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ROCK - SOIL TECHNOLOGY AND EQUIPMENTS

PACCHIOSI DRILL

IMPERMEABILIZZAZIONI

SACRAMENTO (CALIFORNIA - USA)

AMERICAN RIVER COMMON FEATURES - SACRAMENTO RIVER EAST LEVEE, CONTRACT 2

SACRAMENTO (CALIFORNIA - USA)

AMERICAN RIVER COMMON FEATURES 2016 - SACRAMENTO RIVER EAST LEVEE, CONTRACT 2

PROJECT:

Installation of a permanent seepage cutoff wall by jet grouting method in order to correct levee deficiencies identified throughout the flood protection system along the east bank of the Sacramento River (Sacramento - California).

PERIODO DI ESECUZIONE:

March 2021 – February 2022

OWNER AND PRIME CONTRACTOR:

Owner: U.S. Army Corp of Engineers, District of Sacramento

Prime Contractor: Nordic Industries, Inc.

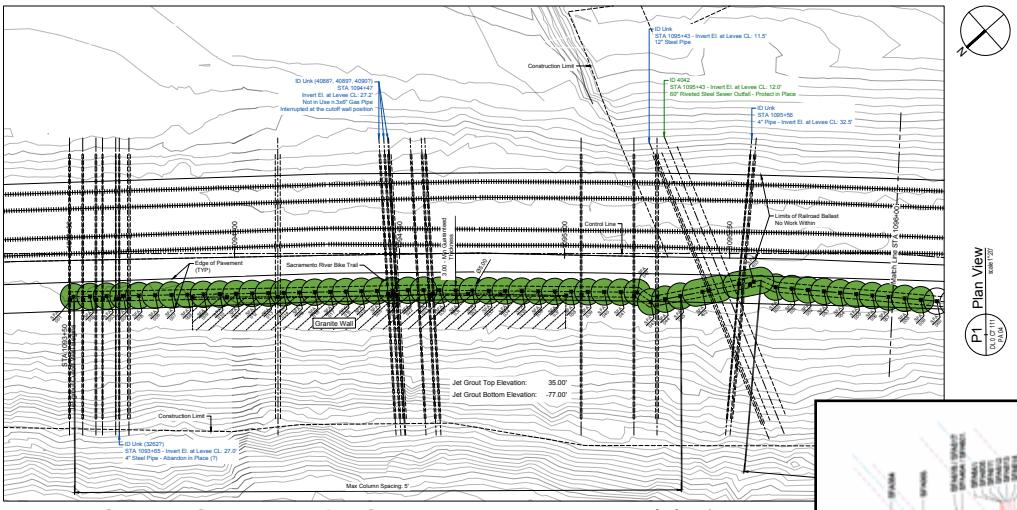

Fig. 1 - Section CLIN0001 FIRM Sta 1.093+50 to 1.098+50 (A) 1/2

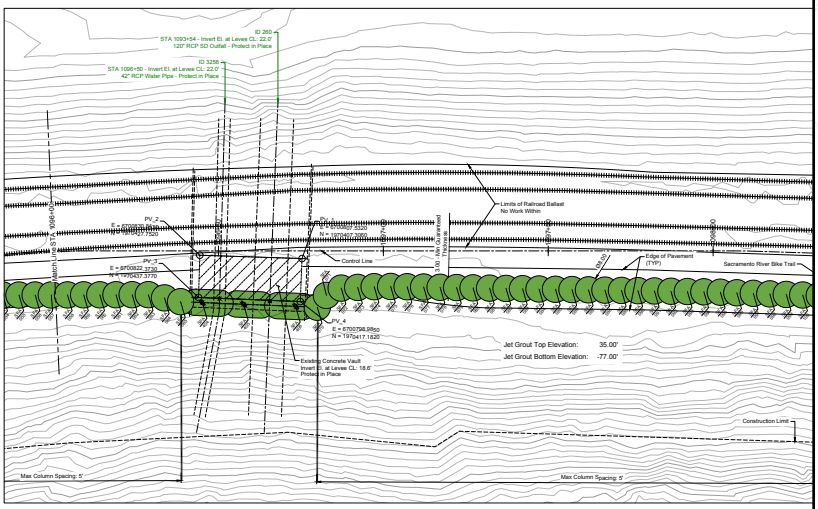

Fig. 2 - Section CLIN0001 FIRM Sta 1.093+50 to 1.098+50 (A) 2/2

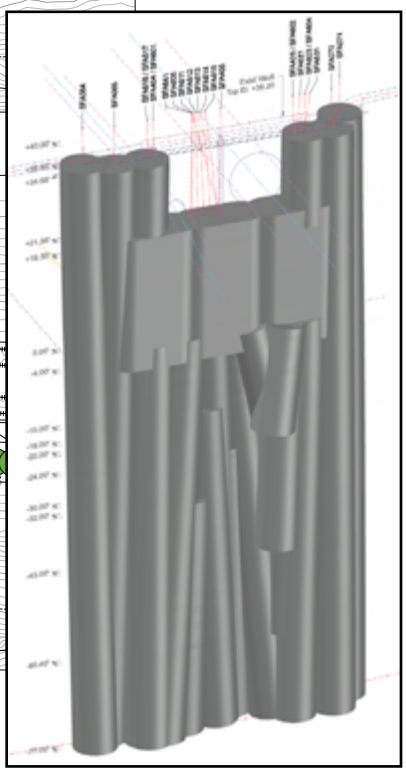

Fig. 3 - 3D reconstruction surgery at the Pioneer Vault

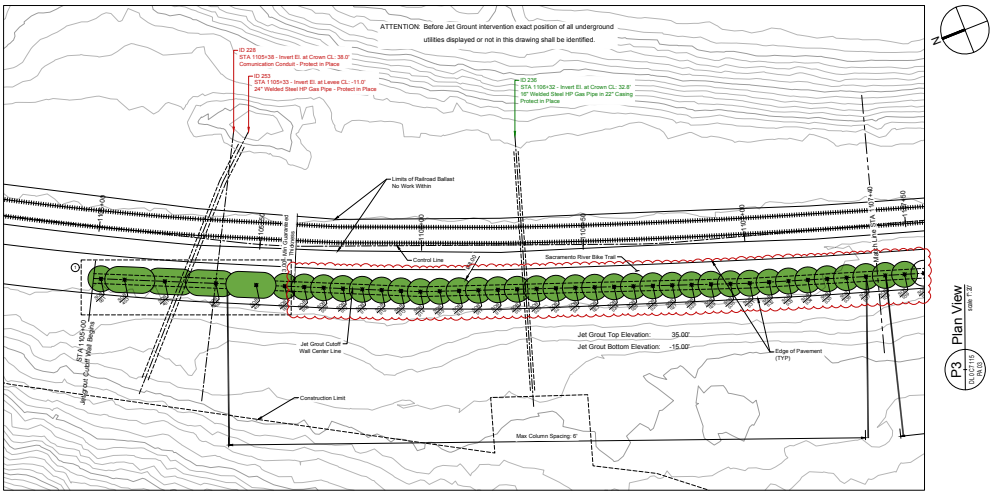

Fig. 4 - Section CLIN1001 OPTIONAL Sta 1.105+00 to 1.112+40 (B) 1/3

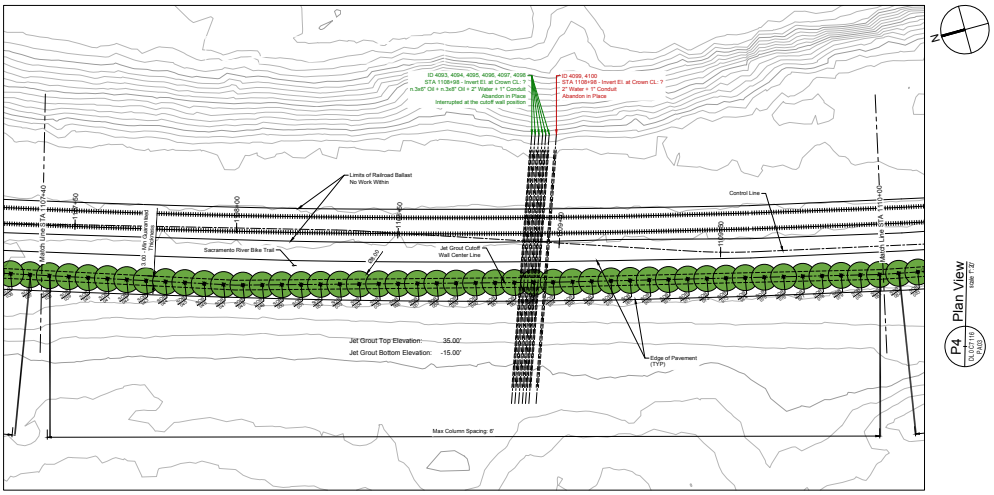

Fig. 5 - Section CLIN1001 OPTIONAL Sta 1.105+00 to 1.112+40 (B) 2/3.

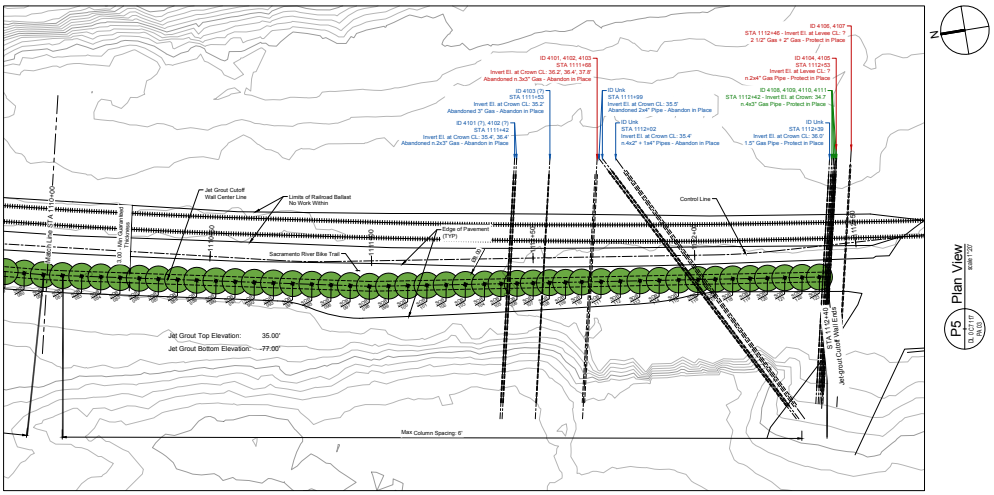

Fig. 6 - Section CLIN1001 OPTIONAL Sta 1.105+00 to 1.112+40 (B) 3/3.

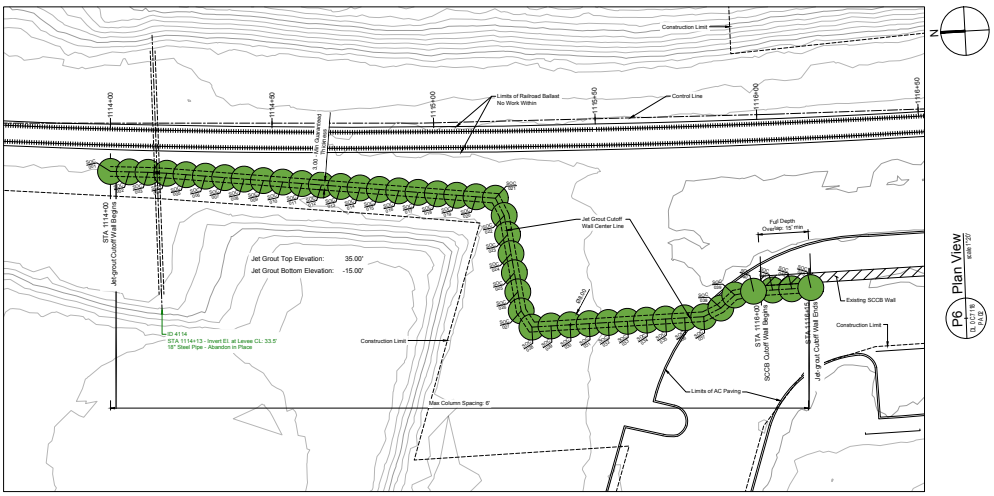

Fig. 7 - Section CLIN1001 OPTIONAL Sta 1.114+00 to 1.116+15 (C).

Background.

Greater Sacramento, California, is often considered to be the most at-risk region in American for catastrophic flooding, relying on an aging system of levees, weirs and bypasses and Folsom Dam to reduce its flood risk. But that system, just like a chain, is only as strong as its weakest link.

The U.S. Army Corp of Engineers and its partners have been continuously modernizing Sacramento's flood infrastructure. In order to achieve this, Pacchiosi has been involved in several projects where jet grouting permanent seepage barrier cutoff walls have been installed. From 2013 to 2016, Pacchiosi, as a prime contractor, successfully completed work on the following projects: R10 (Watt Avenue), L9 and L9A (Fairbairn Water Treatment Plant), R3A (Capital City Freeway Bridge - right bank), L10 (Howe Avenue Bridge - left bank), R7 (H Street Bridge - right bank), L7 (H Street Bridge - left bank). Details for those projects can be found on our website.

Fig. 8 | 9 - P1500 drills in action.

The USACE made tremendous progress in reducing flood risk, but more work remains. As part of this SREL project in 2021, Pacchiosi was once again requested to demonstrate its mastery of the triple fluid jet grouting method.

Subsurface Conditions.

Variable soil formations consisting of silt and sand alluvium and gavel alluvium with cobble and boulder layers.

Numerous active and abandoned underground utilities present along the entirety of the jet grout cut off work area. Located near Sacramento early settlements historical area, unknown structures and various other obstructions were also encountered, identified and finally taken into account during the jet grouting ground improvement treatment.

Description

The jet grouting work for the contract 2 of the SREL Project is located along the east bank of the Sacramento River, approximately from North of US 50 to Broadway in the City of Sacramento.

In order to correct levee deficiencies identified by recent hydraulic and geotechnical investigations and results, jet grouting was installed at three different locations along the levee for a total of length of 1,455 ft.

Before the actual work, an extensive and thorough testing program was completed to allow the client to refine the final project of Jet Grouting treatments; the test field involved the fabrication of numerous Jet Grouting elements, including cylindrical columns over 8 tf in diameter and rectangular panels up to 16.4 x 8.0 ft, variously coupled, (Fig. 11-12) with the aim of:

- examine the relationships between jet grouting treatment parameters, column geometry and the interspace between columns to achieve a continuous diaphragm;
- assess the permeability and strength characteristics of the treat-ed soil;
- determine the optimal injection parameters;

Fig. 10, - PRS3 data acquisition and recording system.

- choose between the possible geometries of jet grouting treat-ments;
- choose the most effective injection methodology

Using the PACCHIOSI PS3 triple-fluid method (air-water-grout), the cutoff walls were generally formed by a single row of overlapping 8.00 ft diameter jet grout columns, with spacing ranging from 5 to 6 ft, depending on the different depths of the treatments.

To depths up to 115 ft, a total of 100,278 SF of jet grout cutoff was installed.

Fig. 11 | 12. Columns with variable geometry made in the test field.

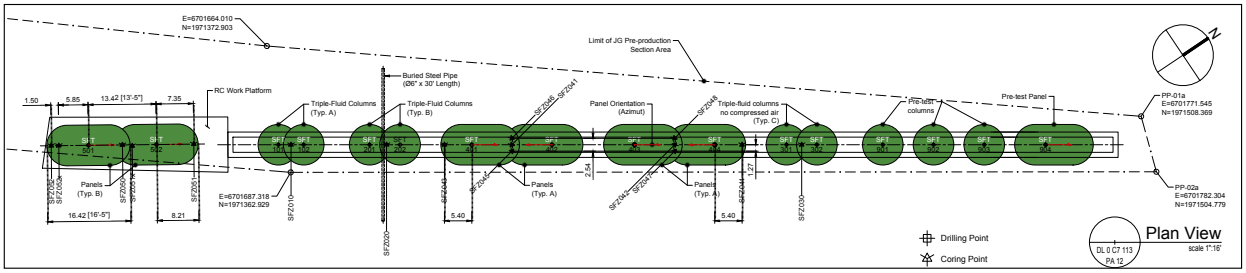

Fig. 13 - Interventions carried out in the test field.

It was performed the measurement of verticality and deviation of all columns before each injection; a continuous data recording was also carried out in both drilling and in-jection phases, using the PACCHIOSI PRS3 system (Fig. 10).

All jet grout spoils were collected at the boreholes using a T-pre-venter head with collected spoils pumped directly to the spoil processing area located at a distance of up to 3,000 ft from the jet grouting location.

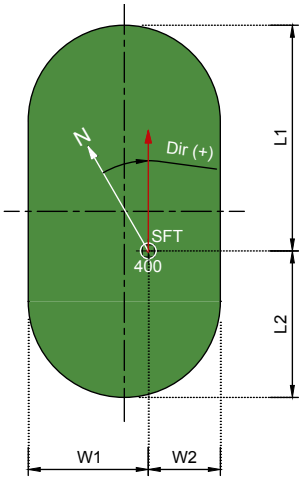

Fig. 14 - .Rectangular panel parameters

Fig. 15 | 16 | 17 - Checks carried out on the columns by means of core drilling.

The main challenge on this project was the installation of jet grout cutoff around numerous existing subsurface utilities. In particular, jet grouting had to be performed below an existing 30-ft wide concrete vault and also under and around a 66-inch outfall pipe, with thw intwrference of steel sheet-piles. To do so, Pacchiosi successfully installed innovative overlapping 16.4-ft long by 8.0-ft wide jet grout rectangular panels.

Fig. 18, - P 1500 drilling machine in action

Specifically, this was a customized intervention, gradually redesigned underway thanks to the real-time measurement of the deviations of vertical and inclined drilling, which allowed the optimisation of the po-sition of the drilling points and the inclination planned to achieve the purpose. As can be seen from the relevant images (Fig. 20 and 21), the situation proved to be particularly complex and potentially Insidious, but thanks to the experience and technologies used, the successful execution of the work was completed without delay.

Another facet of the work that needed a high level of expertise was the ability to keep the drilling deviation to a minimum while reaching depths of 115 ft through significant size cobbles, boulders and various unknown obstructions. All jet grout holes were me-

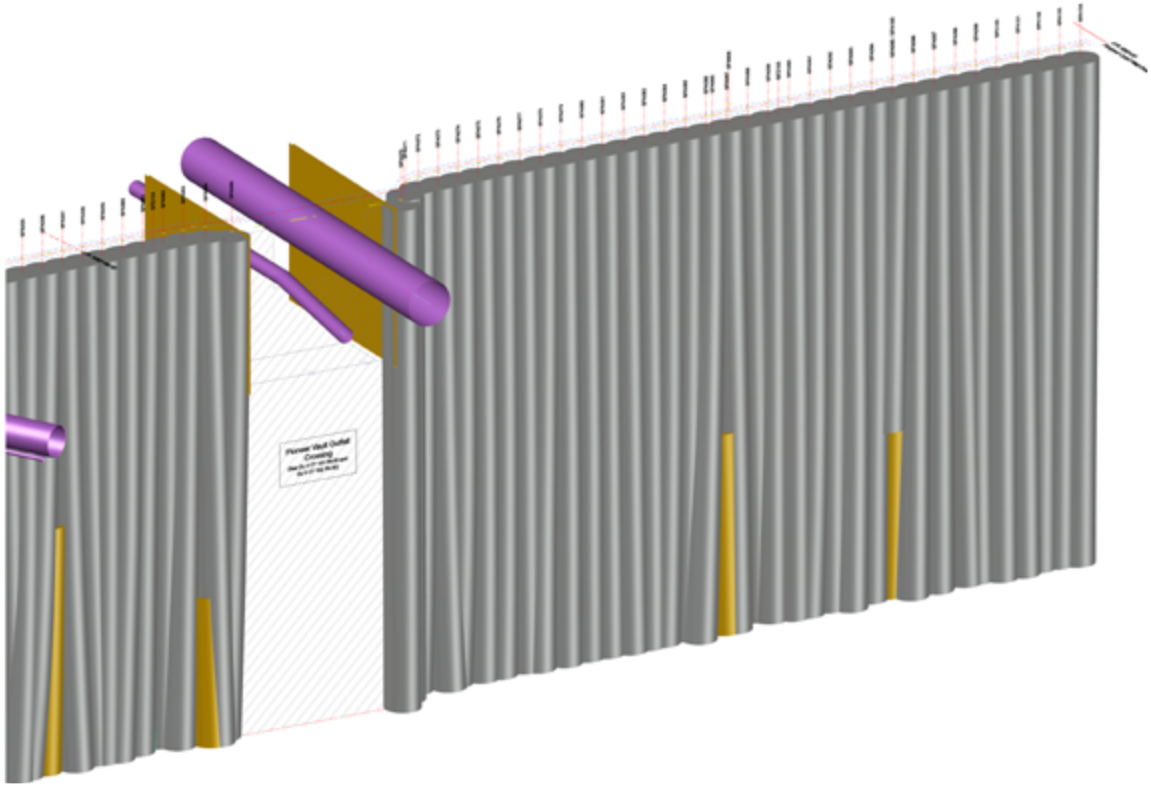

FIG. 19 - Section S1 | Pioneer Reservoir Outfall Crossing

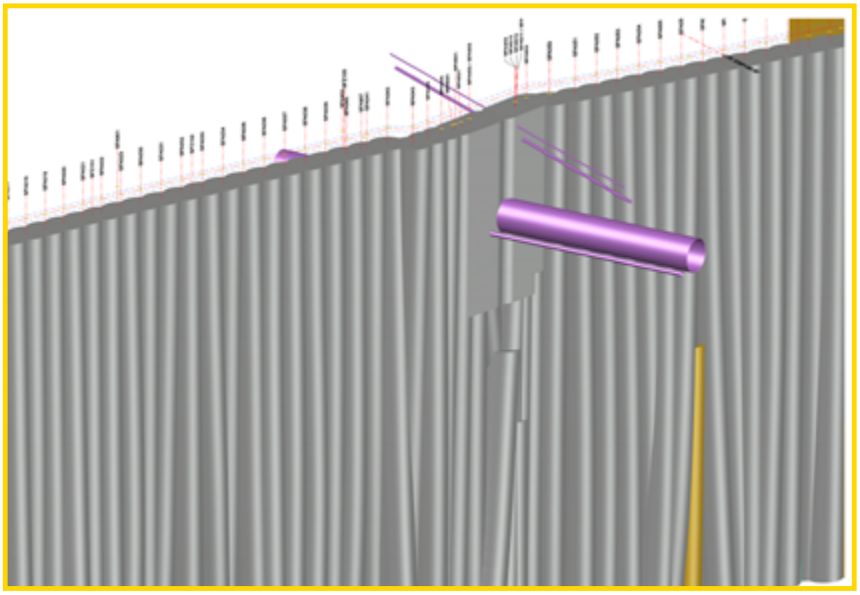

FIG. 19.1 - Section S1 panel execution | Pioneer Reservoir Outfall Crossing

asured for deviation prior to grouting.

The jet grout wall thickness and continuity has been verified using core drilling at numerous locations and through the full depth of the jet grout wall. Specified maximum permeability of 1 x 10-5 cm/s was verified using in-situ water testing of core holes and laboratory tests on cored samples. Borehole camera inspections were also performed throughout the duration of the work.

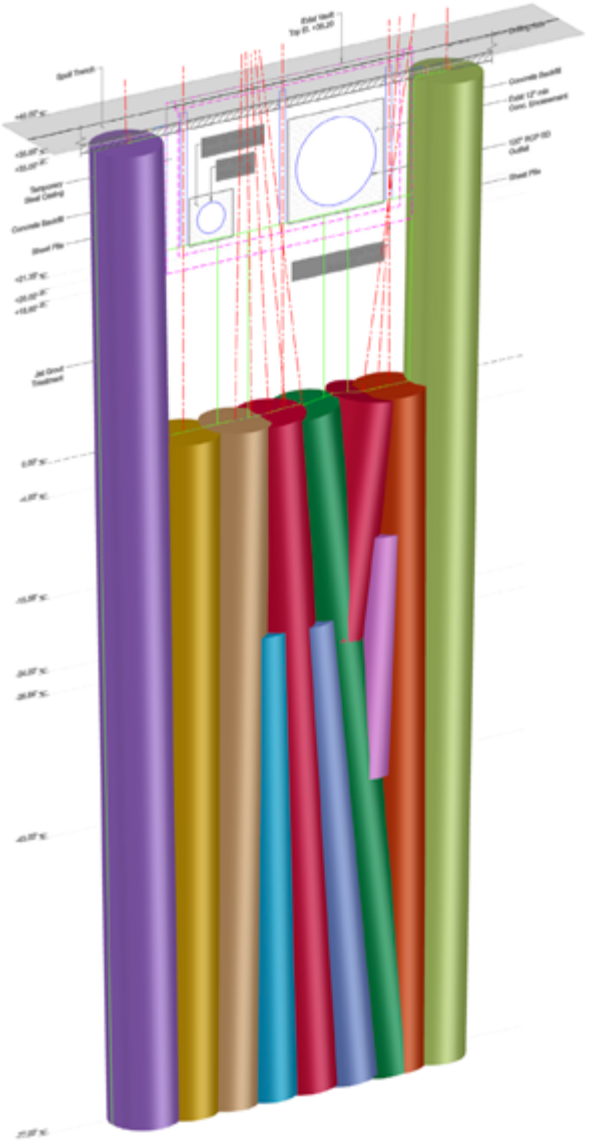

Fig. 20 | Pioneer Reservoir Outfall Crossing
S1 columns execution

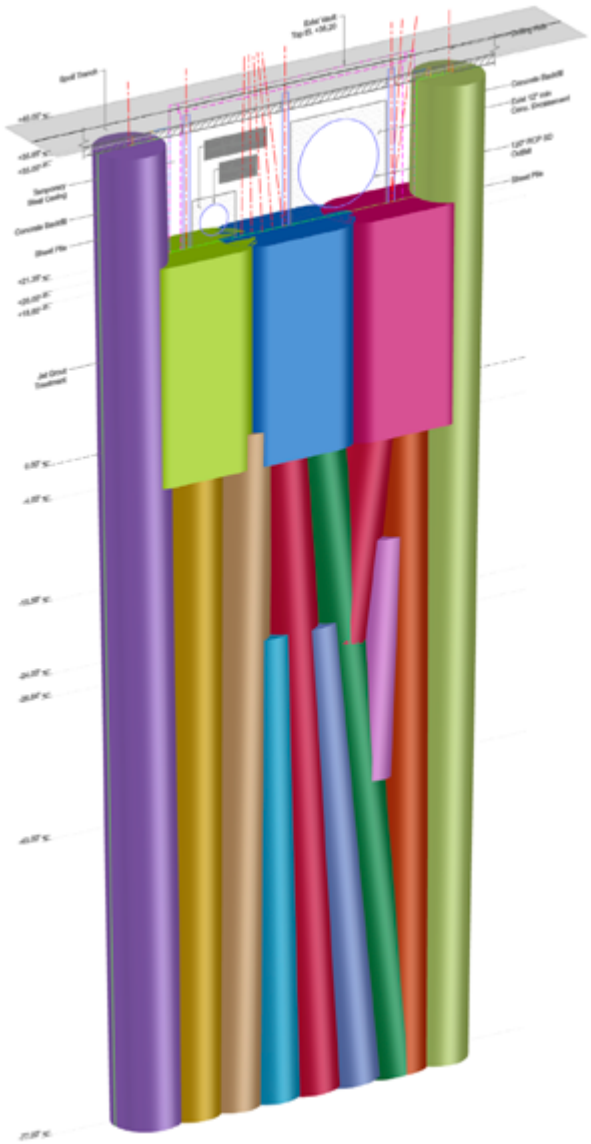

Fig. 21 | Pioneer Reservoir Outfall Crossing
S1 panel execution

Staging Areas

Suitable site areas have been identified near the work areas for the installation of equipment: high-pressure pumps, mixers with cement silos, air compressors, warehouse and workshop containers.

A large tank for collecting drilling and injection spoils has also been set up near the construction site.

Fig. 22 - Site installation

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