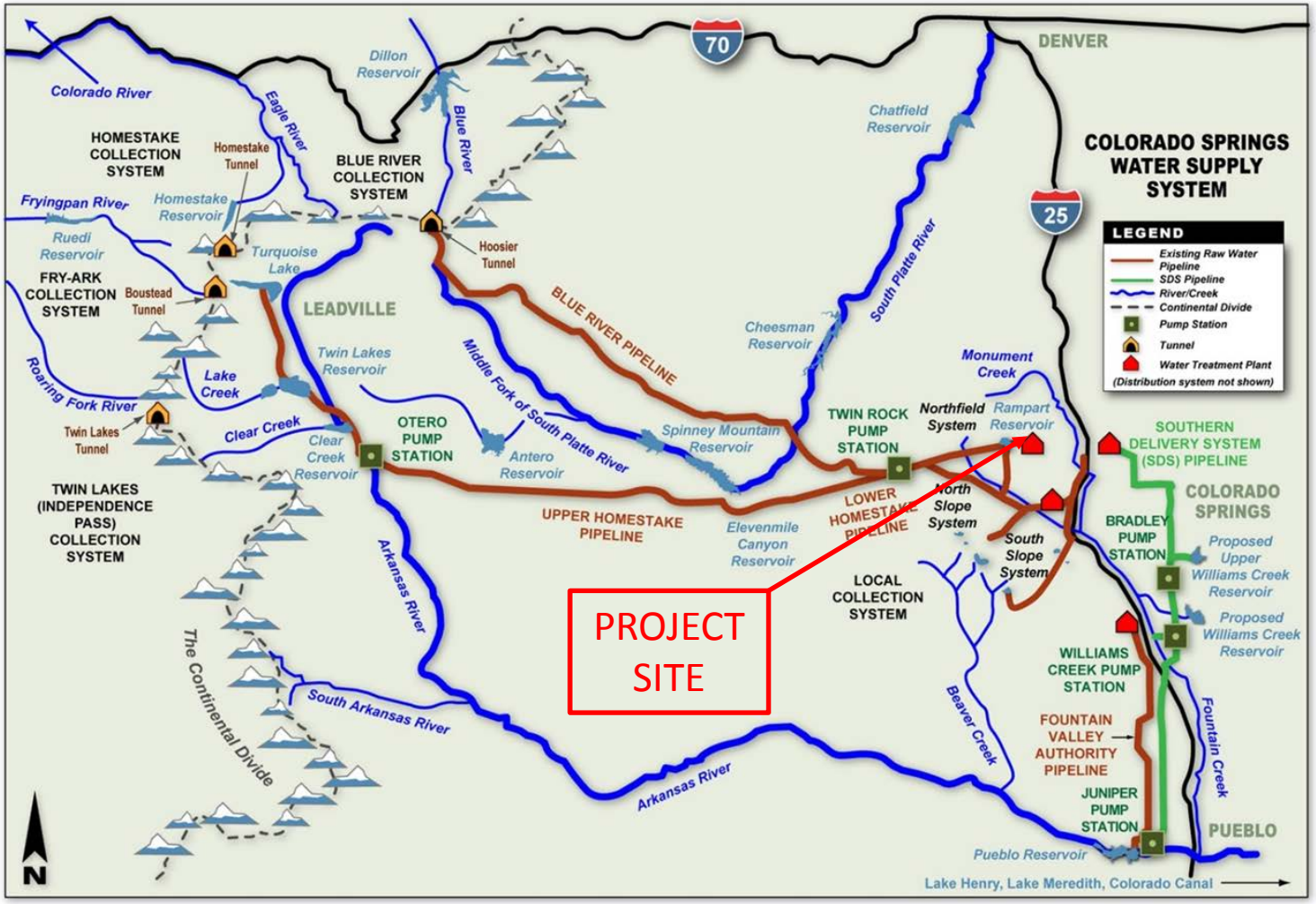
OVERVIEW

LOCATION



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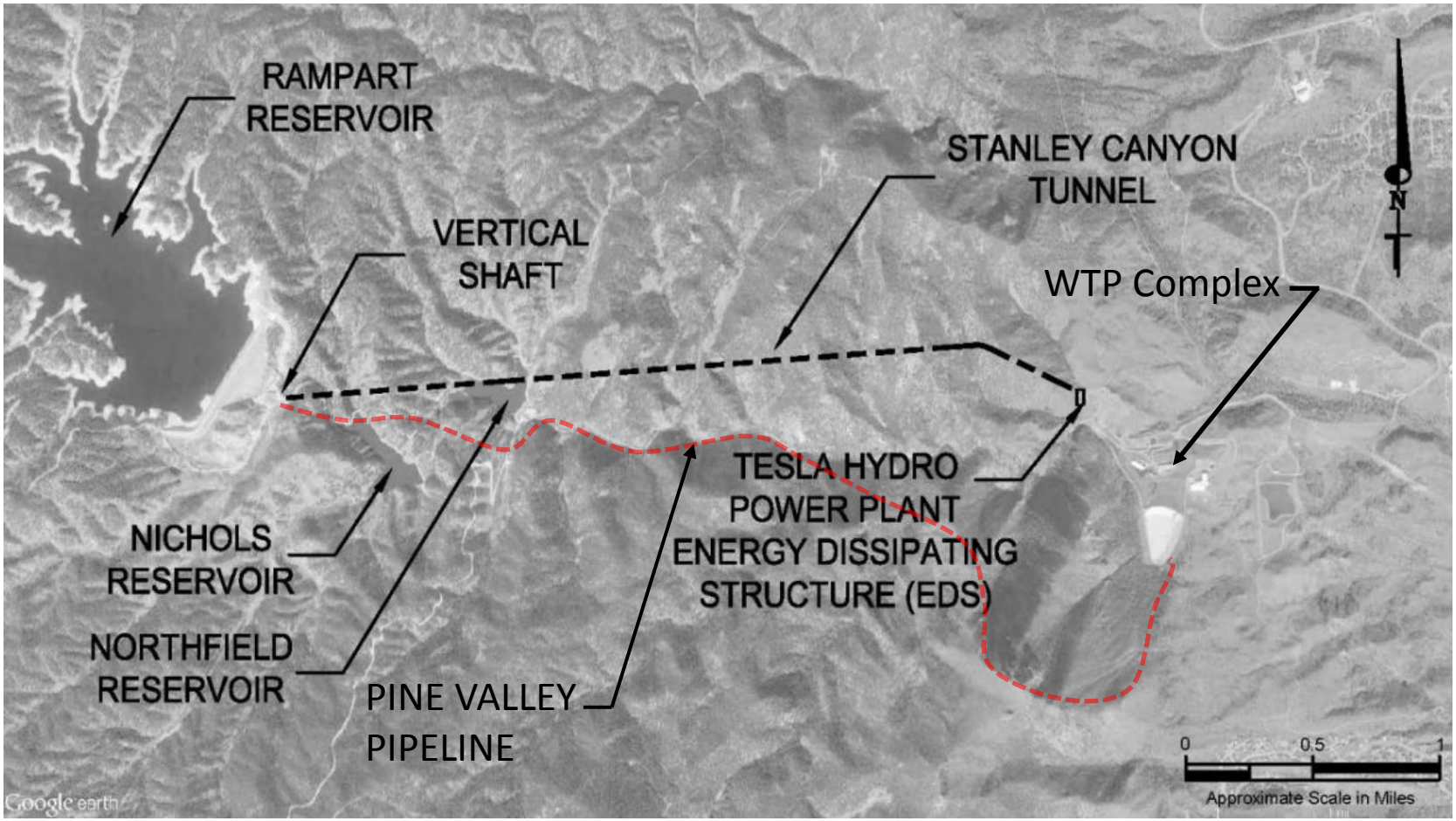
OVERVIEW

LOCATION



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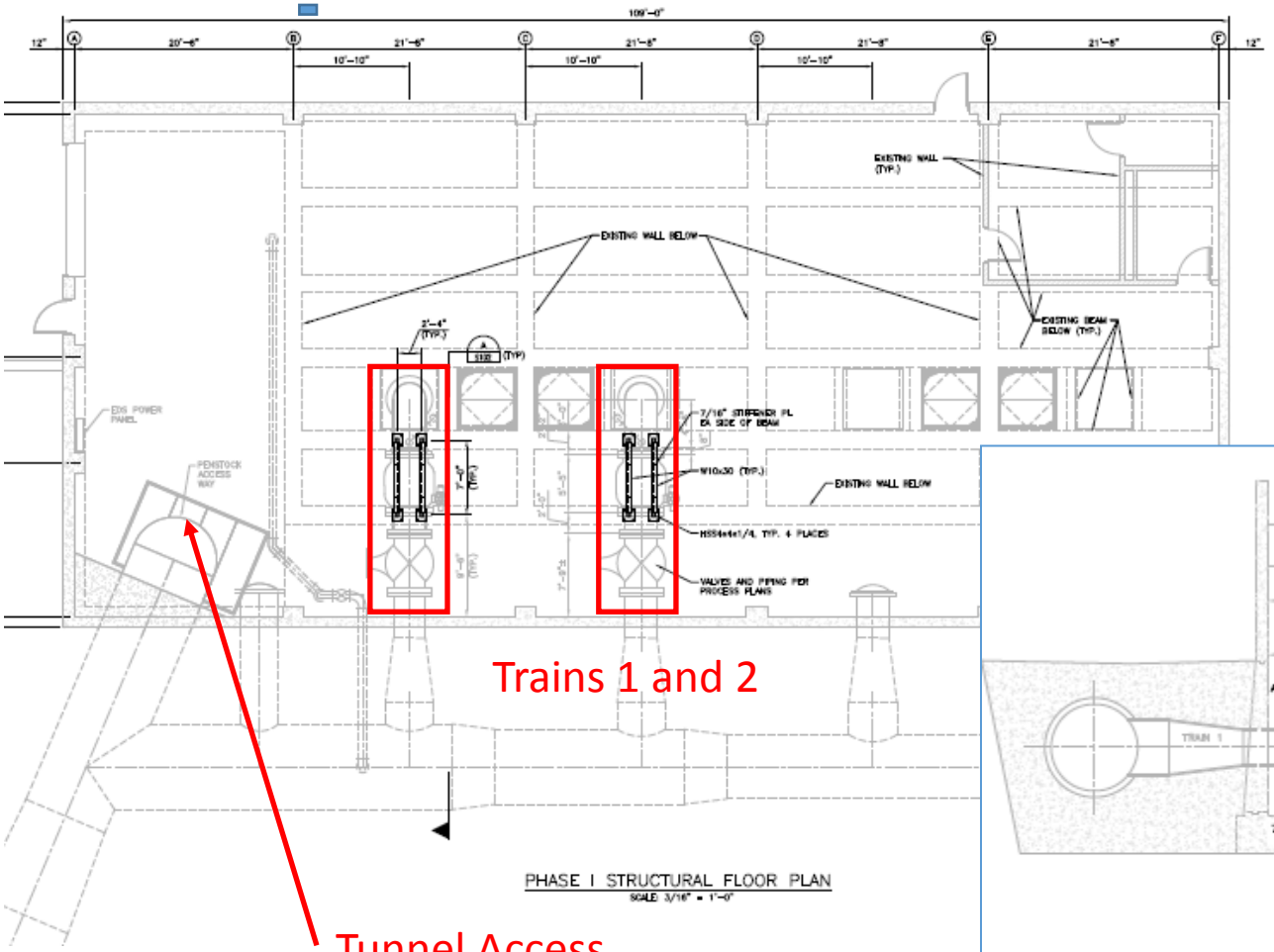
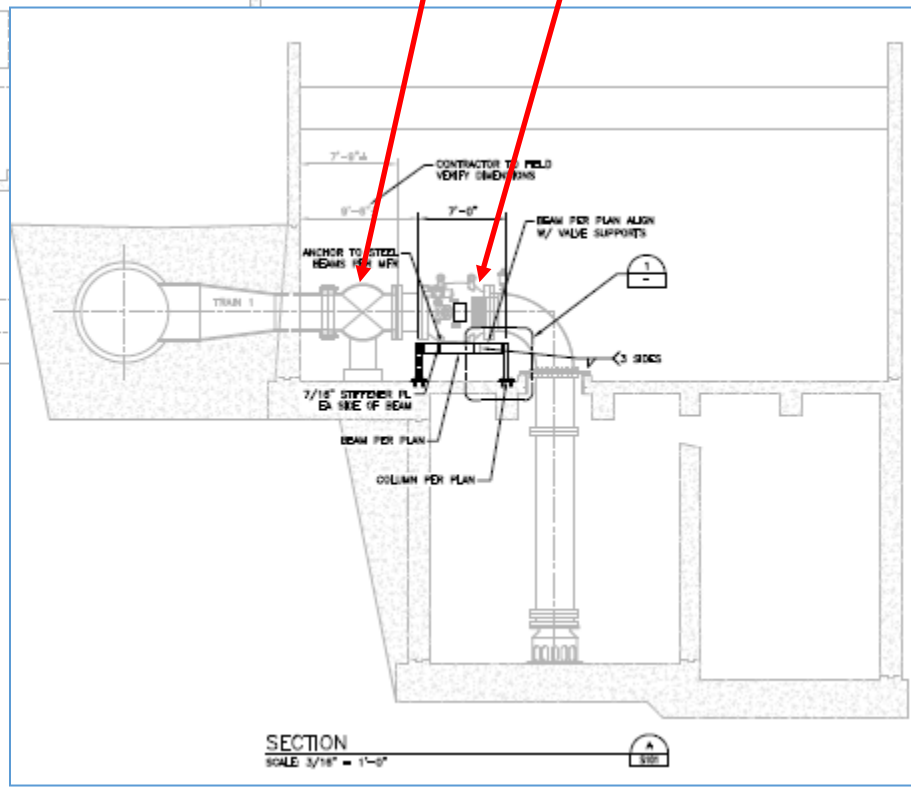


Trains 1 and 2

Tunnel Access

Exist. 36" Isolation Valve

New 36" Control Valve



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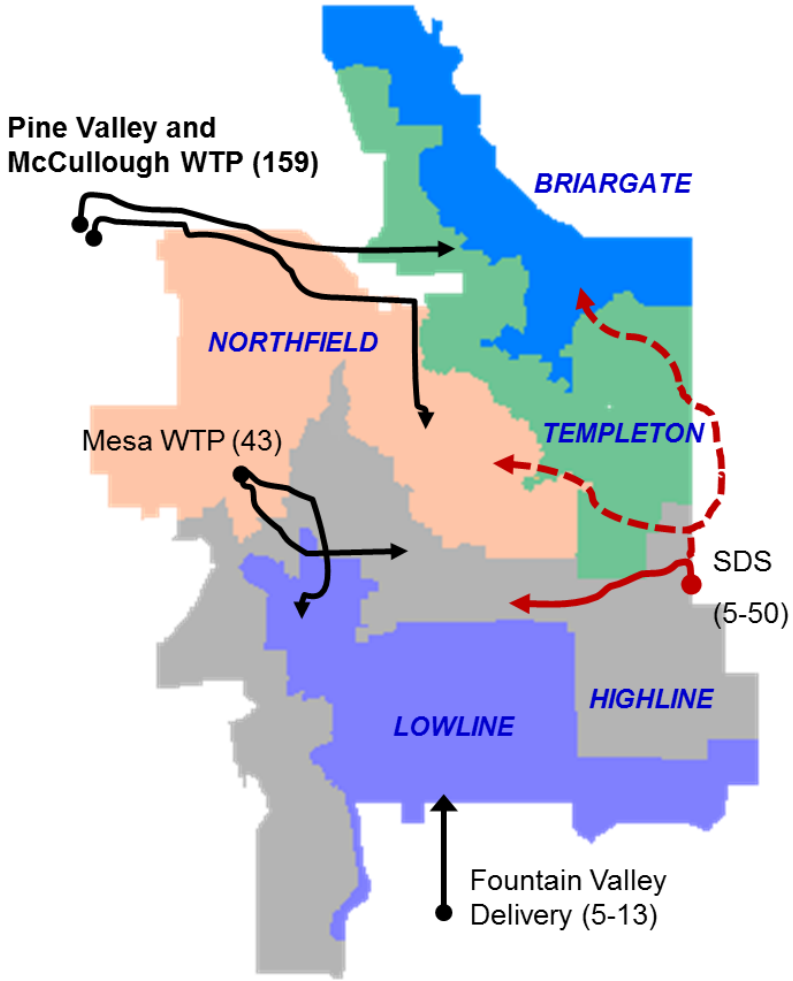
OVERVIEW

PROJECT WATER SYSTEM



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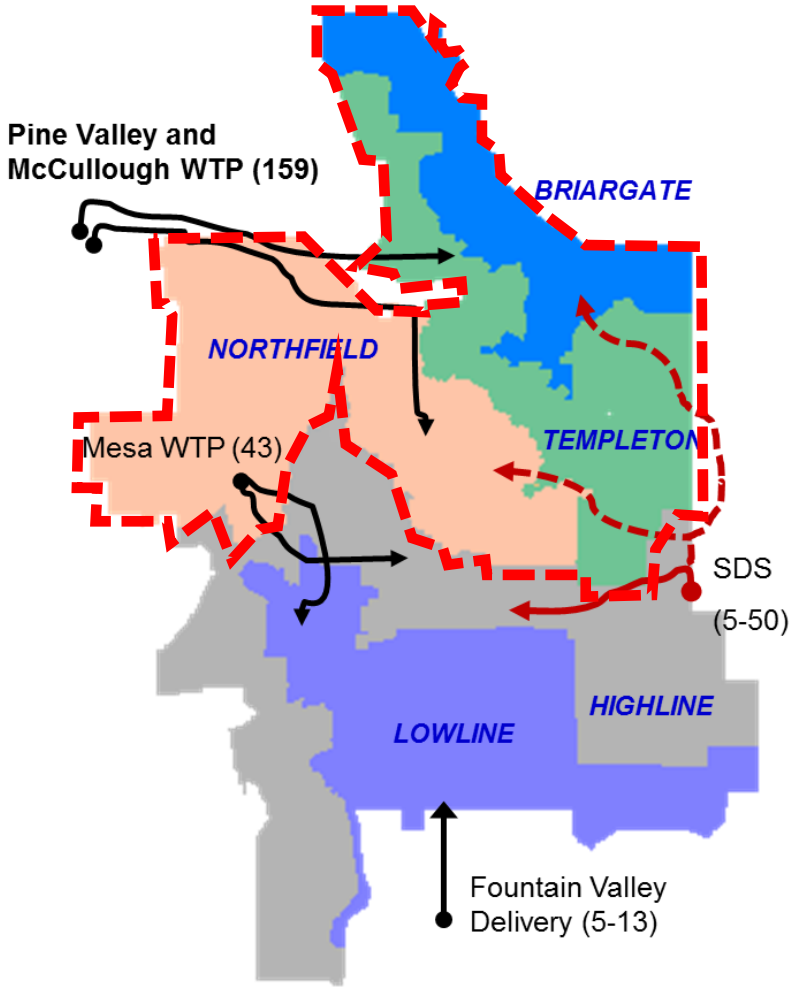
OVERVIEW

PROJECT WATER SYSTEM



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PROJECT REQUIREMENTS

PROJECT REQUIREMENTS

STANLEY TUNNEL / EDS FACILITY PROJECT

UTILITIES' Risks

- ✓ 75% of water supply pass through these facilities
- ✓ Outage duration
- ✓ Multiple shut downs
- ✓ Required 10 year FERC tunnel inspection
- ✓ Owner-supplied valves
  - Control valves: previous replacement / operational challenges
  - Isolation valves: must work 100% at start up

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PROJECT REQUIREMENTS

STANLEY TUNNEL / EDS FACILITY PROJECT

Design-Build Proposal Solicitation

- ✓ Single point of responsibility for both facilities
- ✓ Design validation of previous work
- ✓ Collaborative approach to tunnel inspection / repairs
- ✓ Address Owner and project risks

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PROJECT REQUIREMENTS

PROJECT SCOPE

Project Requirements:

- ✓ SAFETY
- ✓ EDS design validation
- ✓ EDS valves (isolation and control) installation
- ✓ Stanley Canyon Tunnel inspection and repairs
- ✓ Shut down / bypass / start up coordination
- ✓ Key Milestone Dates:
  - RFP Released: Oct. 2014
  - RFP Award: Dec. 2014
  - NTP Dec. 2014
  - Inspection Start / Completion: Oct. 16 / Nov. 30, 2015

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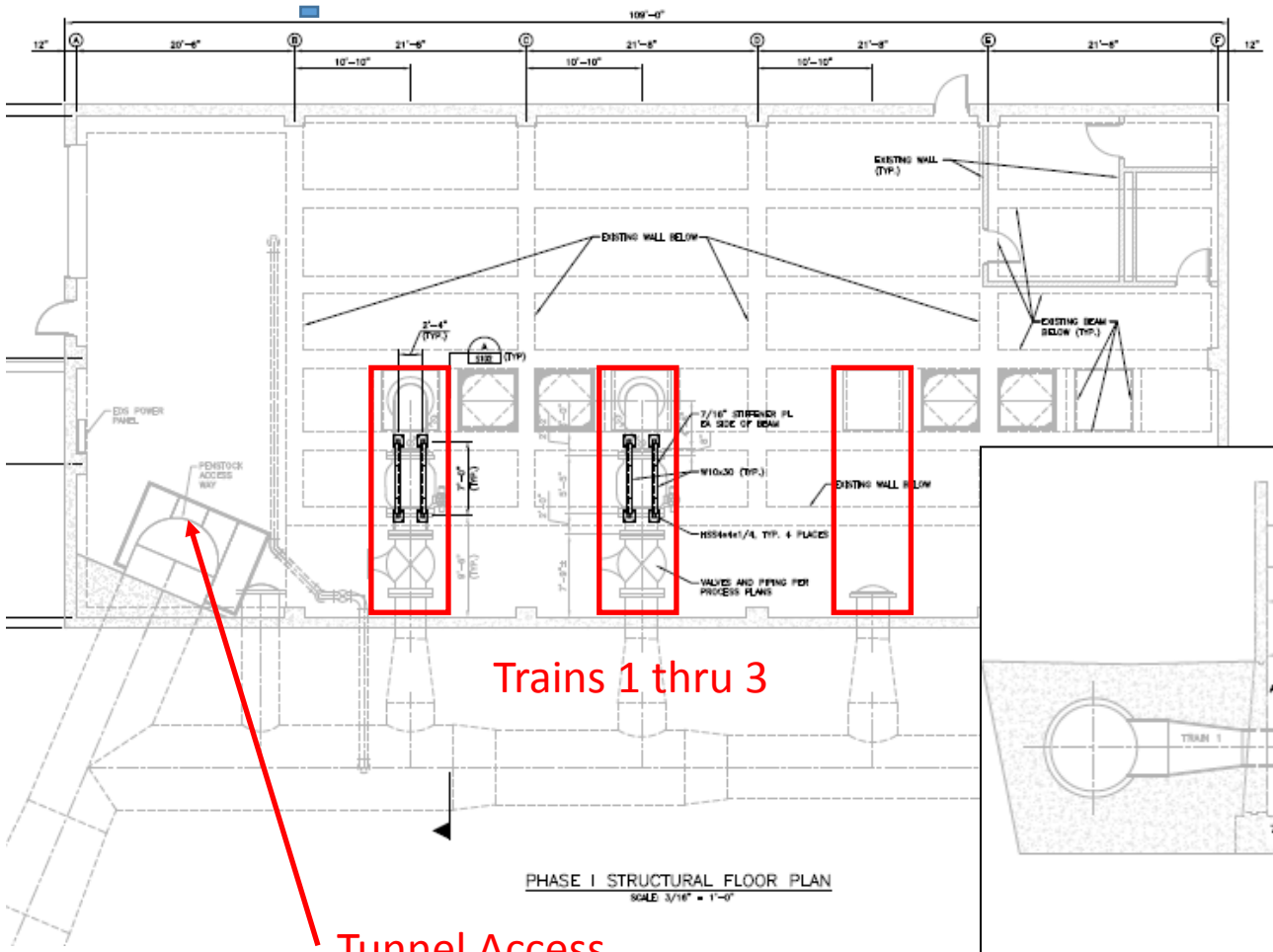
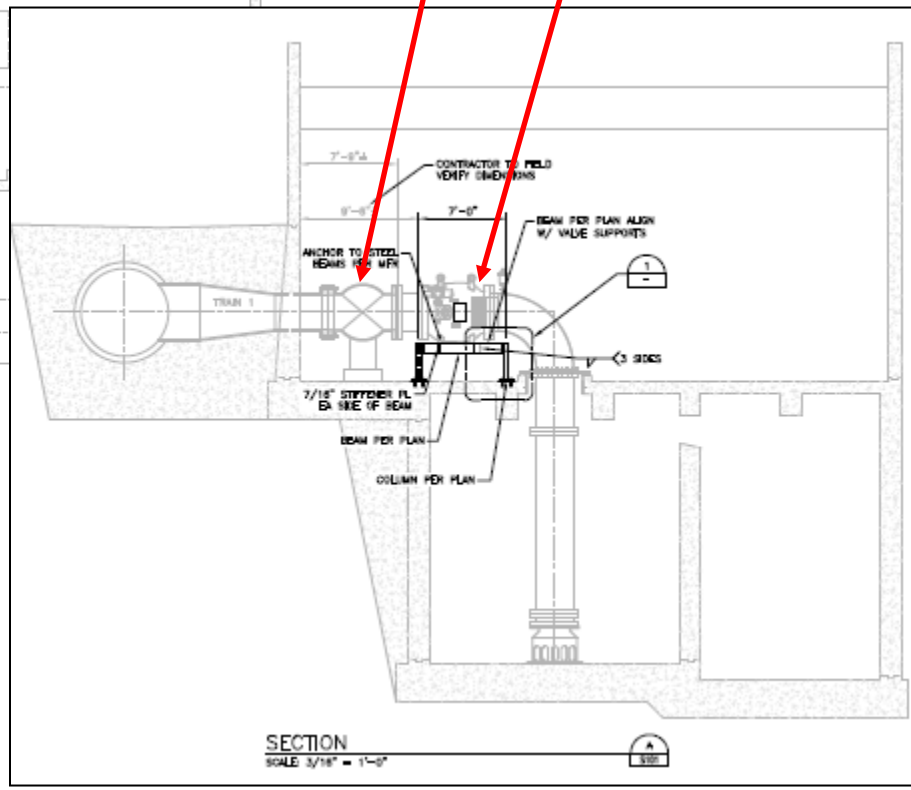


36" Isolation Valve

36" Control Valve



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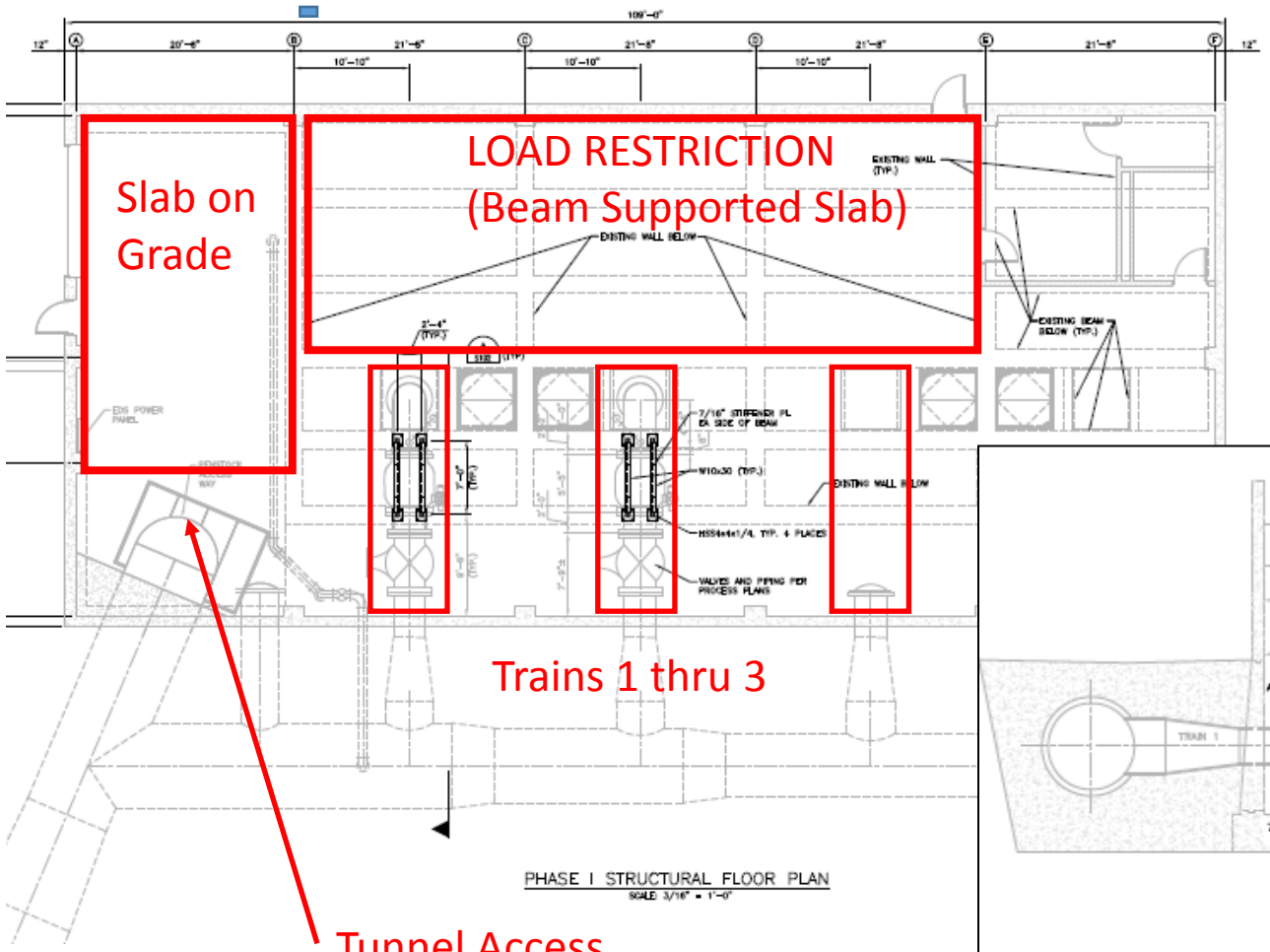

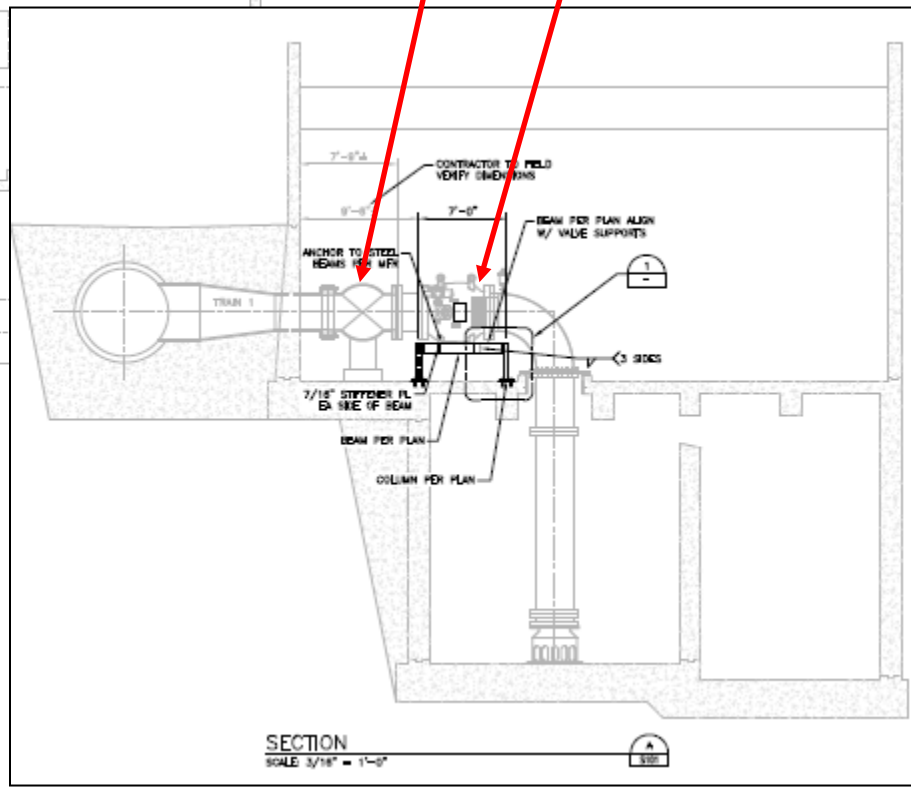

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PROJECT REQUIREMENTS

RFP DEVELOPMENT

Requirements:

- ✓ Project safety and shut down coordination
- ✓ Single point of responsibility
- ✓ Design, inspection, construction coordination
- ✓ Owner–Contractor coordination
- ✓ Owner and project risk mitigation

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PROJECT REQUIREMENTS

RISK MITIGATION

Requirements:

- ✓ Initial RFP release
  - Assign Owner procured valves to Contractor
  - No bids received
  - Review RFP requirements
- ✓ Second RFP release
  - Changed to Owner-furnished specialty valves
  - Owner determined risk associated with valves was manageable based on witnessed Factory Acceptance Testing

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TEAM SELECTION

GARNEY TEAM SELECTED

TEAM ASSEMBLY AND PROPOSAL FOCUS

Developed the Key Project Requirements:

- ✓ Project safety and coordination
- ✓ EDS – Pipe and valve design
- ✓ EDS – Pipe and valve replacement
- ✓ Tunnel inspection
- ✓ Tunnel repairs

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GARNEY TEAM SELECTED

TEAM ASSEMBLY AND PROPOSAL FOCUS

Core Design-Build Team Partners:

- ✓ **Garney -** Pipeline / Facility Expertise & Design Build Management
- ✓ **Dewberry -** Pipeline / Facility Design and Hydraulics
- ✓ **AECOM -** VAG Valve and Modeling
- ✓ **Shannon & Wilson -** Tunnel / Geotechnical
- ✓ **Harrison Western -** Tunnel Safety and Construction

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GARNEY TEAM SELECTED

TEAM ASSEMBLY AND PROPOSAL FOCUS

Proposal Focus Points:

- ✓ Project Team's previous design-build experience
- ✓ Individual entities' expertise
- ✓ Knowledge of the system
- ✓ Knowledge of the secondary water supply system
- ✓ Experience with the site conditions / access issues
  - USAFA
  - Rampart Reservoir
- ✓ Understanding of operational impact for shut down / start up
- ✓ Address Owner design-build risk

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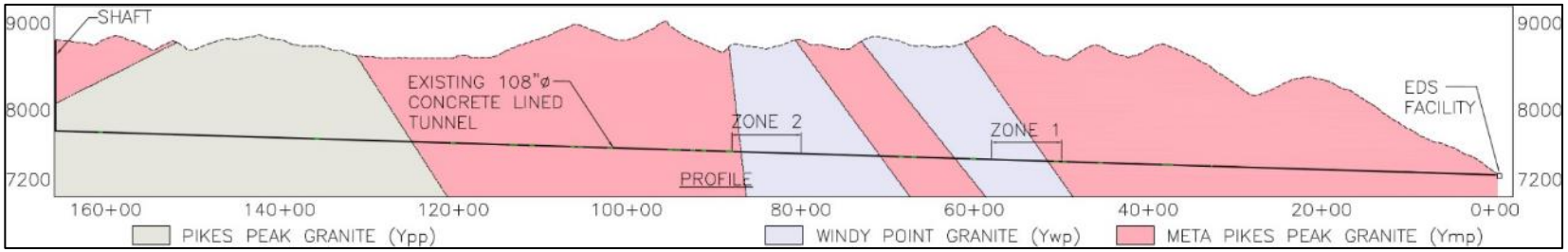
STANLEY CANYON TUNNEL

STANLEY CANYON TUNNEL

OVERVIEW

- ✓ 3.1-miles long (3% grade)
- ✓ 9-ft diameter CIP concrete lining (mostly non-reinforced)
- ✓ Steel section (3,267 LF)
- ✓ High pressure water tunnel (765 psi)
- ✓ 1,000-ft deep shaft (10-ft diameter)



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STANLEY CANYON TUNNEL

SHUT DOWN SCHEDULE

- ✓ October 15 – construct secondary isolation
- ✓ October 16 – begin draining tunnel
- ✓ October 19 – open tunnel and confined space rescue drill
- ✓ October 20-23 – install safety features and survey
- ✓ October 26-29 – inspection and geophysics
- ✓ October 30 – repair prioritization
- ✓ November 3-19 – perform repairs
- ✓ November 23 – perform header repairs
- ✓ November 24 – ready for recommissioning of the tunnel

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STANLEY CANYON TUNNEL

INSPECTION SCOPE

- ✓ One week window – maximize time for repairs
- ✓ 3-person condition assessment team (>500 points)
- ✓ Two 2-person geophysics teams (26 locations)

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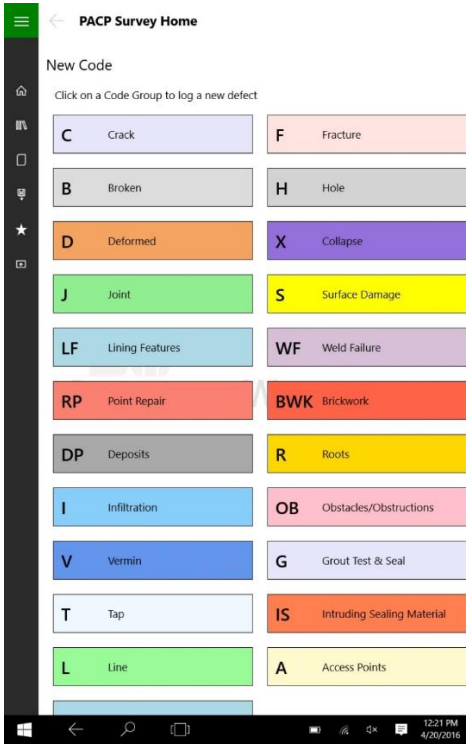
STANLEY CANYON TUNNEL

CONDITION ASSESSMENT METHOD

- ✓ Pipeline Assessment and Certification Program (PACP) of the National Association of Sewer Service Companies (NASSCO)
- ✓ 23 code categories
  - Structural
  - Operation and maintenance
  - Construction features
  - Miscellaneous
- ✓ Custom tablet application and database



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STANLEY CANYON TUNNEL

INSPECTION RESULTS

- ✓ Spalling (~ 6 inches deep)
- ✓ Soft, mushy zones – water attack and poor initial condition
- ✓ Cracks <1/8-inch wide
- ✓ Groundwater infiltration up to 80 gpm (most <5 gpm)

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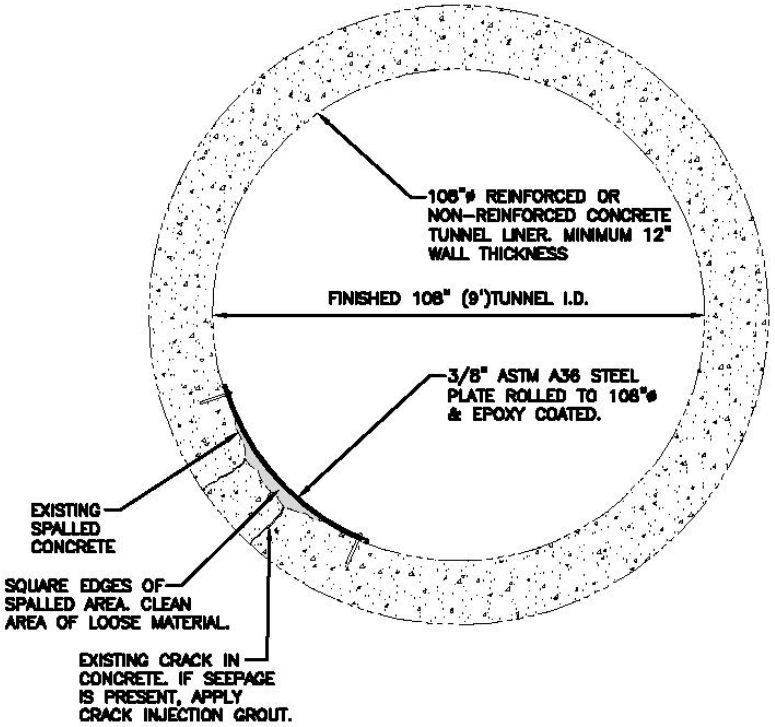
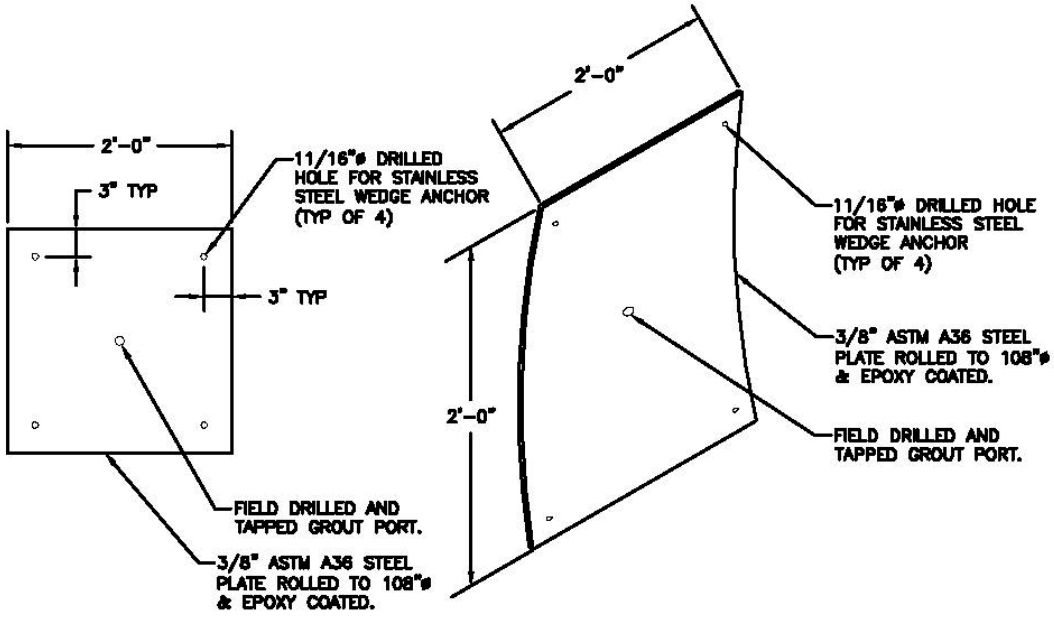
STANLEY CANYON TUNNEL

CURRENT REPAIRS





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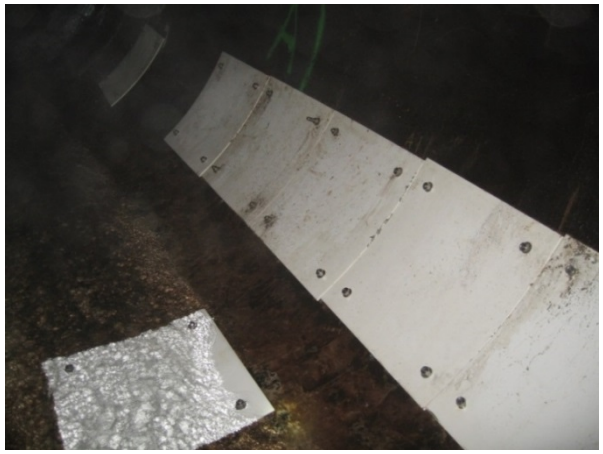
STANLEY CANYON TUNNEL

CURRENT REPAIRS

- ✓ 20 locations
- ✓ 44 2x2 plates, 20 2X4 plates
- ✓ Hydrophobic grout at 5 locations



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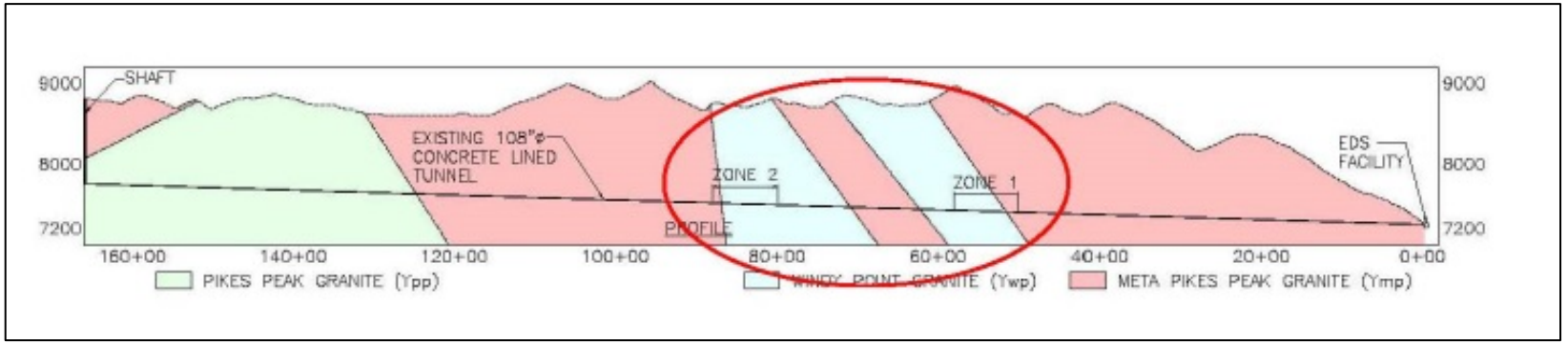
STANLEY CANYON TUNNEL

INSPECTION CONCLUSIONS

- ✓ Continue with 10-year inspection schedule
- ✓ Continue with current repair approach
- ✓ Eventual re-lining of two zones (2,600 LF)
- ✓ Database will allow for future comparison



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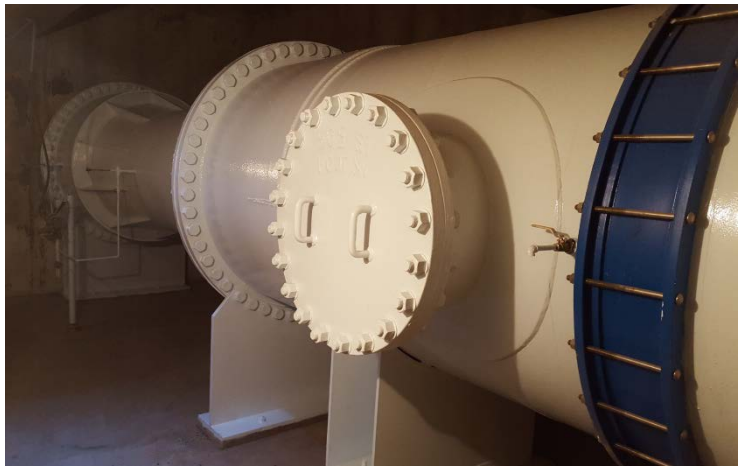
EDS FACILITY

EDS FACILITY

ALLOWABLE SWITCH OVER DURATION

- ✓ Impacts to City Water Supply
- ✓ Bypass System
  - Installed ahead of time
  - Minimum flow in pipeline
- ✓ Detailed Switch Over Plans
  - Modeling of system
  - Detailed timeline
  - Individual assignments



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EDS FACILITY

INSTALLATION CHALLENGES

- ✓ Train 1 elbow swap
  - No dimensional compatibility between trains
  - No fit-up tolerance
- ✓ Class 400 & 600 flanges
- ✓ Train 3 misalignment
- ✓ Not horizontally aligned

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EDS FACILITY

DB APPROACH

- ✓ Taped dimensions not accurate enough
- ✓ 3D survey implemented
- ✓ Shipped-loose, weld on flanges on lower pressure class downstream of PRV
- ✓ Cut-to fit elbow leg
- ✓ Air valves

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EDS FACILITY

HYDRAULIC MODELING

- ✓ Cavitation in top leg of elbow at low flows
- ✓ Vacuum in discharge elbow
- ✓ Previous design had single air valve with isolation
- ✓ Previous design lacked surge analysis and recommend enabling ramping and interrupter of valve actuators

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EDS FACILITY

HYDRAULIC MODELING

- ✓ Implemented dual air valve header with no isolation
- ✓ Disabled ramping and interrupter
- ✓ Remote pressure reading
- ✓ Two valve manufacturers

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EDS FACILITY

HEADER INSPECTION / REPAIR

- ✓ 96” steel header internally inspected
- ✓ Isolated locations of corrosion pitting up to 3/8”
- ✓ Short window before tunnel refill
- ✓ Spot repair with epoxy

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RISK MITIGATION / LESSONS LEARNED

RISK MITIGATION

WATER SUPPLY TO CITY

	Risk	Mitigation
1	Single isolation from reservoir	Designed and installed a dished bulkhead (12 hour maximum shut down)
2	Limited system shut down and switchover duration	Design and installed bypass system to reduce fill time / Detailed operation shut down and switchover plan
3	Significantly higher than expected water demand due to weather	Planned outage schedule was delayed two weeks and the Project Team re-sequenced the schedule
4	Coordination with other projects	Workshops meetings develop plans to maintain operations and other project schedules

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RISK MITIGATION

TUNNEL

	Risk	Mitigation
1	No continuous site access (1.5 hour round trip)	Full time attendants with radio communication
2	Air flow in tunnel	Designed air flow for double the maximum occupants / Implemented reversible flange to work with natural air flow
3	Emergency rescue	Developed, trained and maintained a full-time rescue team onsite
4	Tunnel drain duration control	Onsite operations monitor / standby personnel operating valves

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RISK MITIGATION

EDS FACILITY

	Risk	Mitigation
1	Restricted floor weights	Detailed work plan (floor markings and lift plans)
2	Concurrent access for both Tunnel and EDS	Detailed access plan with physical delineations / Pre-outage work
3	Pipe fit up	3D laser survey of all pipe trains to determine dimensions to 1/32” / Designed pipe connections with welded connections on low pressure
4	Concern for 96” header condition	Additional engineering and inspection services brought to jobsite / Inspected and repaired steel header in 1.5 weeks
5	Valve deliveries	Contract remained with UTILITIES – open dialog

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LESSONS LEARNED

- ✓ Owner needed to understand acceptability of risk
- ✓ Identify areas of shared risk
- ✓ Some risk too high a price financially and difficult to quantify
- ✓ Minimized Owner's risk with single point responsibility
- ✓ Communication between Owner and D/B Team
  - Shut down / bypass / start up
  - Pipe and valve design and construction
  - Tunnel inspection and repairs

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QUESTIONS & ANSWERS

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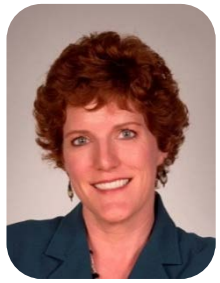

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