



From a Blemish to a “Butte”

Rehabbing Butte’s Basin Creek Dam #1

Justin Evertz, PE, Great West Engineering



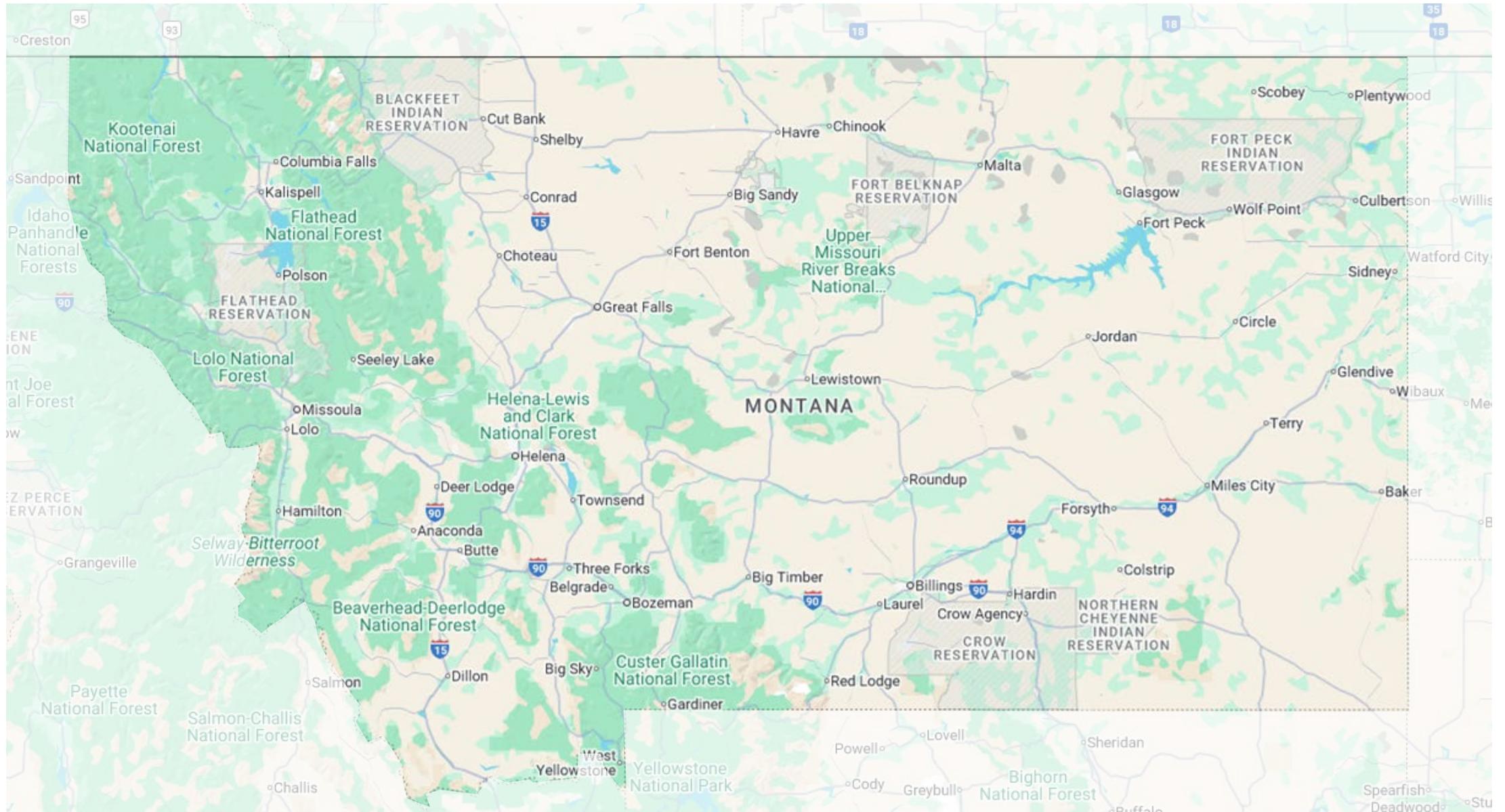
OVERVIEW

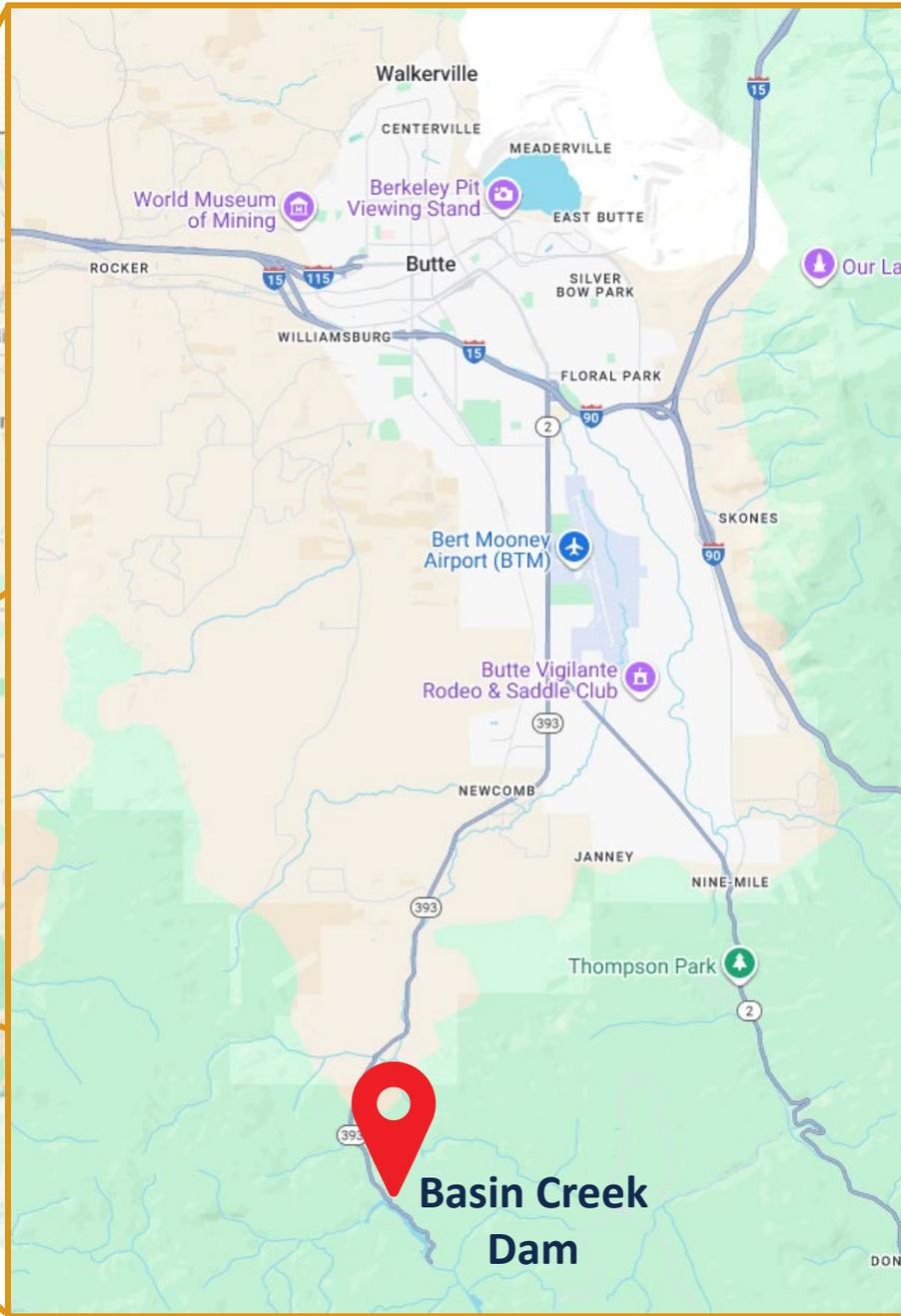
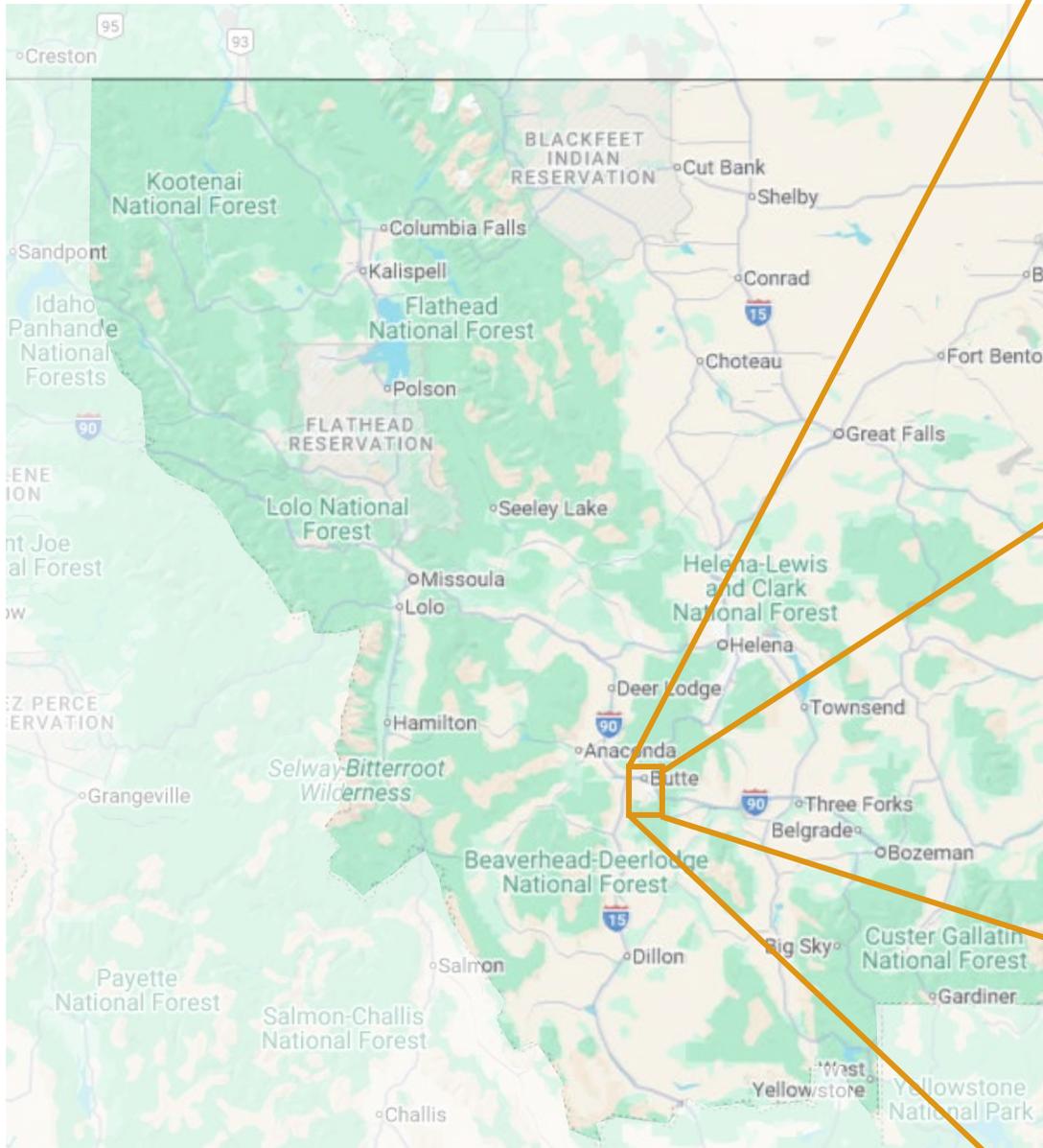
Background
Inspection Findings
Structural Assessment
Funding
Design
Construction
Questions



BACKGROUND







BACKGROUND

Hazard Classification: High

Purpose: Provide water to the City of Butte



BACKGROUND

Original Construction

Year: 1897

Design: Curved Masonry

Height: 88 feet



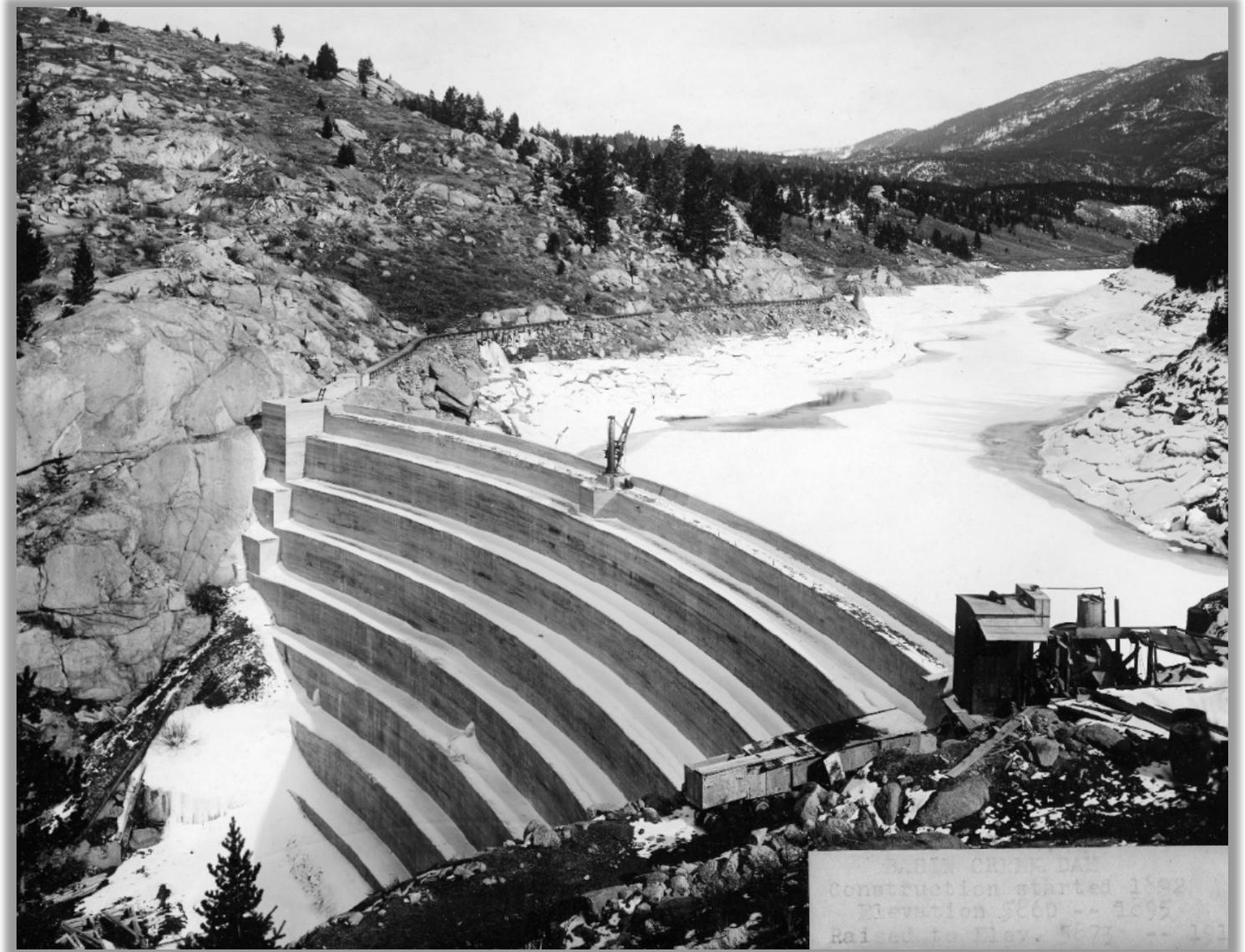
BACKGROUND

Modification

Year: 1913

Design: Mass Concrete

Height: 101 feet



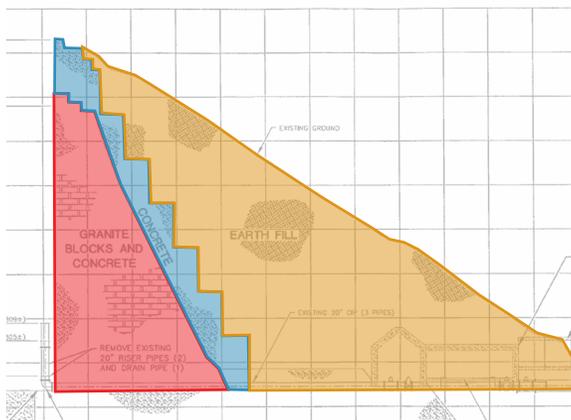
BACKGROUND

Modification

Year: 1930s

Design: Embankment Berm

Height: 101 feet



INSPECTION FINDINGS



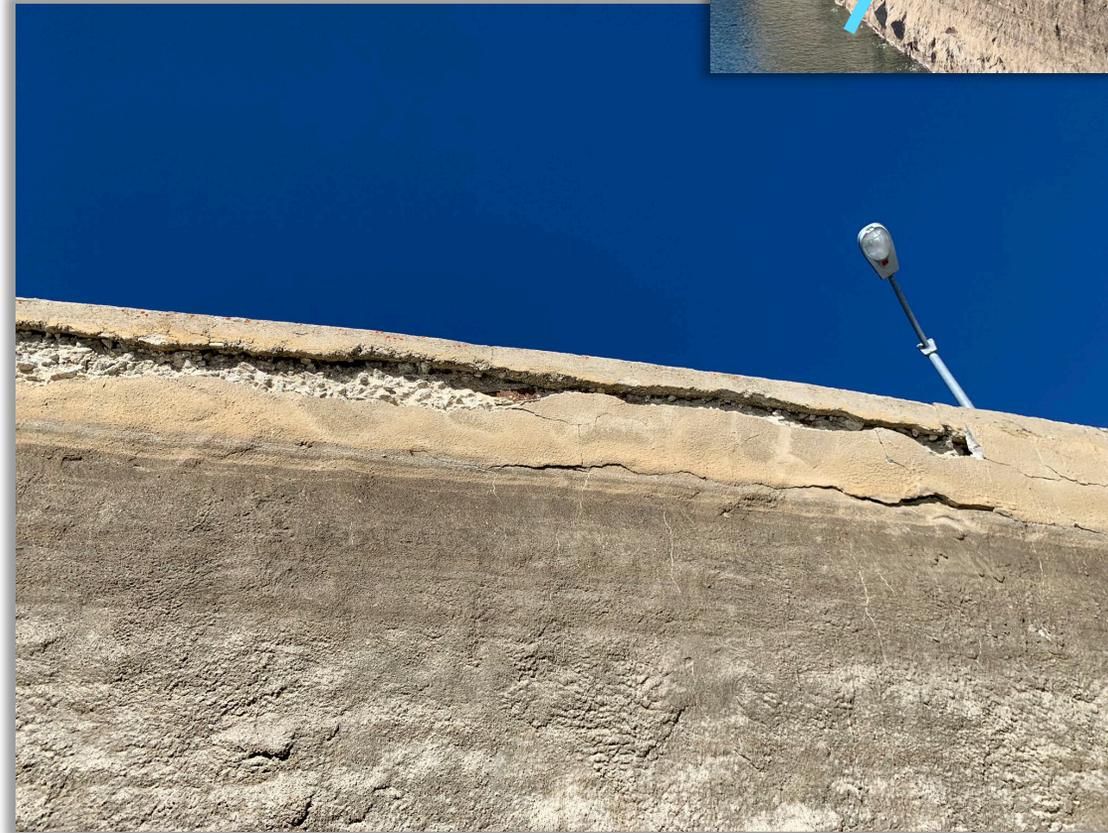
INSPECTION FINDINGS

Deterioration of upper mass concrete had been identified in prior inspections and was being monitored.



INSPECTION FINDINGS

The 2019 inspection noted the rate of deterioration had increased significantly.



INSPECTION FINDINGS

The 2019 inspection recommended that a plan be developed to address concrete deterioration within the next year.



INSPECTION FINDINGS

Comments provided by Montana DNRC expressed concern and if the deterioration was left unaddressed, DNRC would impose reservoir restrictions.



FUNDING



Funding

- BSB had planned to complete a feasibility study to apply for an RRG Construction Grant.
- Ultimately completed a full PER to pursue MCEP and RRG funds as the dam supplies drinking water to the community.
- MCEP - \$500,000
- RRG - \$125,000
- ARPA - \$2M

CITY-COUNTY OF BUTTE-SILVER BOW

2020 Preliminary Engineering Report

Basin Creek Dam #1 Rehabilitation



STRUCTURAL ASSESSMENT



CONCRETE CORING

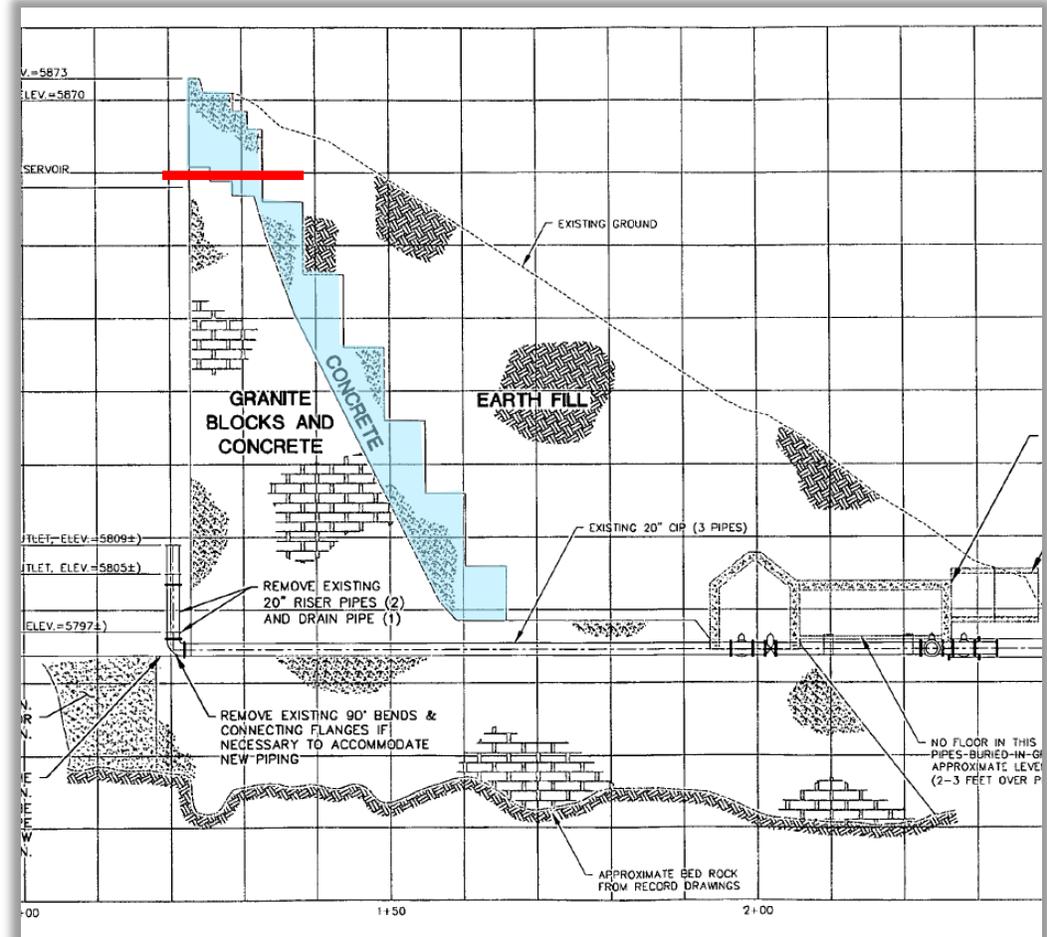


CONCRETE CORING



STABILITY ANALYSIS

- Structural Evaluation
 - Critical analysis plane – mass concrete/masonry cold joint
 - >500-year flood overtops upstream parapet
 - Stability not adequate for overtopping conditions



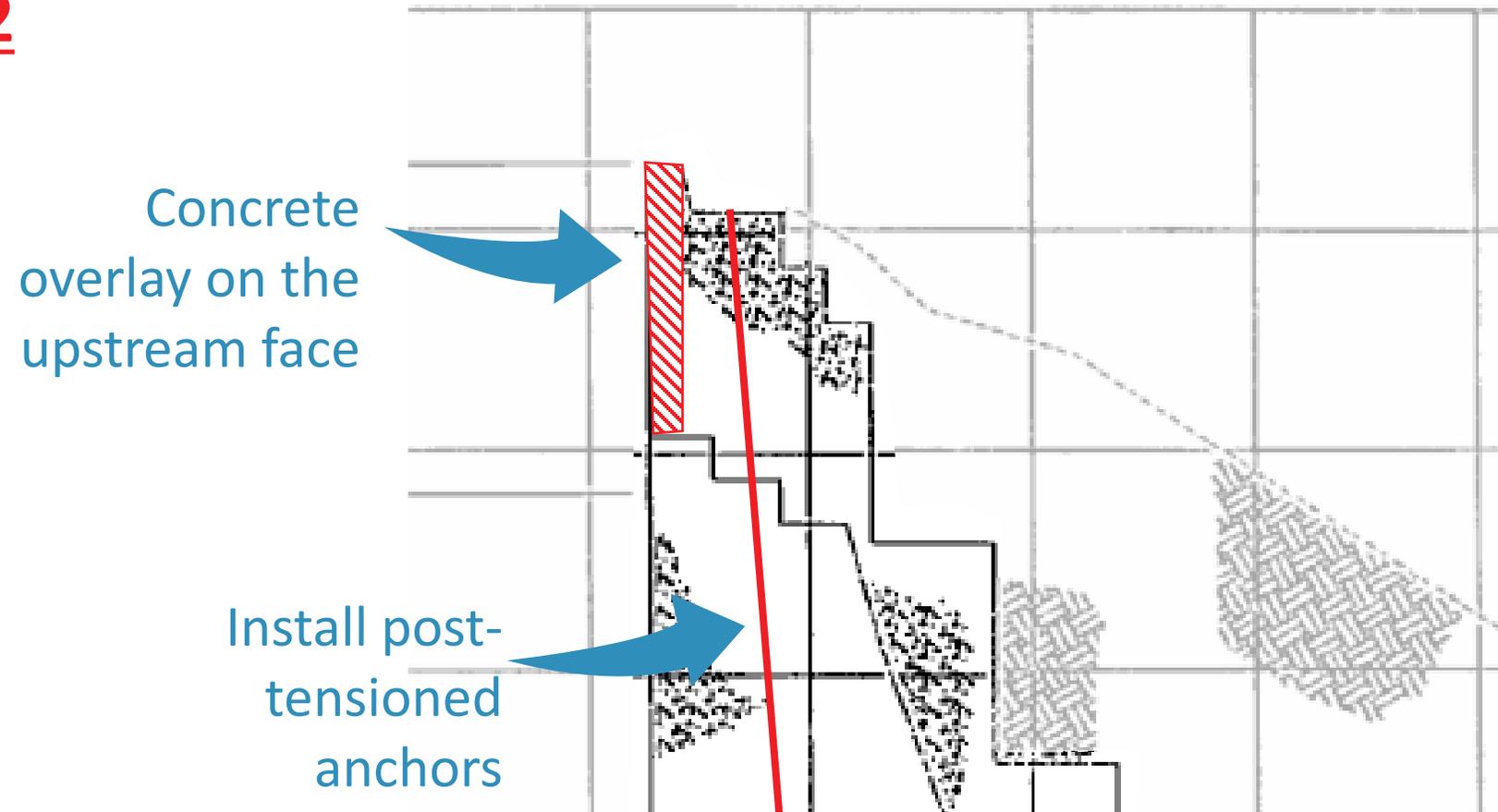
ALTERNATIVES ANALYSIS

ALTERNATIVE #1



ALTERNATIVES ANALYSIS

ALTERNATIVE #2



ALTERNATIVES ANALYSIS

ALTERNATIVE #3

Fully remove
and replace the
top 13-feet of
the dam



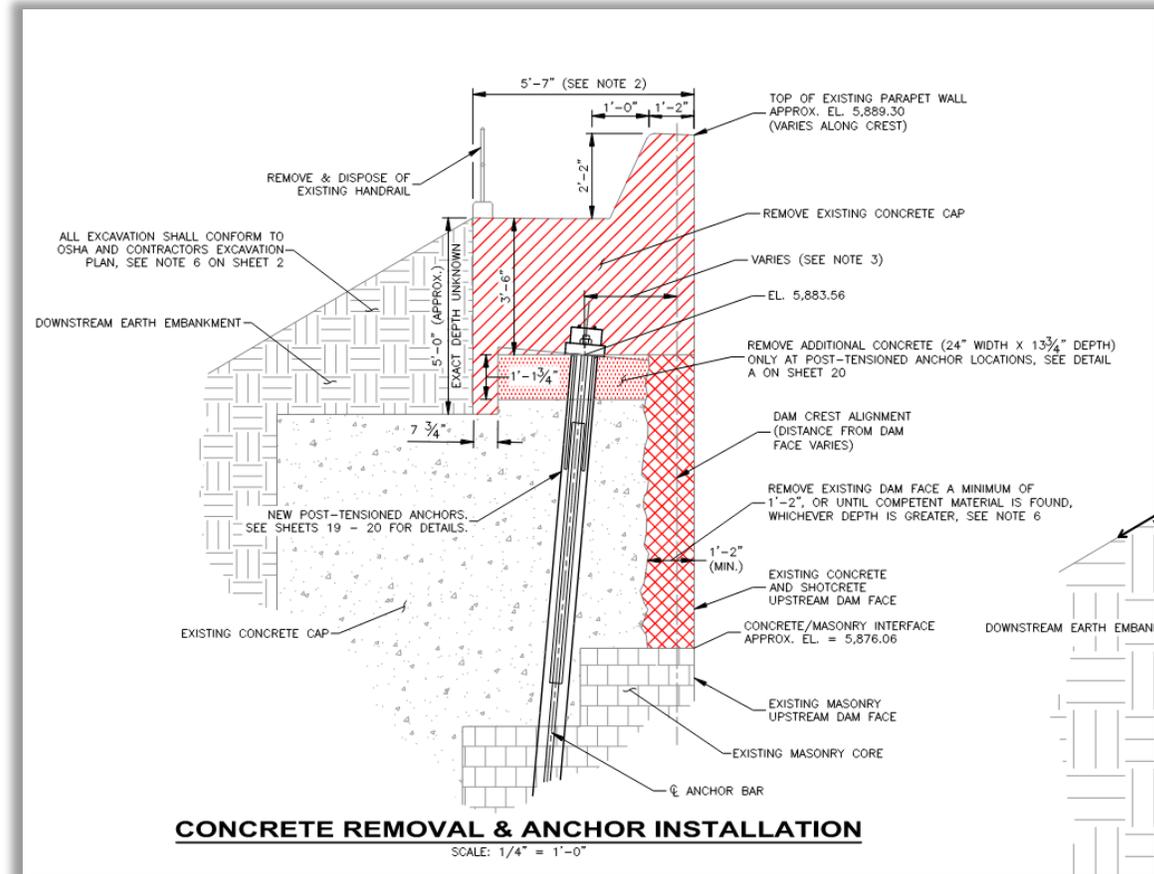
DESIGN



DESIGN

CONCRETE OVERLAY

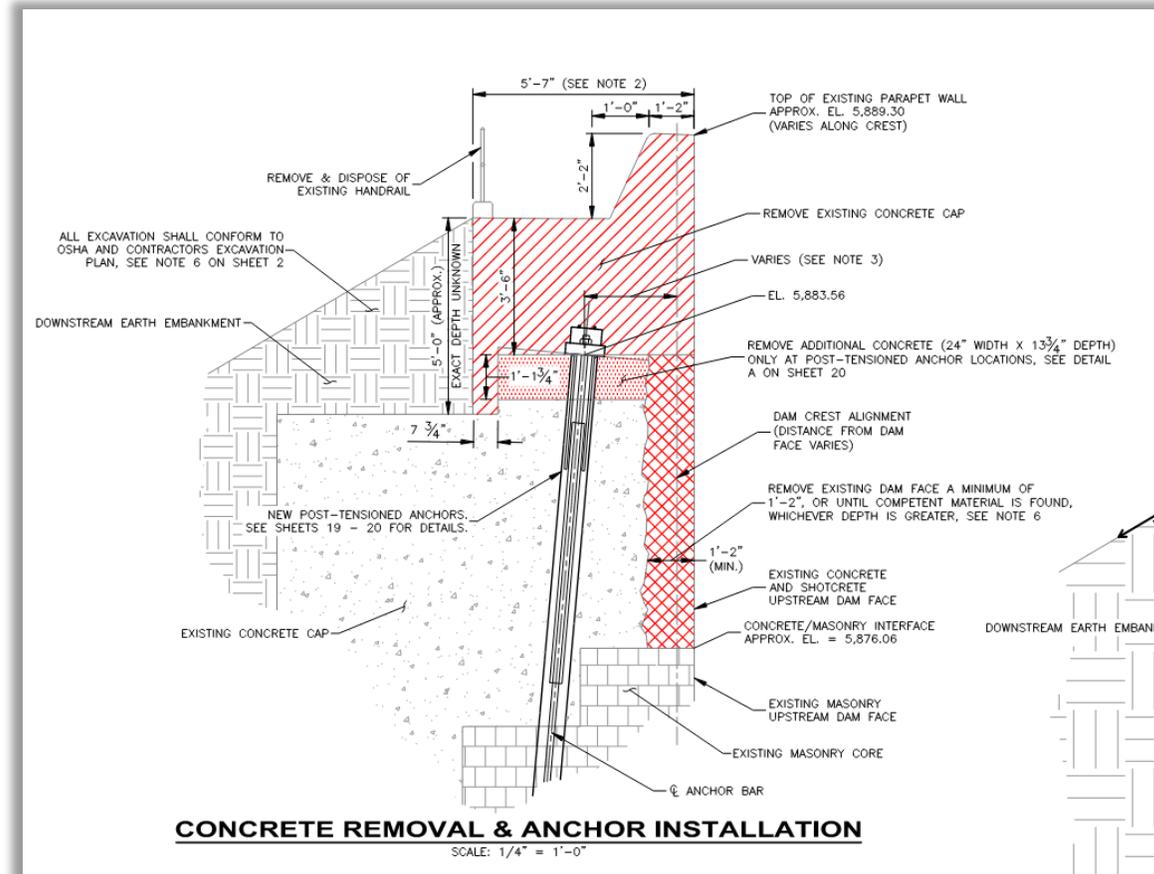
- Address concrete deterioration
 - Remove deteriorated concrete
 - Install reinforced concrete overlay
 - Prevent additional freeze-thaw damage



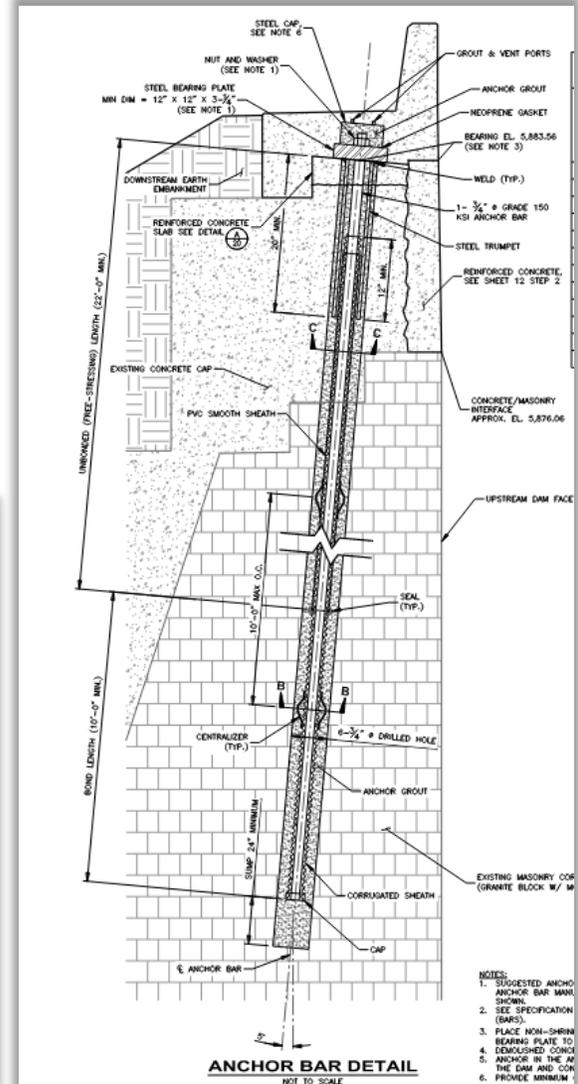
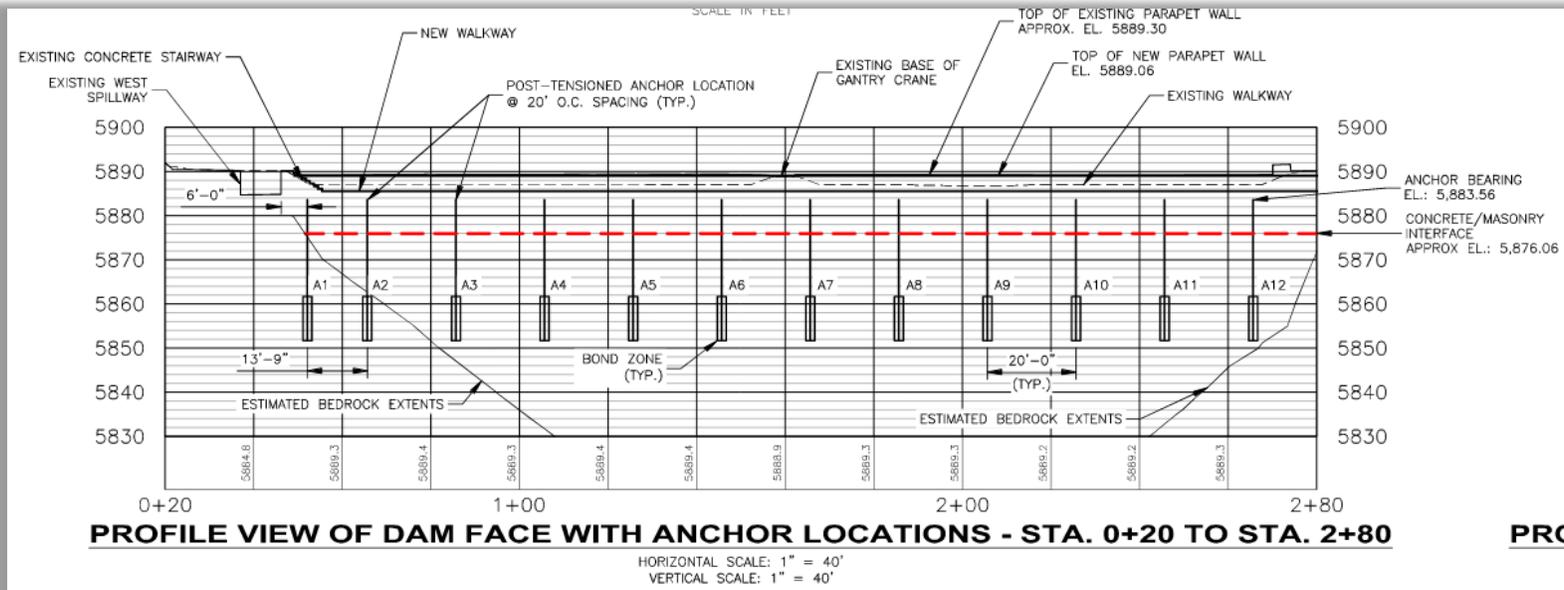
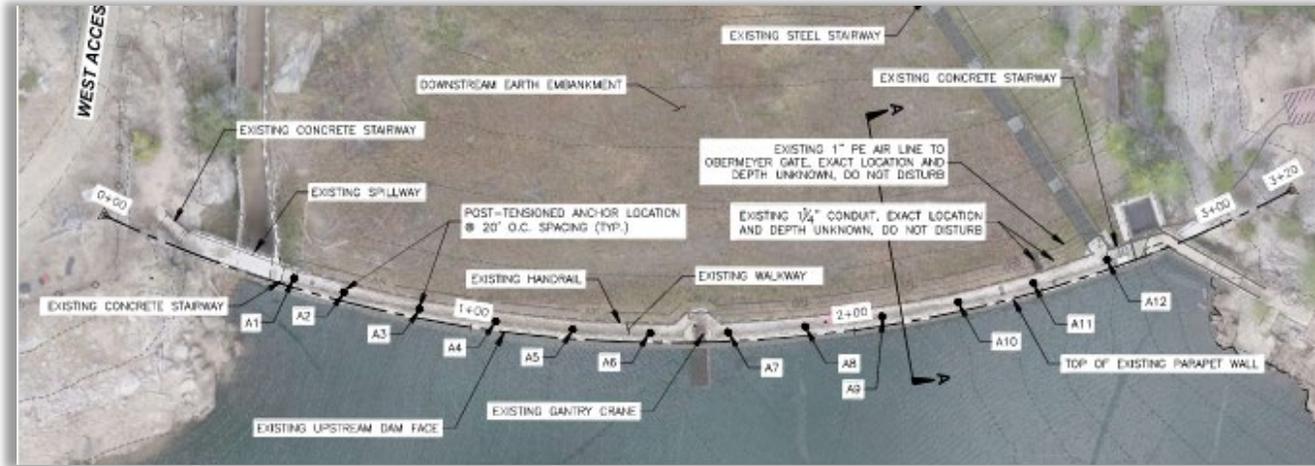
DESIGN

POST-TENSIONED ANCHORS

- Address stability concerns
 - Install post-tensioned anchors to stabilize upper mass concrete
 - Bar anchors chosen; more cost effective than strand anchors
 - Reinforced concrete bearing pad for anchors



DESIGN: PTAs

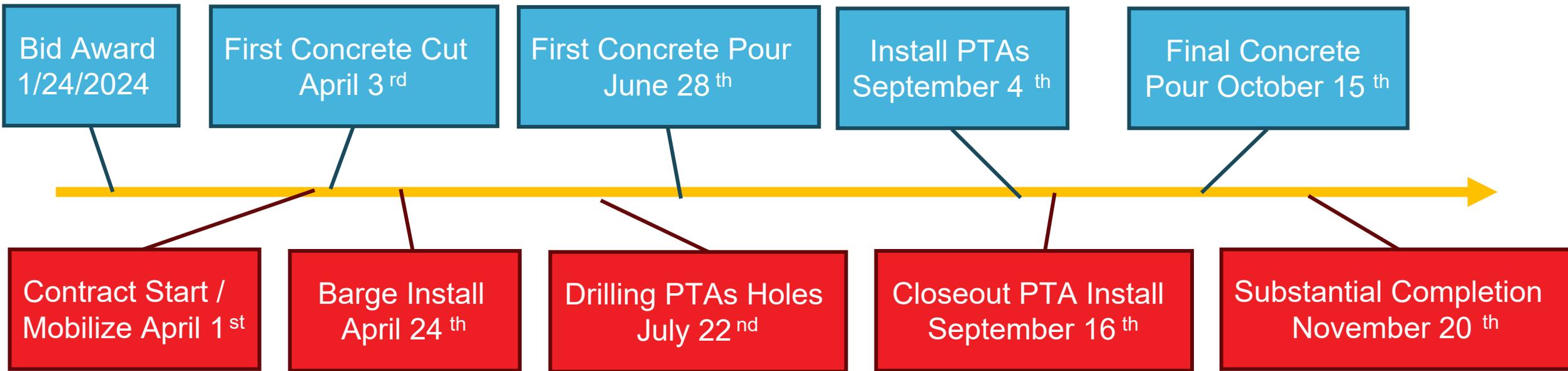


CONSTRUCTION



Pre-Construction

- Reservoir Drawdown
- Three other projects scheduling near the dam that year
- Planned to complete in one construction season



Site Access and Mobilization

- Mobilized April 1st
- Site access added complexity



Site Access and Mobilization

- Utilized west access road almost exclusively for equipment access
- Required snow removal, surfacing, and minor widening



Site Access and Mobilization

- Barges were first priority to get on-site and installed
- Had to perform AIS inspection prior to entering reservoir
- Installed late April



Site Access and Mobilization

- Excavator walked up downstream face to near crest



Pilot Hole Drilling/Core Samples

- Pilot holes were prioritized early in the project so anchor design could be verified
- 5 week lead time on anchor bars once approved
- Utilized hand packable drill rig



Pilot Hole Drilling/Core Samples

- Drilled 5 total pilot holes at anchor locations
- Pilot holes confirmed poor concrete in top 2-3 feet of overlay



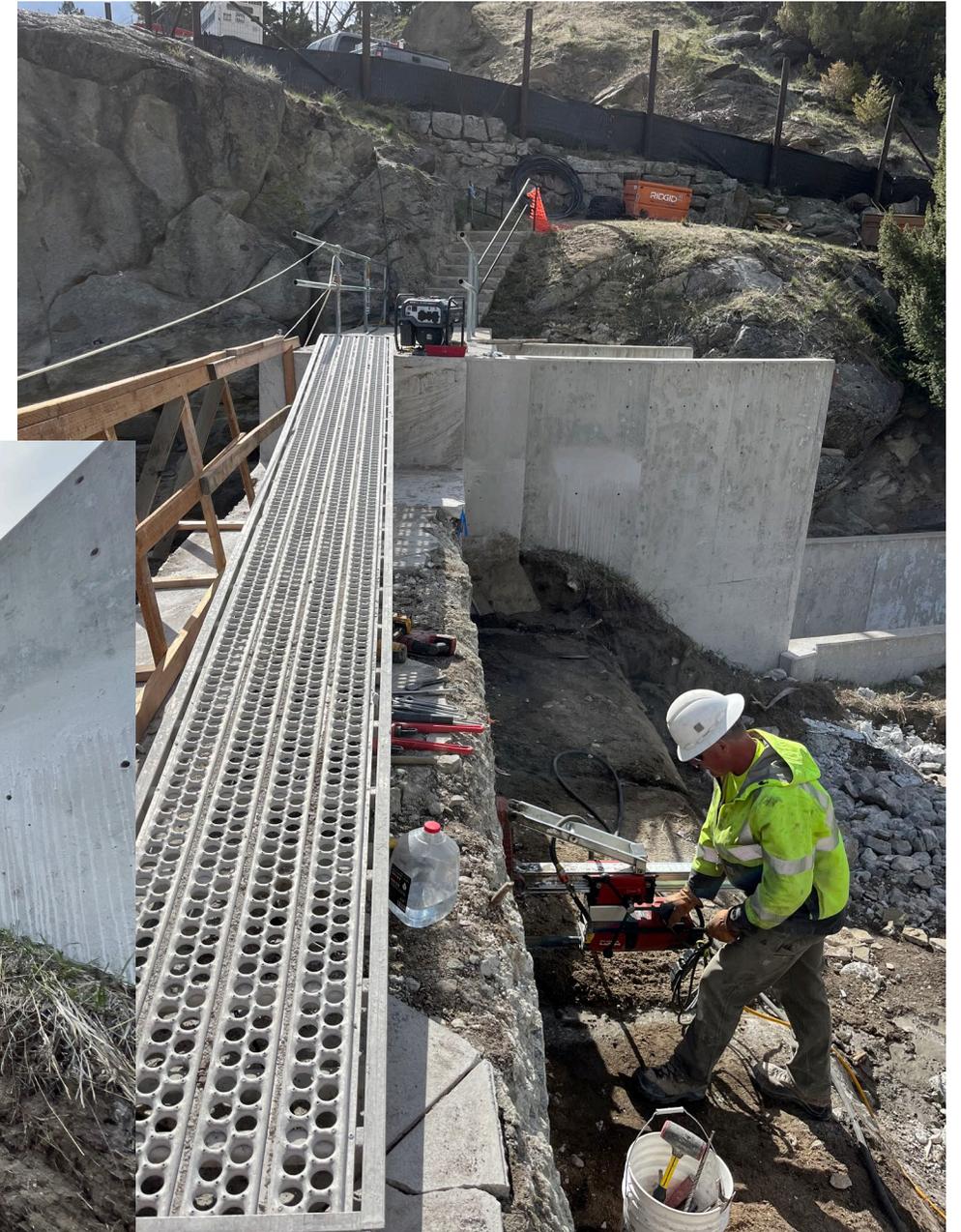
Concrete Removal

- Contractor elected to use wire saw to remove concrete



Concrete Removal

- Required core holes to be strategically and accurately drilled to run wire.



Concrete Removal

- Rail saw used to cut relief along concrete masonry interface



Concrete Removal

- Excavator used to lift cut mass concrete



Pouring The Dam Face

- First pour on June 28th
- Generally poured 20 foot panels



Pouring The Dam Face

- All pours were completed from the base of the dam
- Had to pump vertically 80 feet and 60 horizontally



Pouring The Dam Face



Pouring The Dam Face



Post-Tensioned Anchor Installation

- Drilling started last week of July
- Drill rig transported by barge and lifted by excavator onto dam crest



Post-Tensioned Anchor Installation



Post-Tensioned Anchor Installation

- A series of drilling, grouting, re-drilling, and watertightness repeated itself until all holes were sealed
- No reinforcing found in concrete, but many more voids than anticipated
- Process took almost a month

	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	
Pilot Hole	Y	N	Y	N	N	N	Y	N	N	Y	N	Y	
Initial Drill <small>(paid under separate bid item)</small>	Date	5-Aug	6-Aug	5-Aug	6-Aug	6-Aug	8-Aug	5-Aug	8-Aug	9-Aug	21-Aug	22-Aug	9-Aug
	Depth - CJ (ft)	36	36	36	36	36	36	36	36	36	35	35	36
	Depth - GWE (ft)	36	36	36.5	36	36	36	34	36	36	35	34.92	36
Re-drill 1	Date	19-Aug	19-Aug	19-Aug	19-Aug	20-Aug	20-Aug	20-Aug	20-Aug	20-Aug	8/23 & 26	24-Aug	20-Aug
	Depth - CJ (ft)	35	35	35	35	35	35	35	35	35	35	35	35
	Depth - GWE (ft)	35.58	34.67	35.17	36	34.92	36.92	35.42	35.17	35.17	34.83	35	35.17
	Drilled Length (ft)	35	35	35	35	35	35	35	35	35	24.4	24.4	35
	Date of Passed Water Test	Failed	20-Aug	Failed	Failed	20-Aug	Failed	21-Aug	Failed	Failed	26-Aug	26-Aug	Failed
Re-drill 2	Date	28-Aug		27-Aug	27-Aug		8/26 & 27		26-Aug	26-Aug			23-Aug
	Depth - CJ (ft)	35		35	35		35		35	35			35
	Depth - GWE (ft)	35.1		35.1	35.2		35		35.1	35			35
	Drilled Length (ft)	25.4		25.4	25.4		25.4		25.4	25.4			25.4
	Date of Passed Water Test	28-Aug		27-Aug	27-Aug		27-Aug		Failed	26-Aug			24-Aug
Re-drill 3	Date								28-Aug				
	Depth - CJ (ft)								35				
	Depth - GWE (ft)								35				
	Drilled Length (ft)								25.4				
	Date of Passed Water Test								28-Aug				

Post-Tensioned Anchor Installation

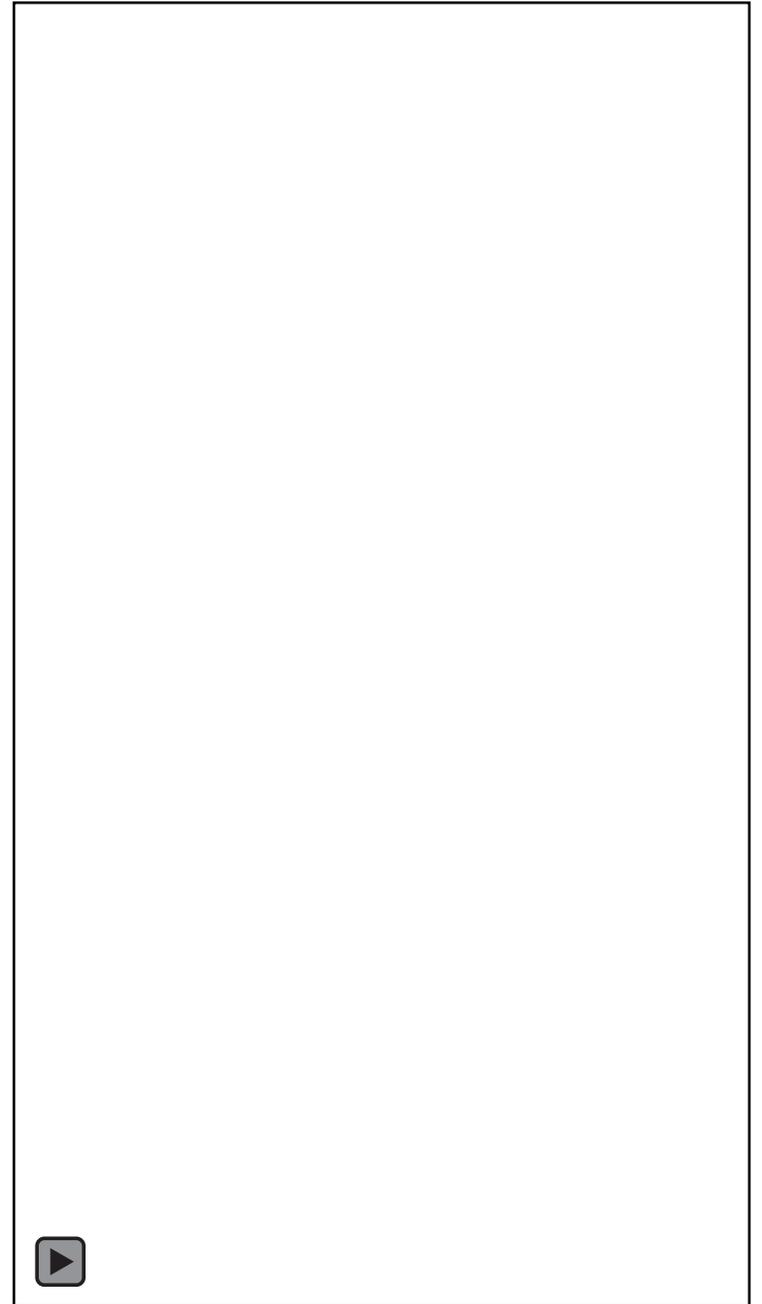
- PTAs originally planned for install via barge and excavator
- Pivoted and decided to use a helicopter instead



Post-Tensioned Anchor Installation

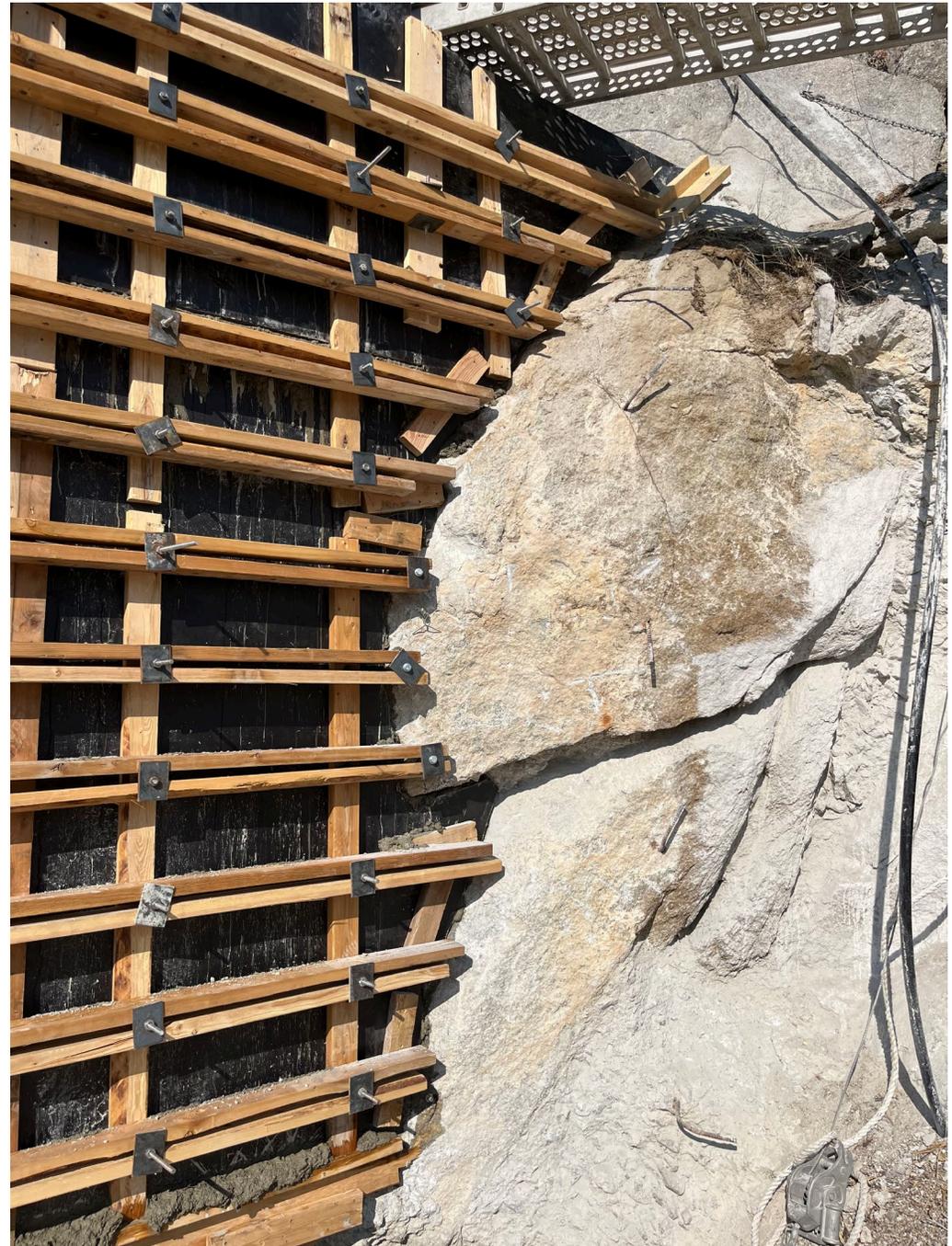


Post-Tensioned Anchor Installation



Final Concrete Installation

- Last pour October 15th
- Overlay and parapet were poured, along with stairs and new bypass spillway.



US Dam Face



US Dam Face



US Dam Face



DS Dam Face



DS Dam Face



DS Dam Face



DS Dam Face



West Bent



West Bent





Thank You!

Justin Evertz - jevertz@greatwesteng.com

