Microtunneling Under the Buffalo River

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AM Track 1 – Gas, Power, Telecommunications

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Project Overview

- Owner: National Grid
- Trenchless Engineer: Haley & Aldrich
- Contractor: Ward & Burke

- Objective
  - replace an outdated, undersized, and unsafe existing tunnel with a new tunnel for a 20 way conduit bank underneath the Buffalo River to serve future power demands in the First Ward

Project Timeline and Presentation Overview

- Site and subsurface conditions
- Issued For Construction – June 2017
- Procurement – July to October 2017
- Construction – November 2017 to July 2018
  - Shaft construction November 2017 to May 2018
  - Media Day – 1 May 2018
  - Microtunneling – 2 to 24 May 2018

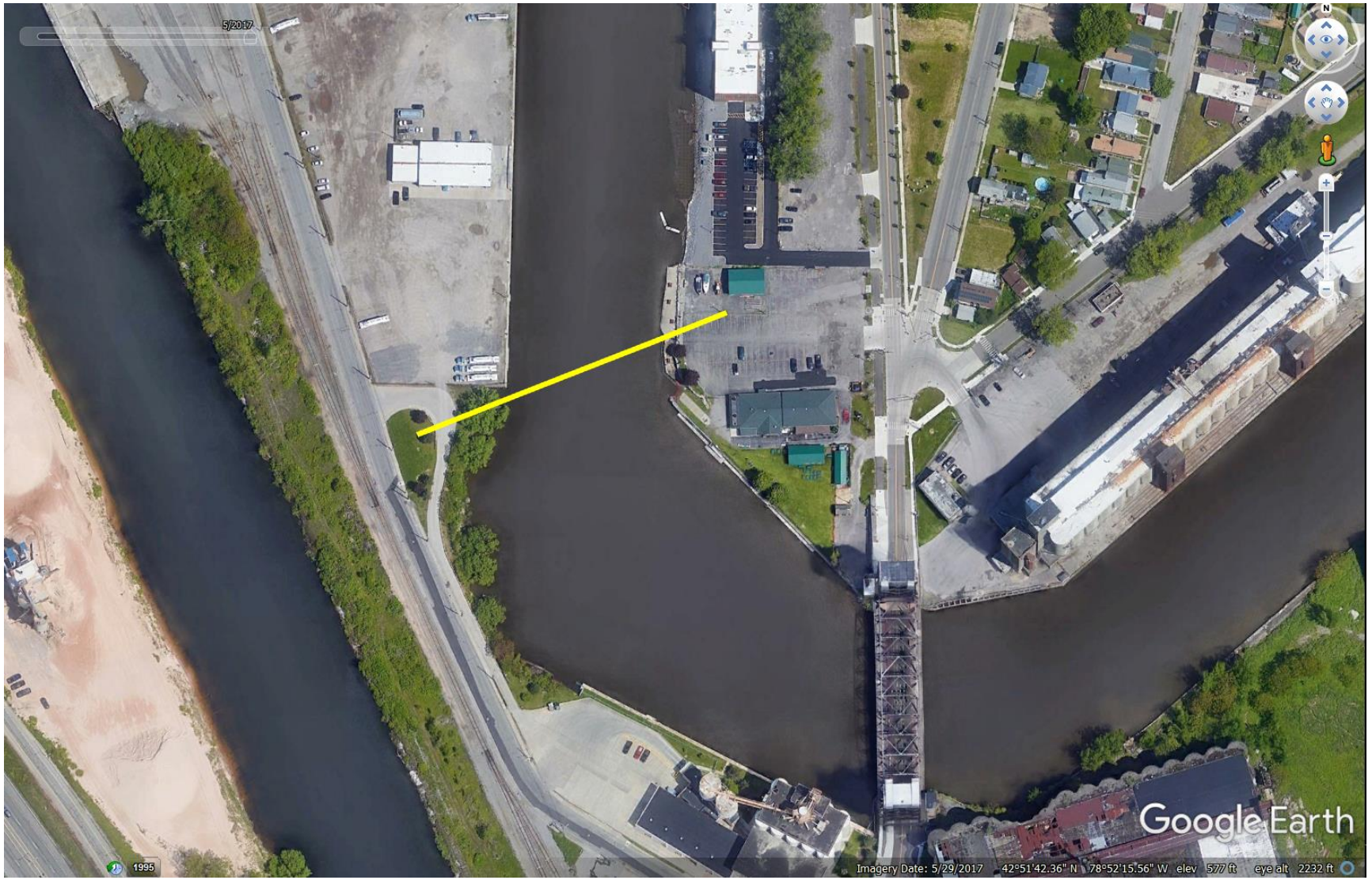
Project Location

Map Source: ESRI

Circuits to be Replaced

- Owner is a co-occupant in the existing tunnel which is owned by the City of Buffalo
  - Tunnel built circa 1900
  - Approximately 400 ft long
  - Approximately 80 ft deep
  - Tunnel is no longer safe for entry, too costly to upgrade for safe work entry
- Three 23kV submarine cables
- One 5kV submarine distribution circuit
- Several retired 25Hz circuits

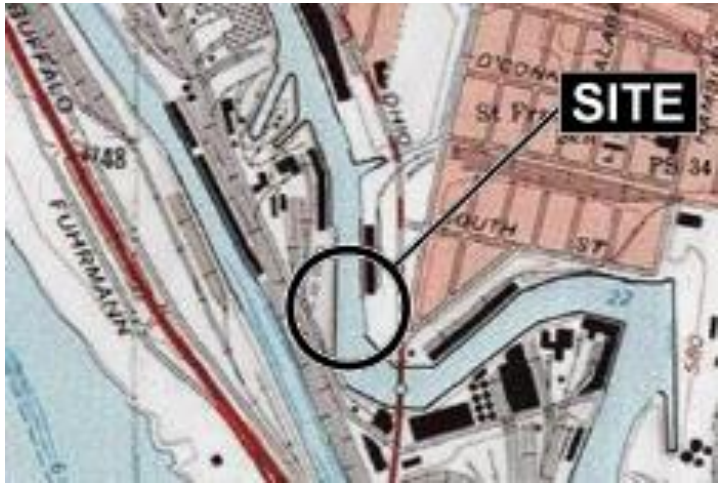
Existing Site Conditions



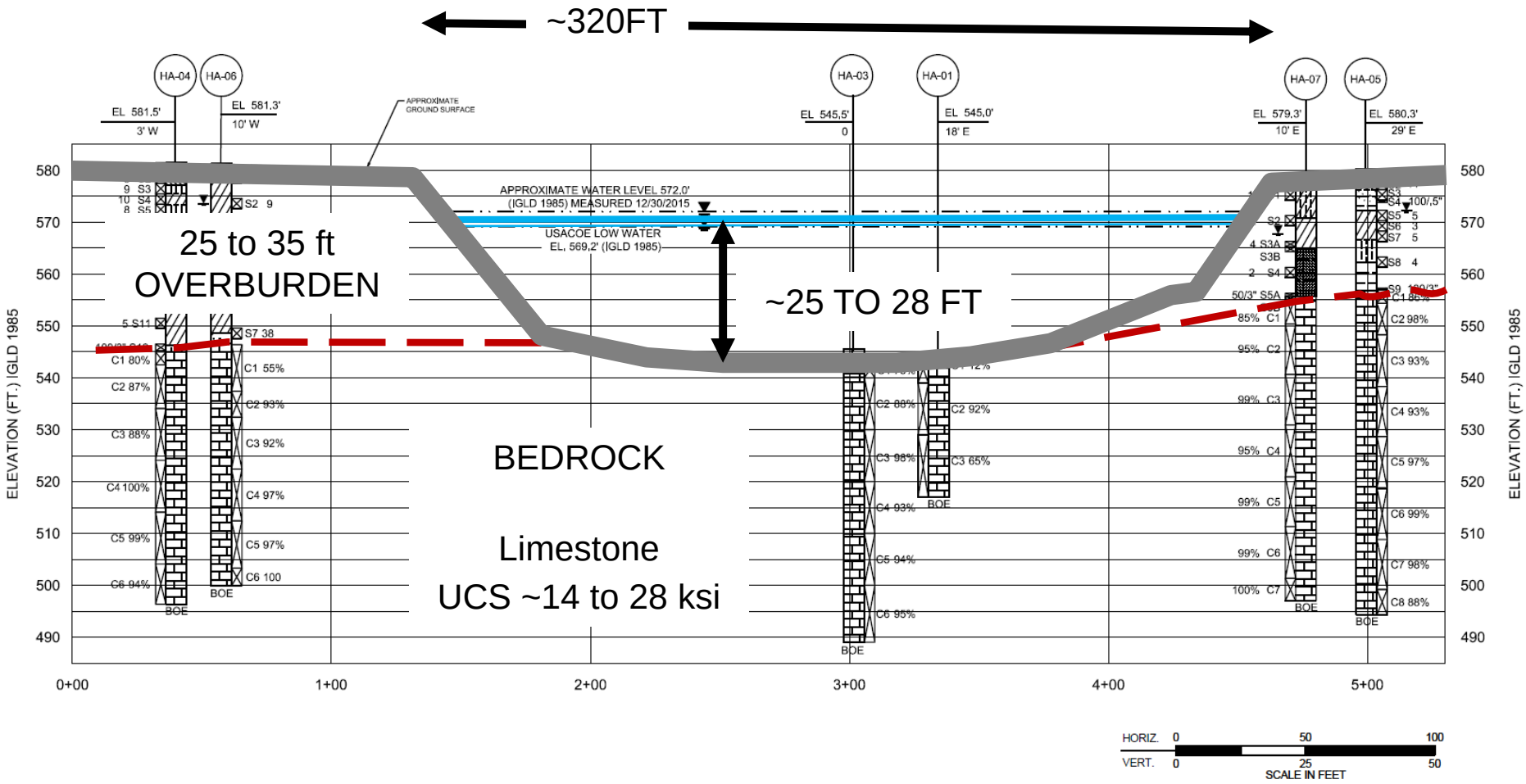
Selection of Trenchless Method

- HDD or Microtunnel?
- Considerations
  - Geometry of the river
  - Potential for vertical fractures in rock
  - Diameter of installation
  - Available workspace on either side of the river

→ Microtunnel selected

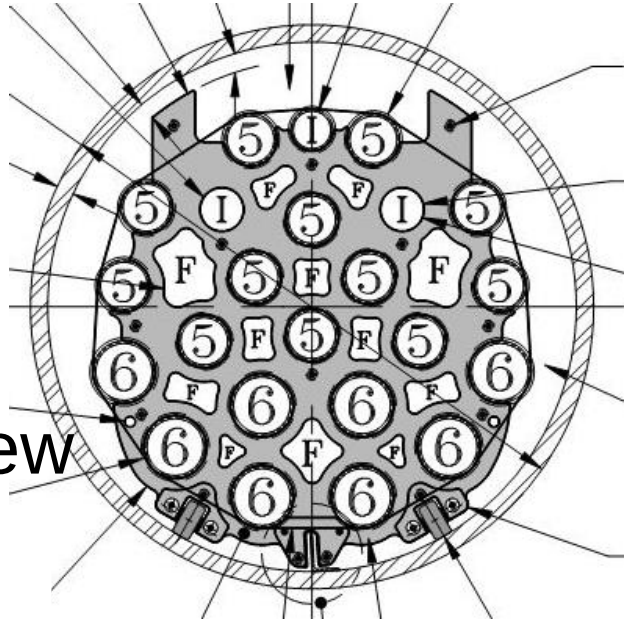


Subsurface Conditions



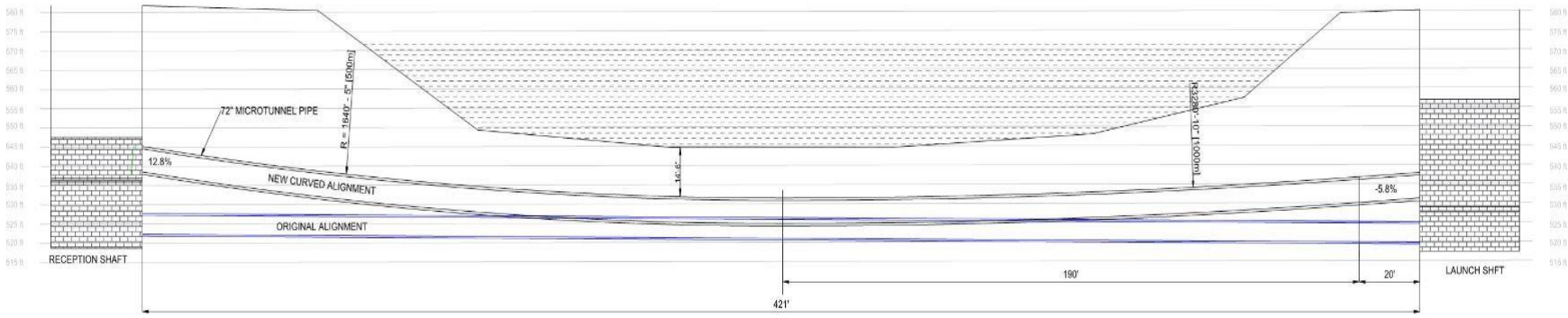
Issued For Construction

- Two new manholes
- One new tunnel
  - Approximately 425 ft in length
  - 60 inch diameter steel casing
    - 20 way conduit bank
- New conduit bank to tie into a new 34.5 kV Station
- 20 way conduit bank
  - Twelve 5 inch nominal ID PVC
  - Eight 6 inch nominal ID PVC



Detail from IFC Drawings

Construction Phase



- Curved Microtunnel proposed by the Contractor
  - Reduce the depth of the shafts
- Increased tunnel diameter
  - From 60 inch minimum to approx. 90 inches

Image from Project Submittal

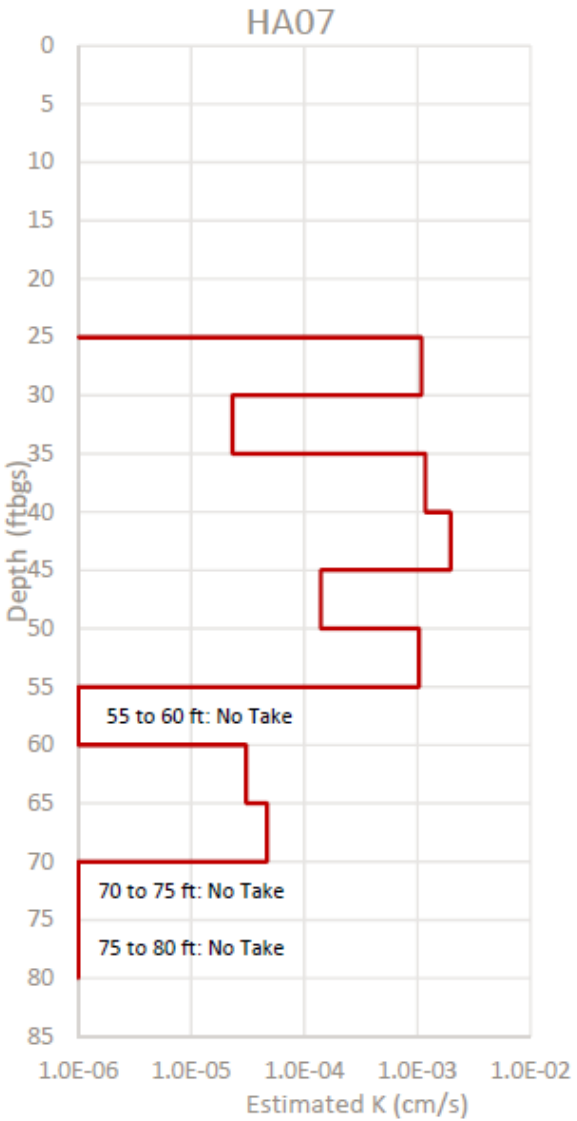
Construction Phase

Curved microtunnel alignment reduced shaft depths by approximately 18 ft on the Reception side and 12 ft on the Launch side.

Thereby reducing the amount of rock excavation

Image from Project Submittal

Packer Testing



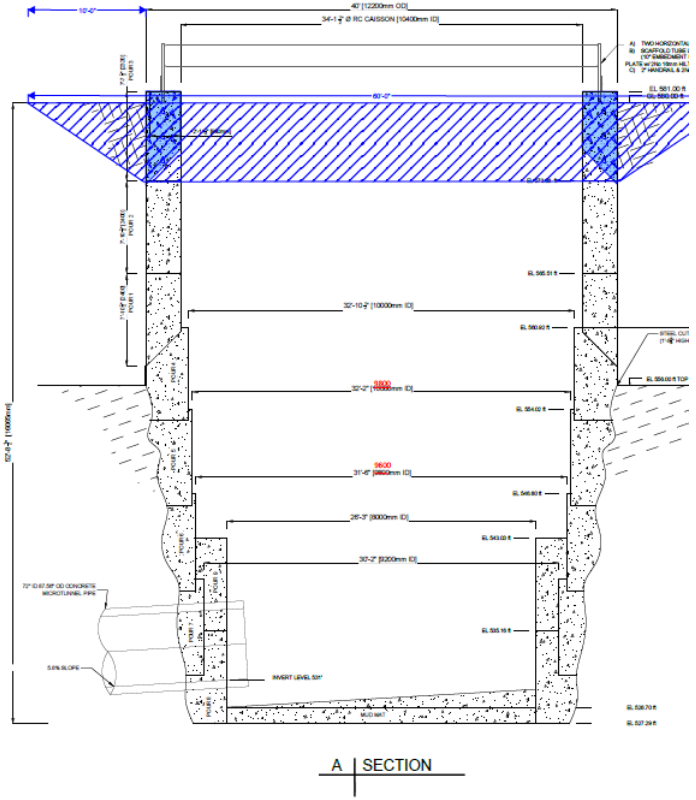
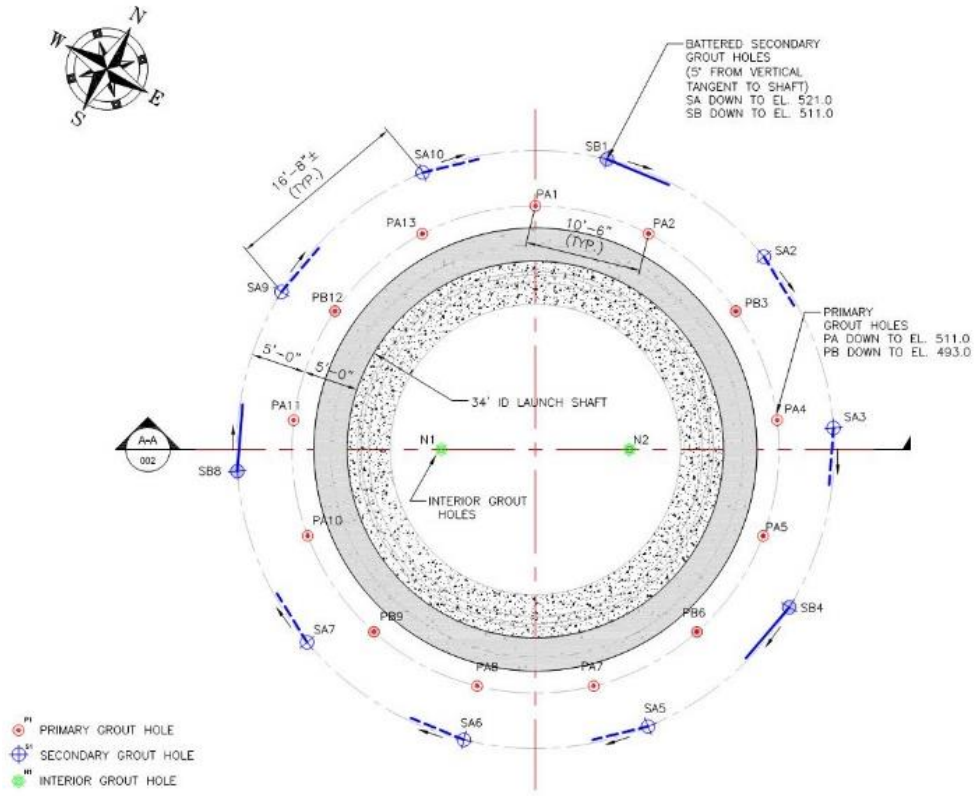


Image from Project Submittal

Pressure Grouting



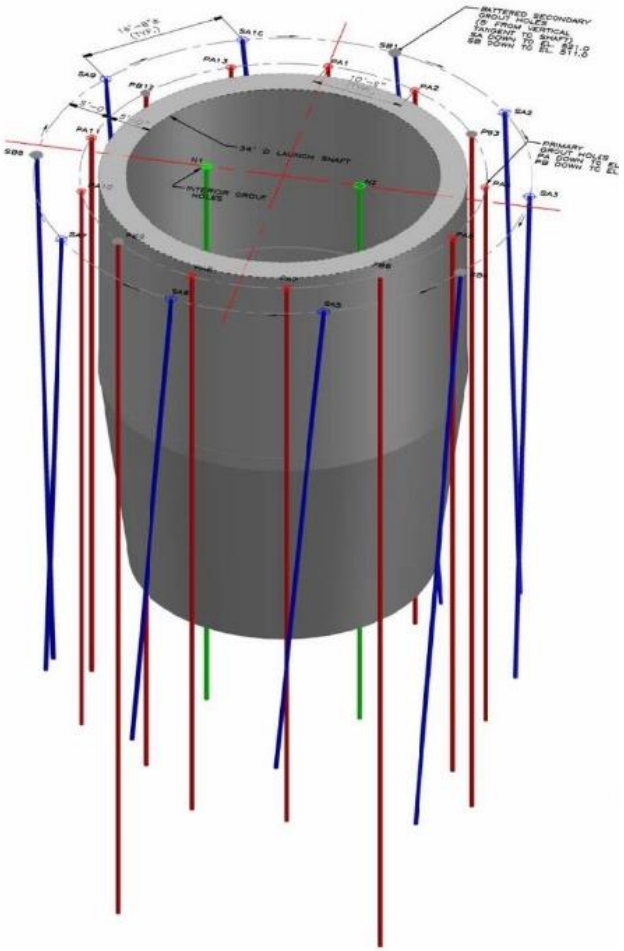


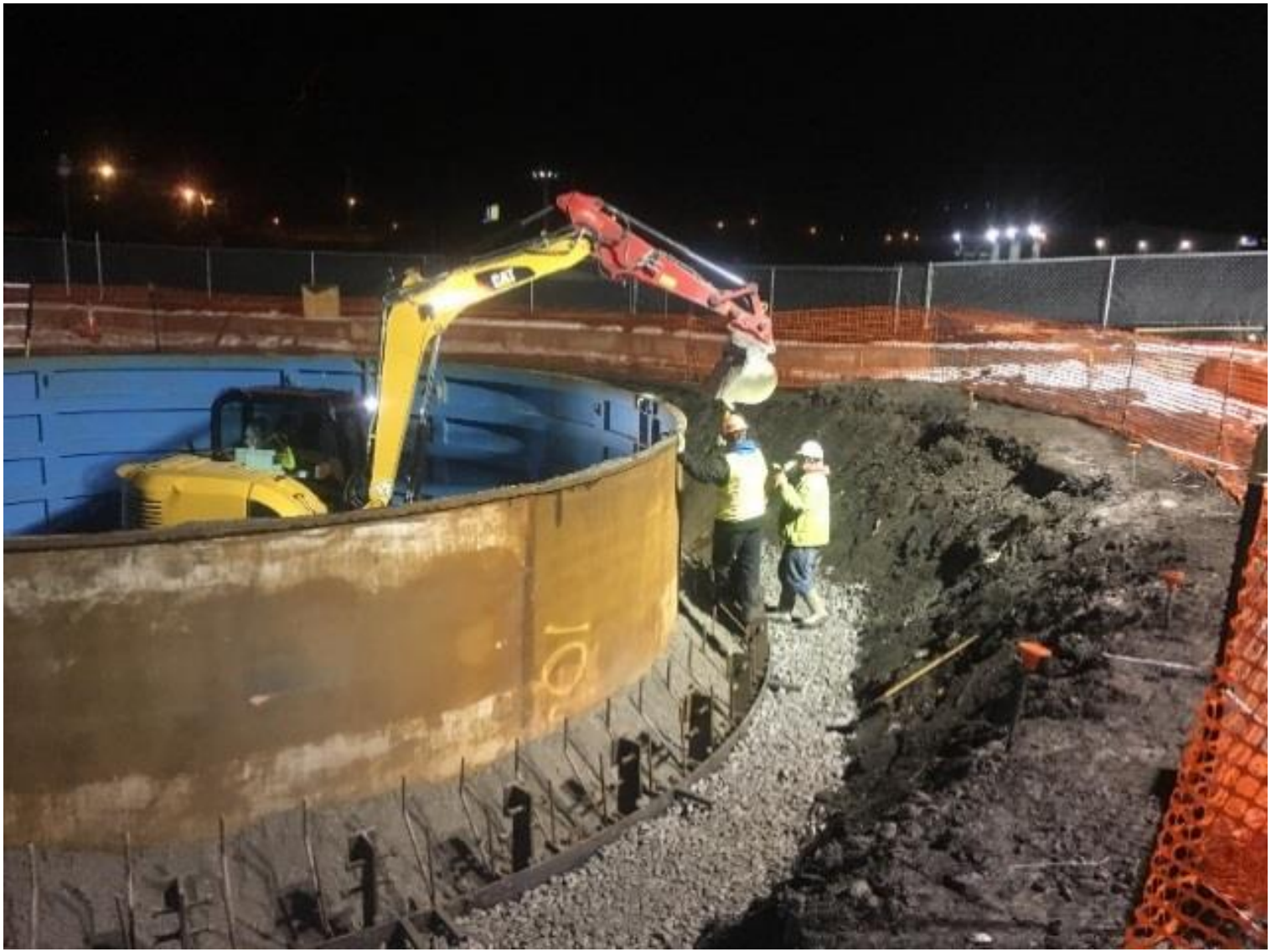
Image from Project Submittal

Pressure Grouting

Launch Shaft

Reception Shaft

Shaft Construction



Caisson Sinking

Shaft Construction

Shaft Construction

Tip of shaft seated on top of bedrock

Shaft Construction

Hoe ram

Splitter

Expanding grout

Shaft Construction

Drilled holes for both the mechanical splitter and for expanding grout.

Shaft Construction

Shaft Construction

Drainage board was used on the lower portion of the shaft

Due to water infiltration, the shaft was allowed to flood and the concrete placement was done under water.

Microtunneling System

Microtunnel Boring Machine (MTBM)

Control Container

Telescopic Gripper Can (Telecan)

MTBM

- Herrenknecht
- AVN 1800
- Rock Cutterhead
- Closed face
- 2260 mm Diameter (~ 90 inches)

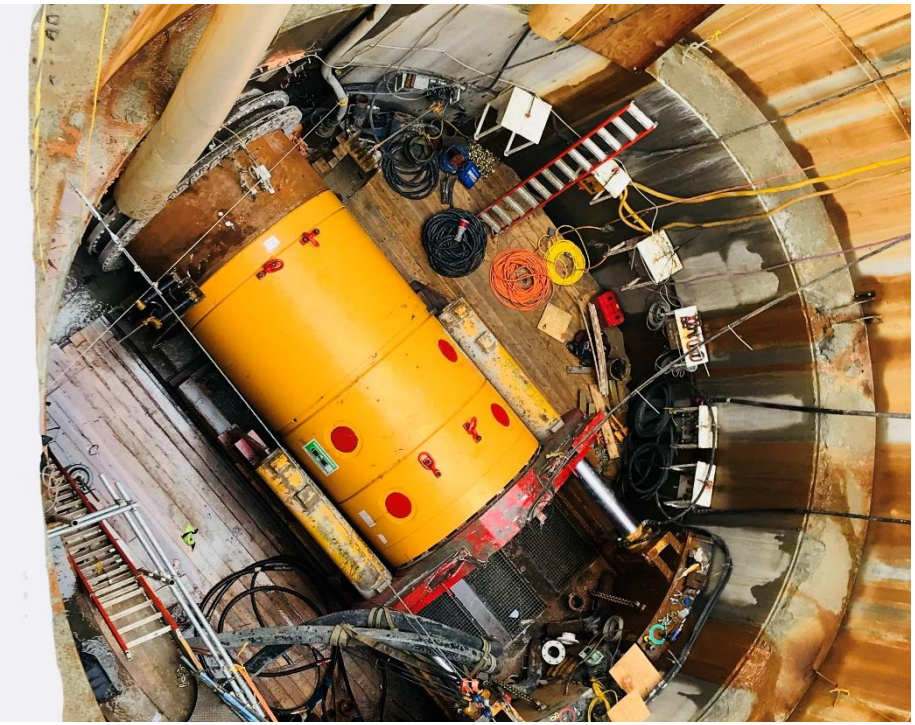
MTBM in Launch Shaft

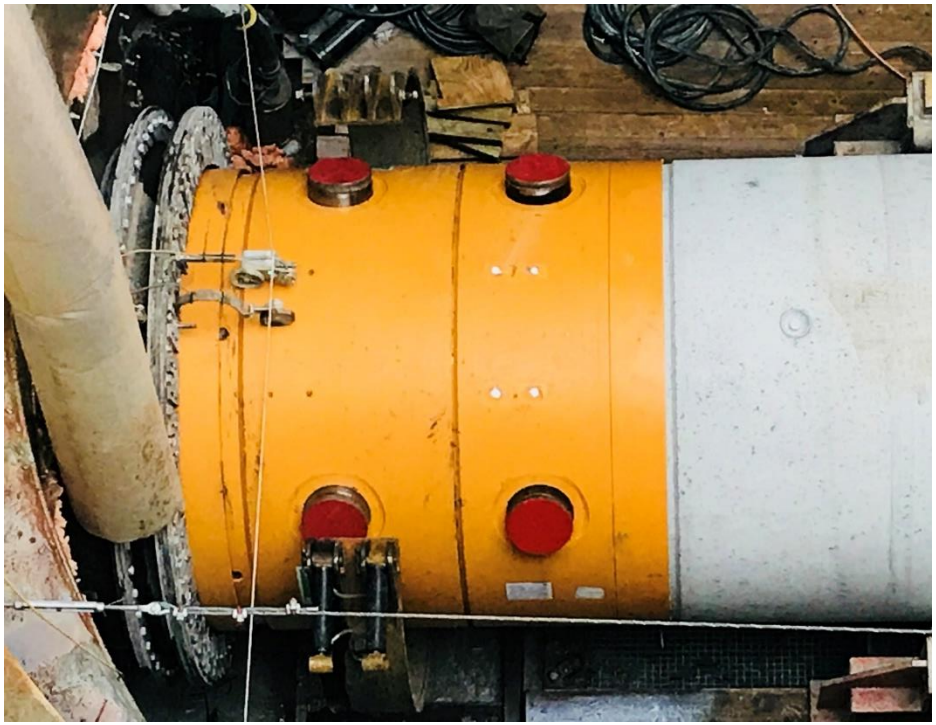
Control Container

- Guidance system
- Hydraulic power pack
- Electrical distribution
- Pumps for slurry bypass and cutter wheel
- Jacking frame
- Hydraulic oil tank

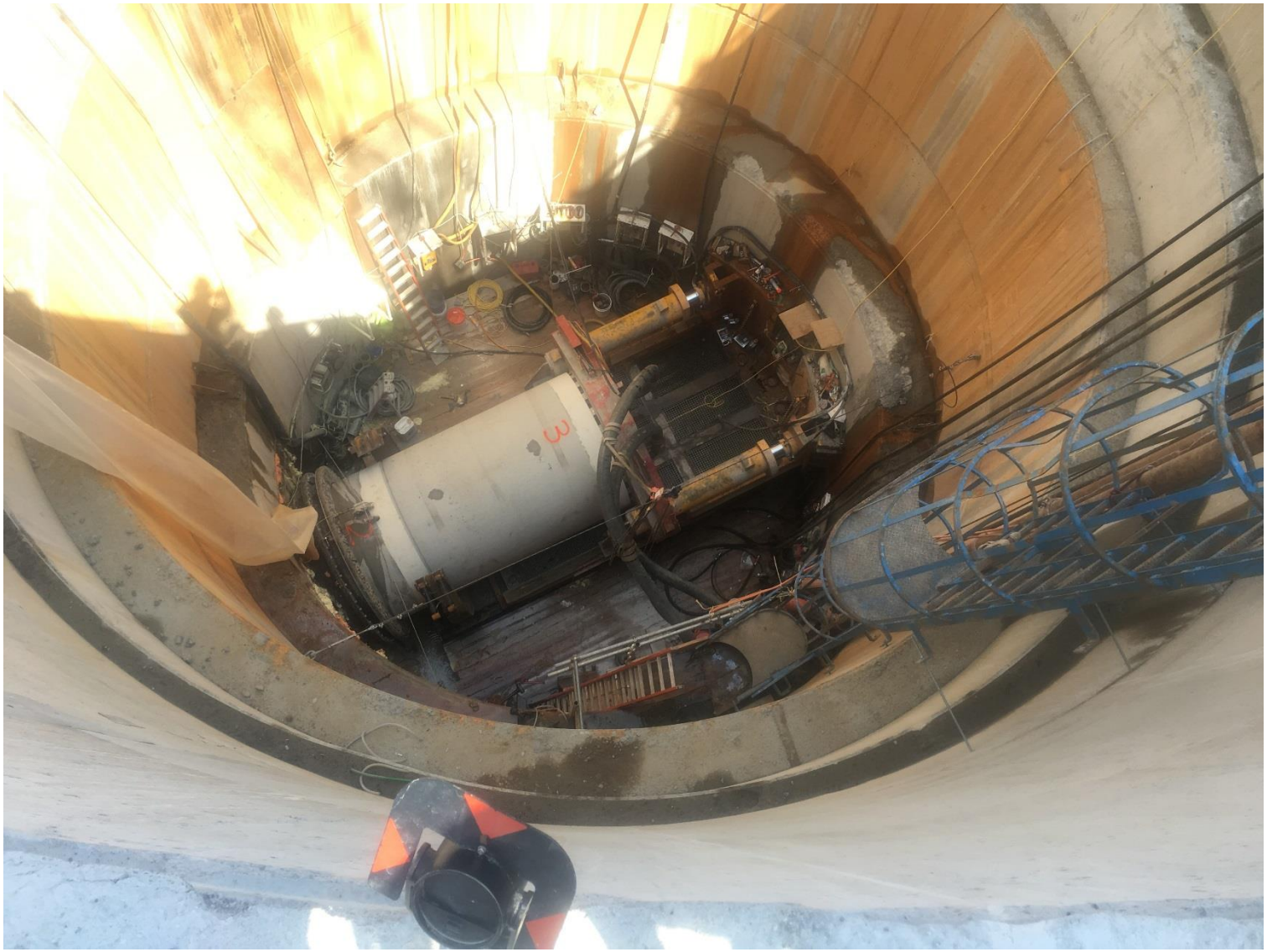
Telecan

- Telecan equipped with Grippers for rock
- Avoids excessive MTBM roll
- Eliminates the face pressure on pipe





RCP in Launch Shaft



Reinforced Concrete Pipe (RCP)

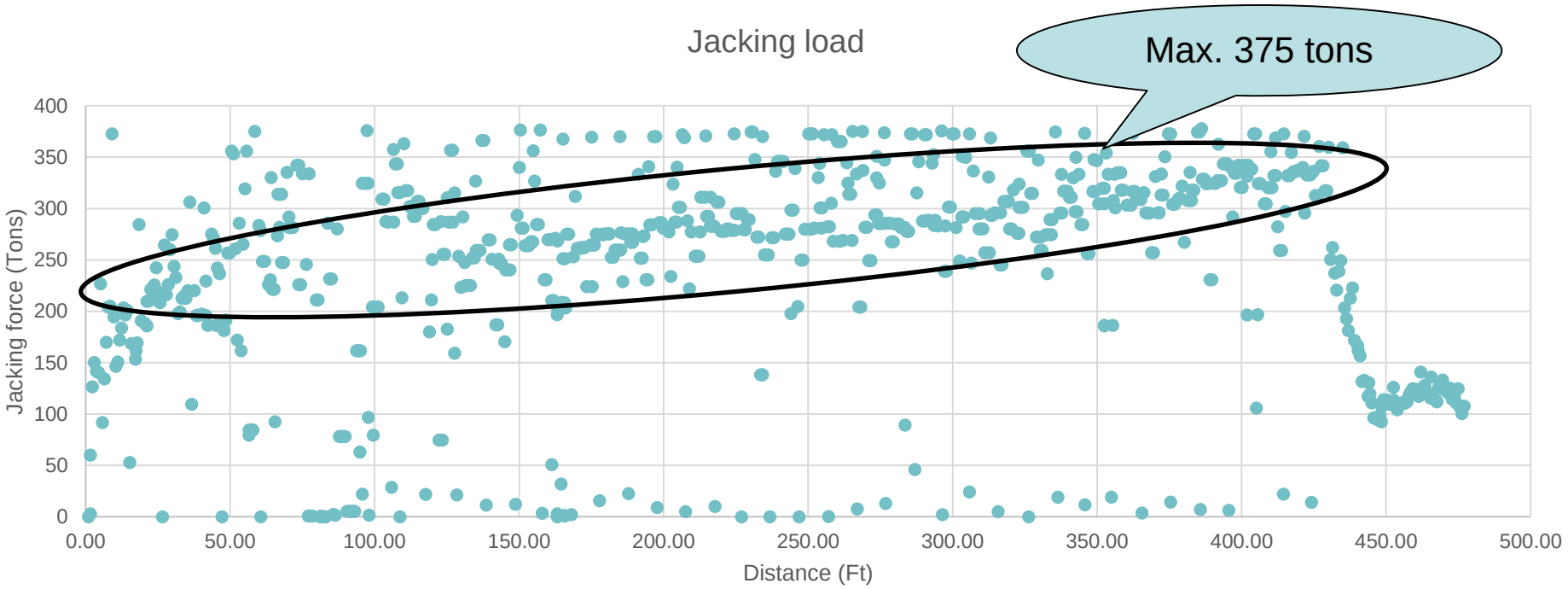
- Class V
- Concrete strength: 6000 psi
- 72 inch I.D.
- 87.5 inch O.D.
- 7.75 inch Wall
- 9.85 ft Length
- 1410 ft Radius
- MDF Packer

Packer at RCP Joint

Estimation of Jacking Loads

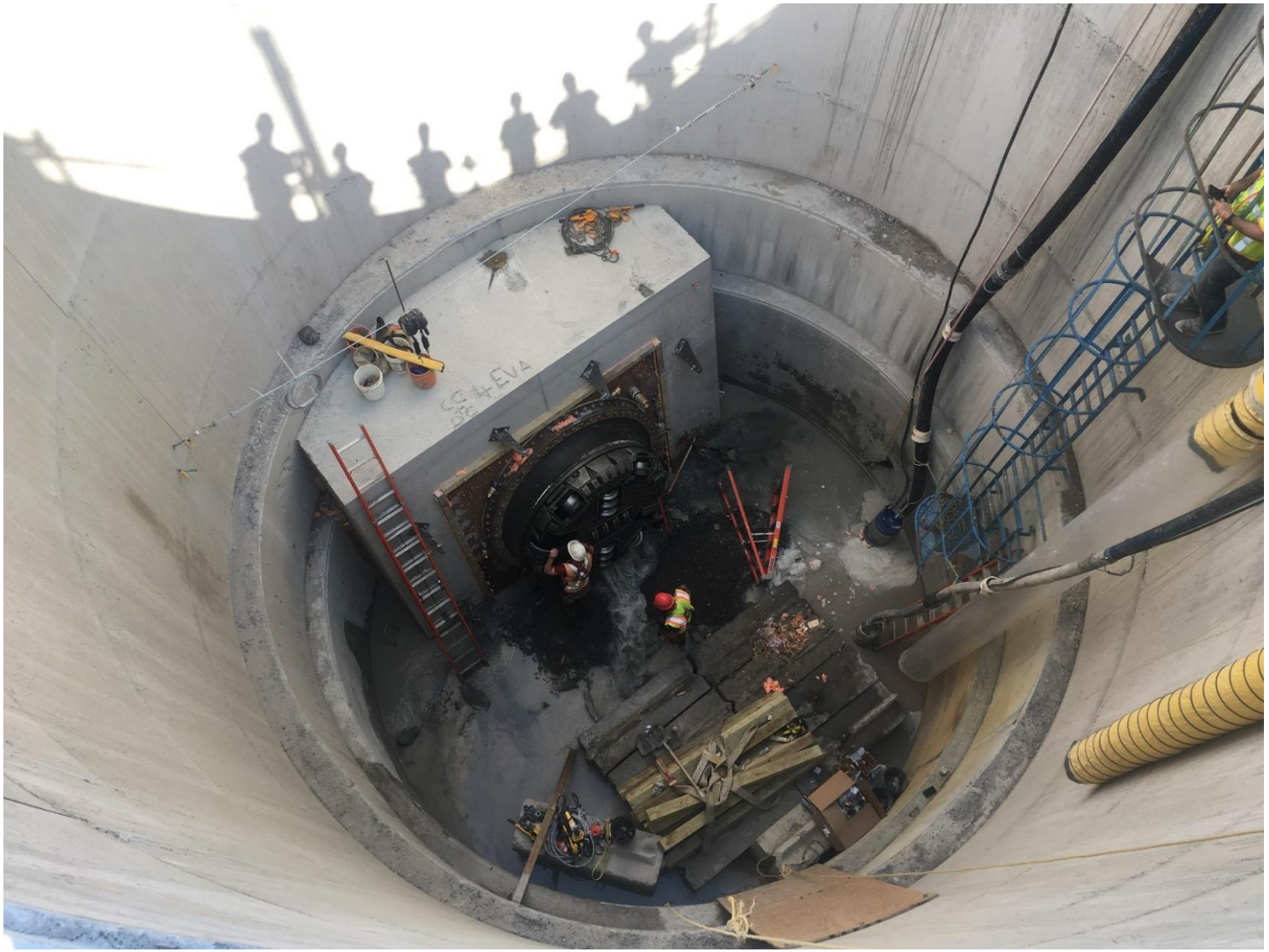
	Allowable jacking load along straight section	**Reduced allowable jacking load along curved section**
Haley & Aldrich	60” Steel casing ~ 1,420 tons	-
Forterra	72” RCP full contact eccentric load ~ 1,430 tons	~ 590 tons
Ward & Burke	72” RCP full contact eccentric load ~ 1,180 tons	~ 475 tons

Actual Jacking Load



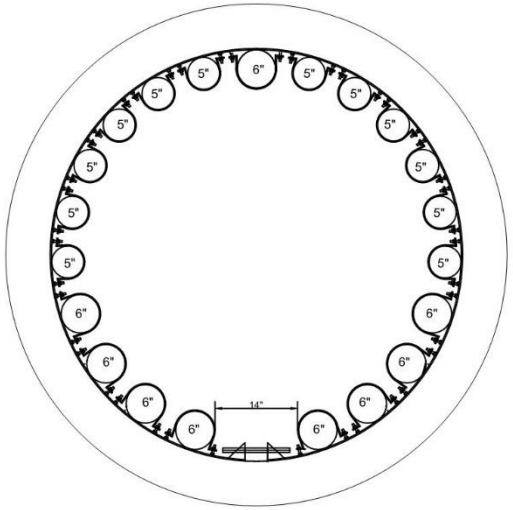
Spoil Separation Plant

MTBM at Reception Shaft



Lowest Point in the Tunnel

Conduit Configuration



As-built conduit configuration within 72 inch I.D. RCP

Thermal Grouting

Thermal grouting of tunnel completed in 3 phases

Conduit Transition to Vault

Conduit transition from tunnel to shaft

Box out for thermal grout around conduits and flowable fill for the rest of the shaft

Questions?