City of Astoria

Water Main Replacement in Century Old Hand-dug Tunnel

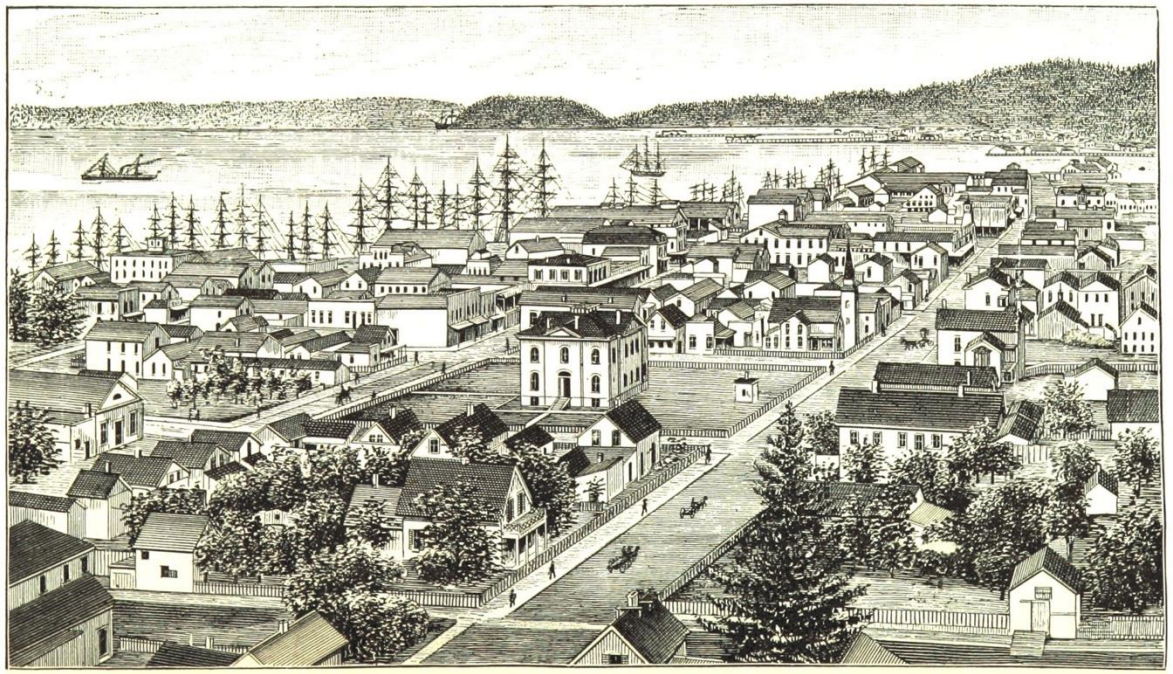
John Edwards, PE (City)
Dan Johnston, PE (HDR)
Randy Harrington, PE (HDR)
Minsong Kim, PE (HDR)

April 2026



Why Talk about the Project?
<John>

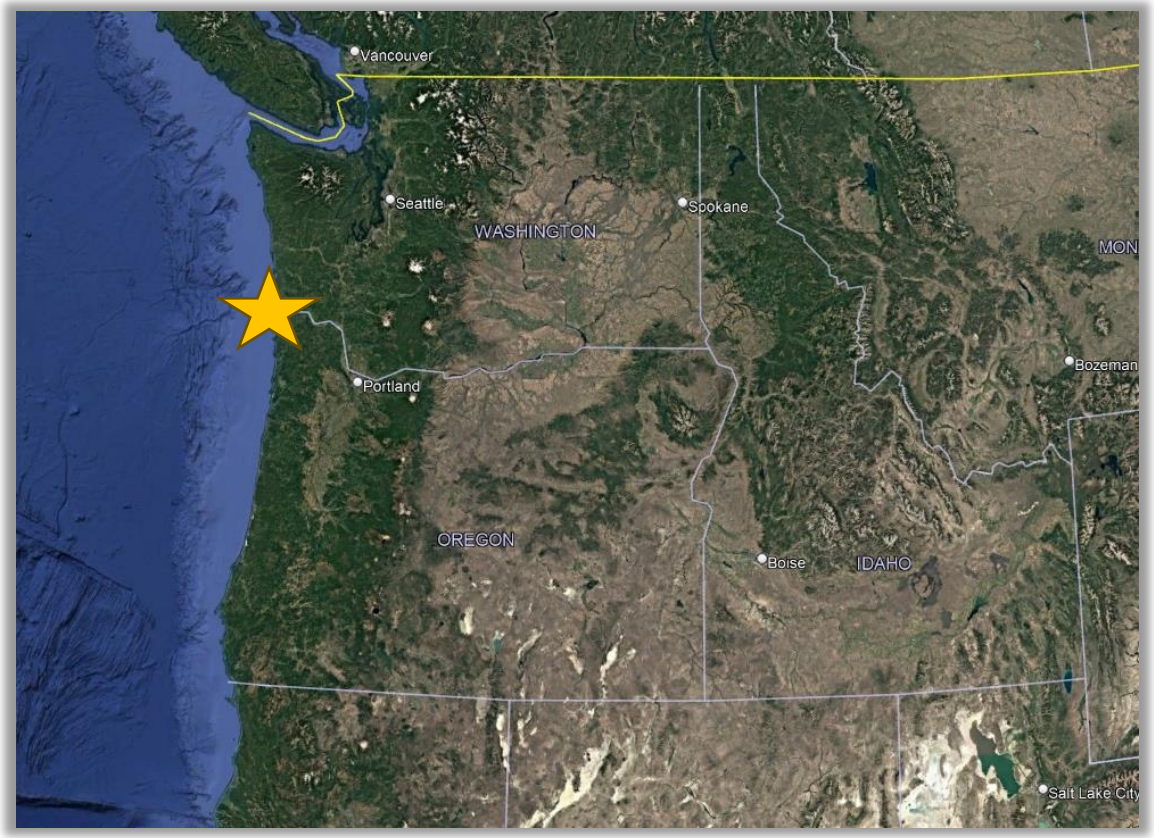
- Unusual Project – historic area, unique tunnel, critical water main
- Design Challenges – solutions and alternatives weren't obvious
- Project had been in the "too hard" box for a long time
- Alternative Delivery – not the typical approach for pipeline work
- Successful Collaboration and Construction



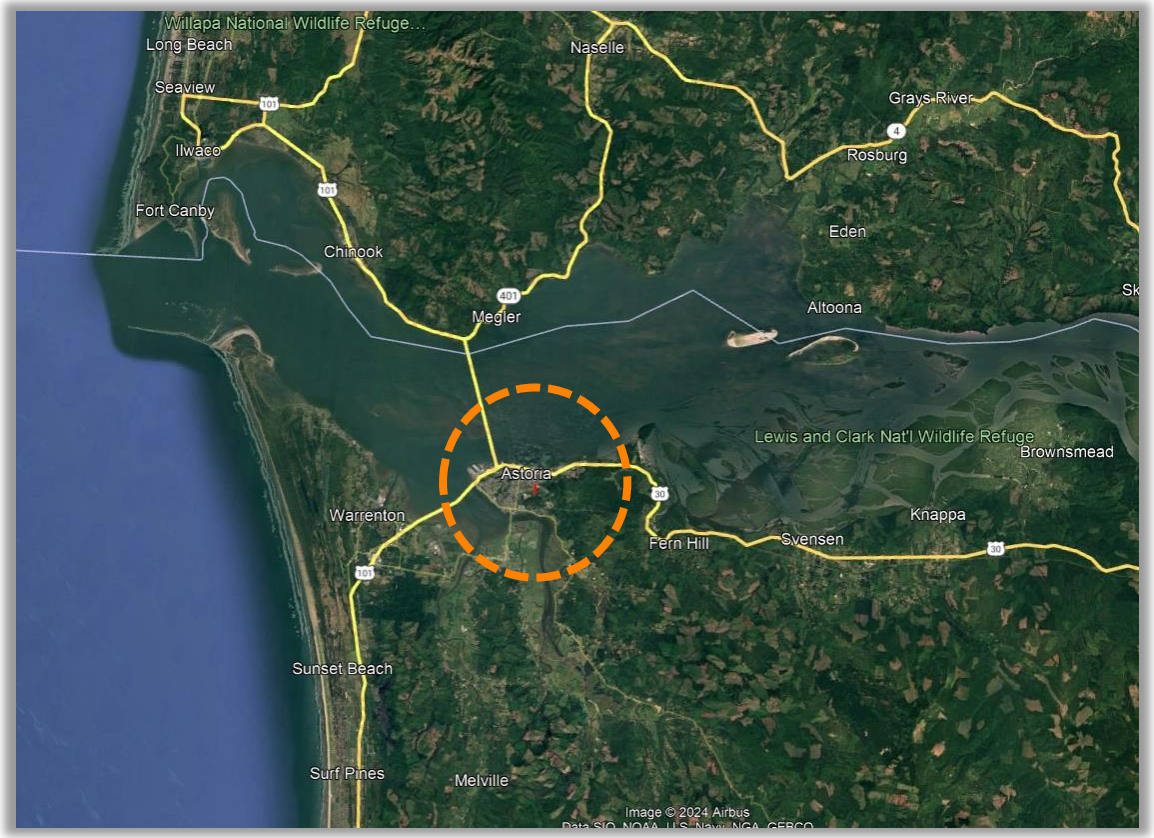
ASTORIA, OREGON, ENTRANCE TO COLUMBIA RIVER.



Map Orientation



Northwest Region



Mouth of Columbia River

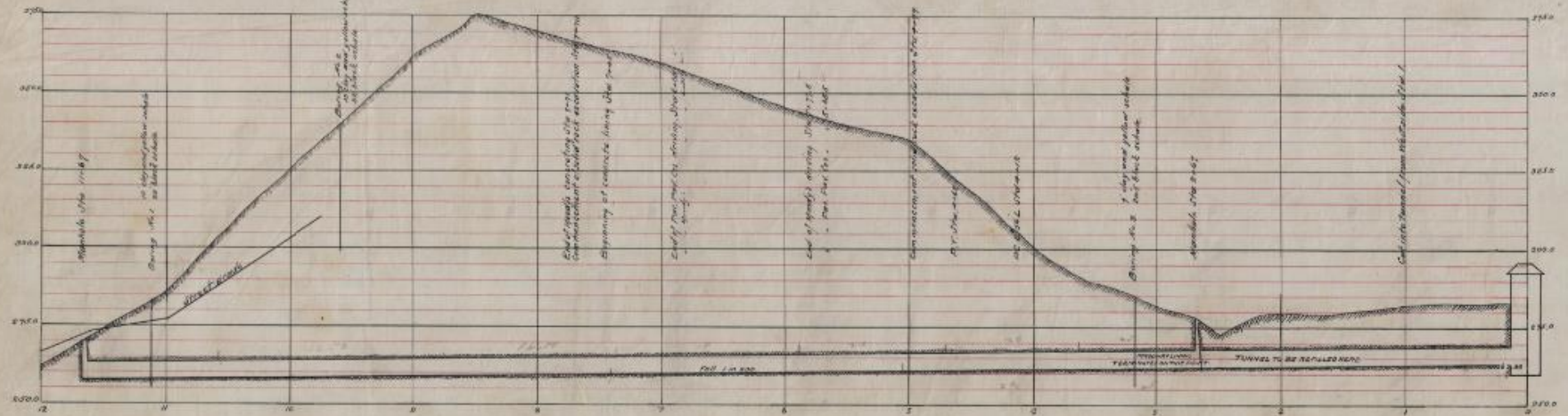
Map Orientation



City and Port



Close to Astoria Column



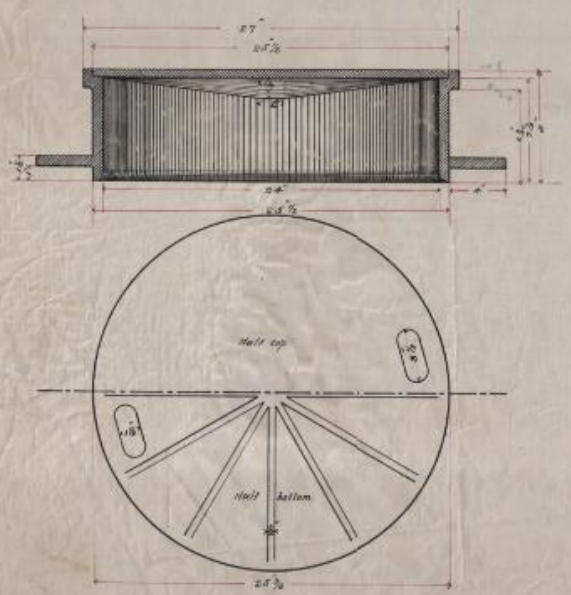
PROFILE OF TUNNEL.

Plan of

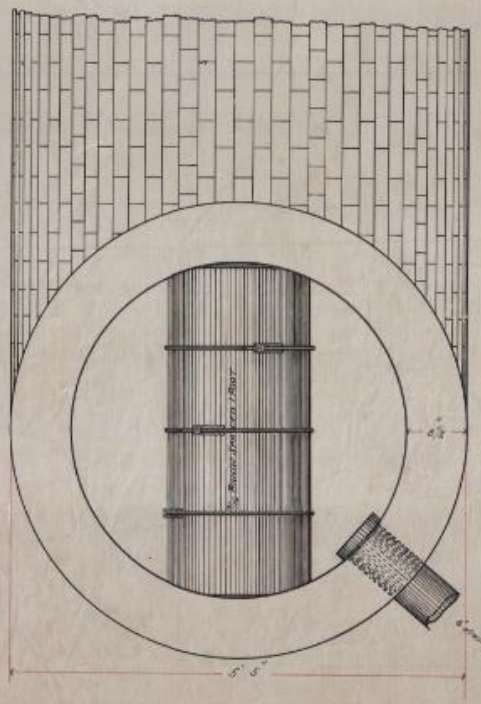
ATHENIA

Scale 1/10" = 1'.

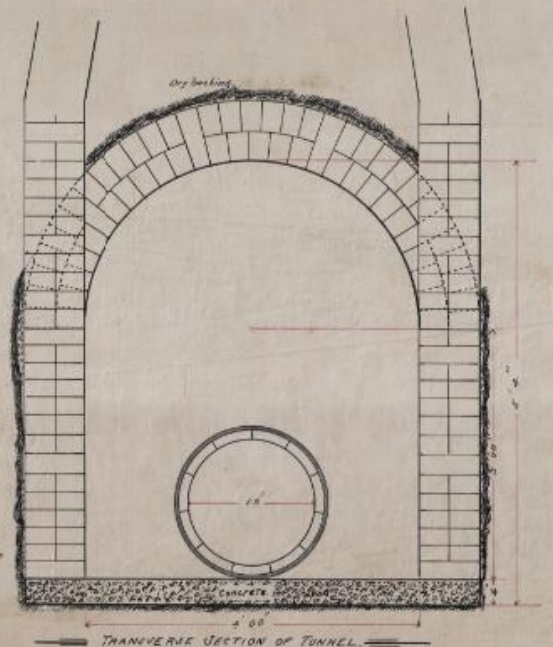
Adams & Gemmell
Engineers



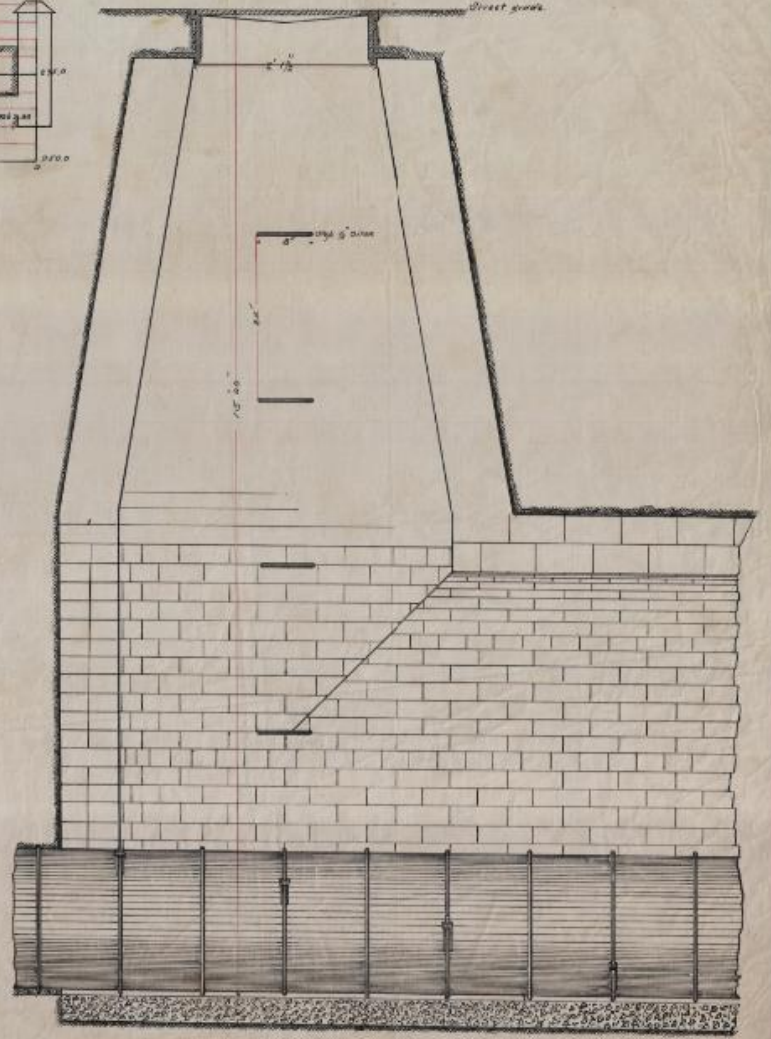
MANHOLE COVER AND FRAME.



PLAN OF MANHOLE AND TUNNEL AT JUNCTION.



TRANSVERSE SECTION OF TUNNEL.



SECTION OF TUNNEL AND MANHOLE.

T.1

23.114

Surface Access to Tunnel



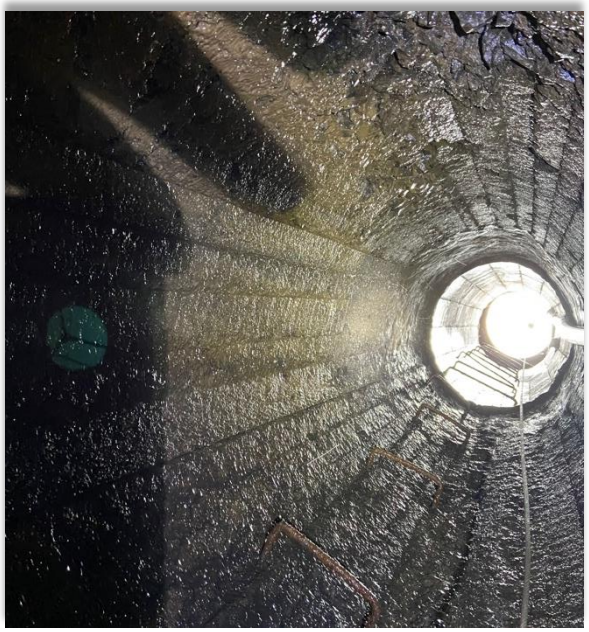
Northern Access



Northern Access



Southern Access



Southern Access

Existing Tunnel



Tunnel Lining



Tight Fit!

Existing Tunnel



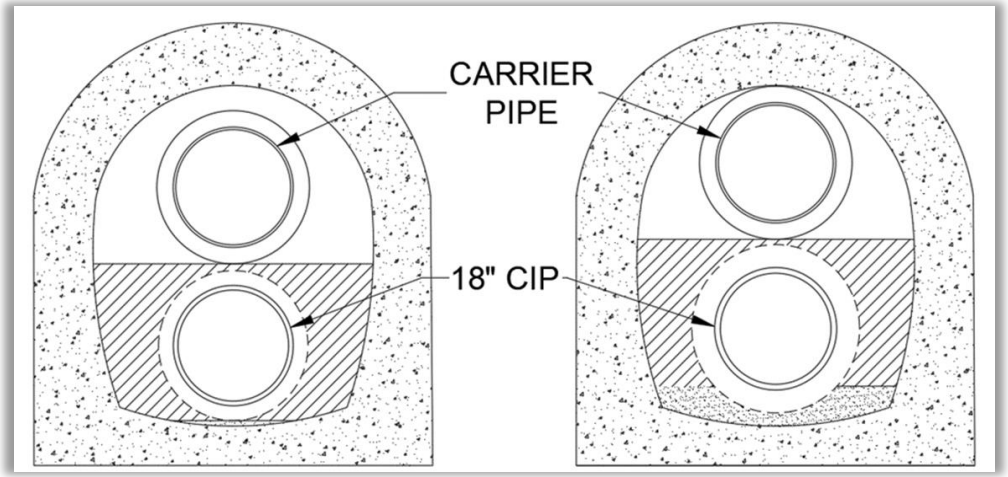
Lined Tunnel

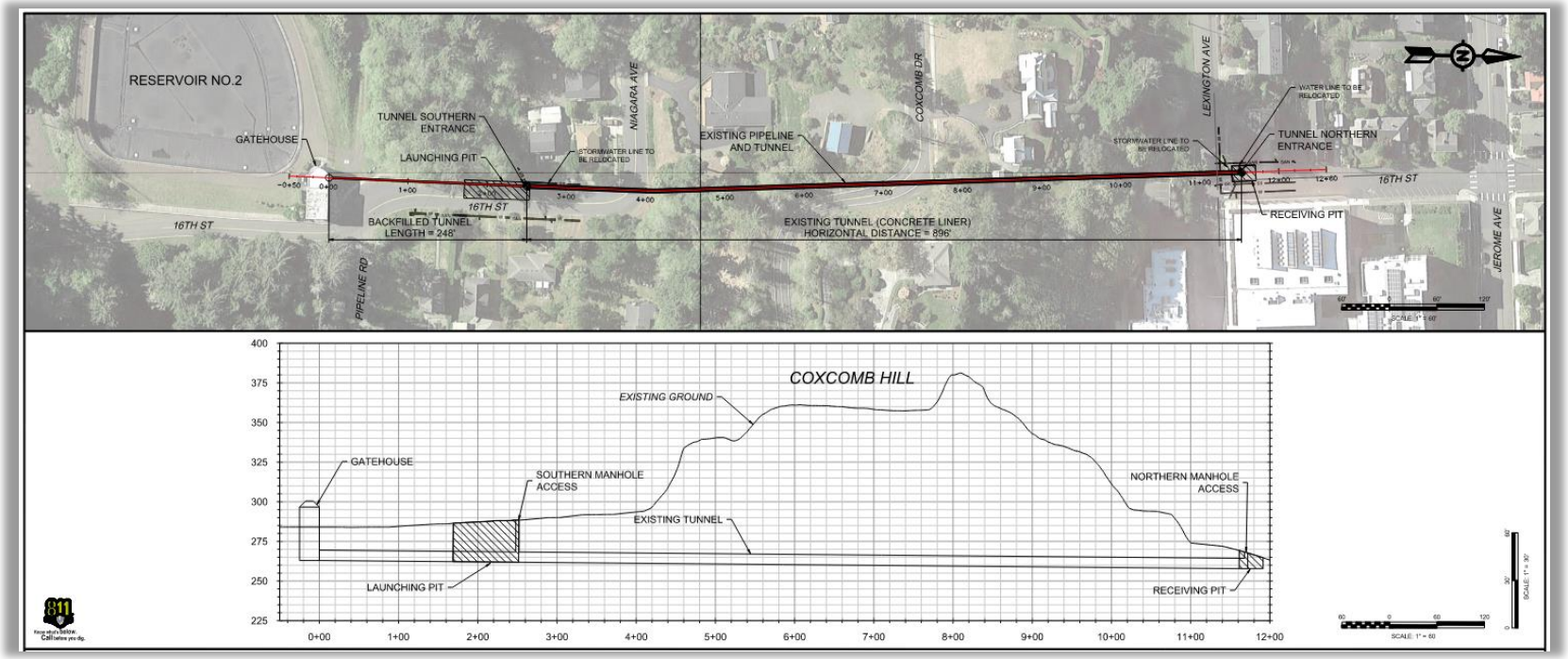


Unlined Tunnel

Alternatives Evaluation

1. HDD New Main Adjacent to Existing Tunnel
2. Remove or Burst Existing Water Main in Tunnel and Sleeve New Water Main
3. Sleeve New Water Main Over Top of Existing Water Main





Still Several Unknowns

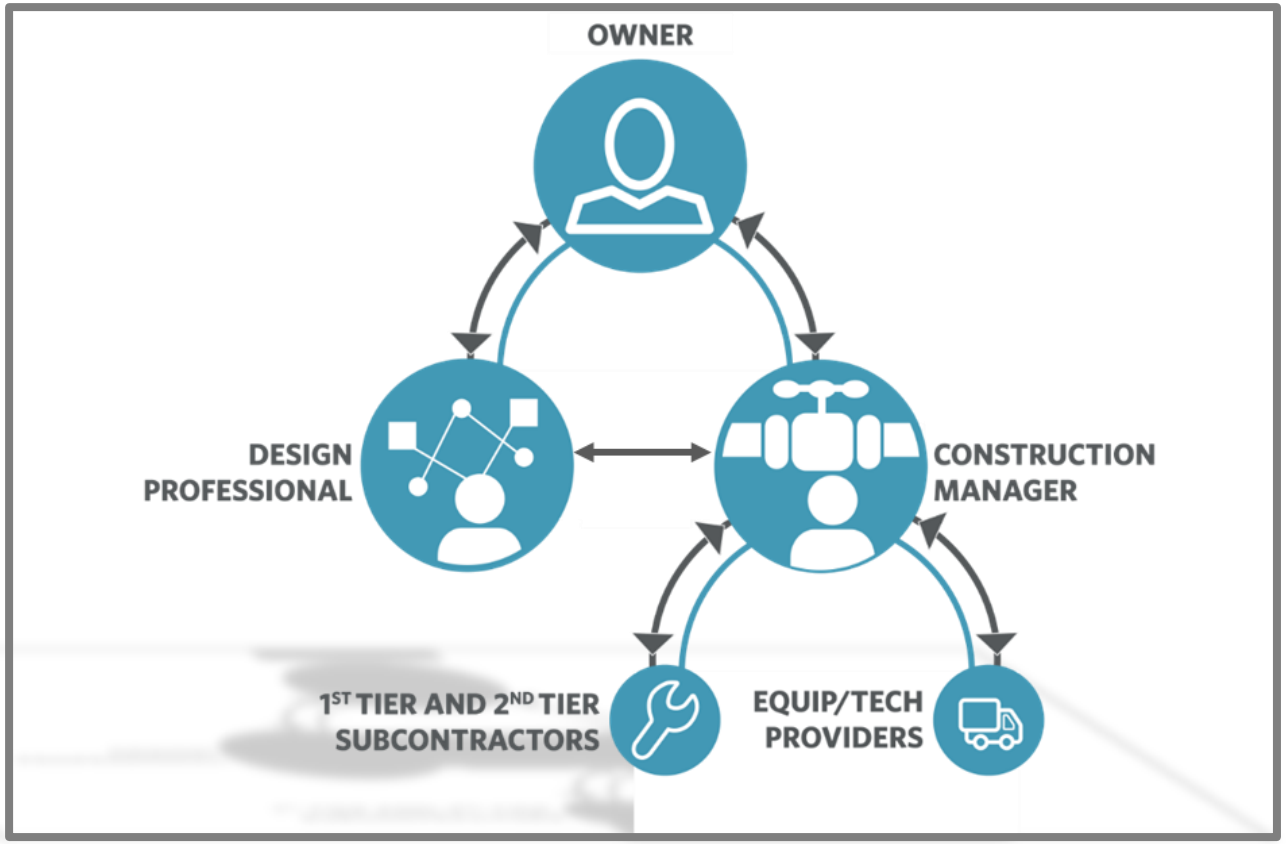
- Tunnel Condition – potential cave-ins
- Seismic Risks – potential collapse
- Ability to Work Safely inside Tunnel
- Constructability for Removal/Sleeving
- Construction Cost for Risk



Alternative Delivery

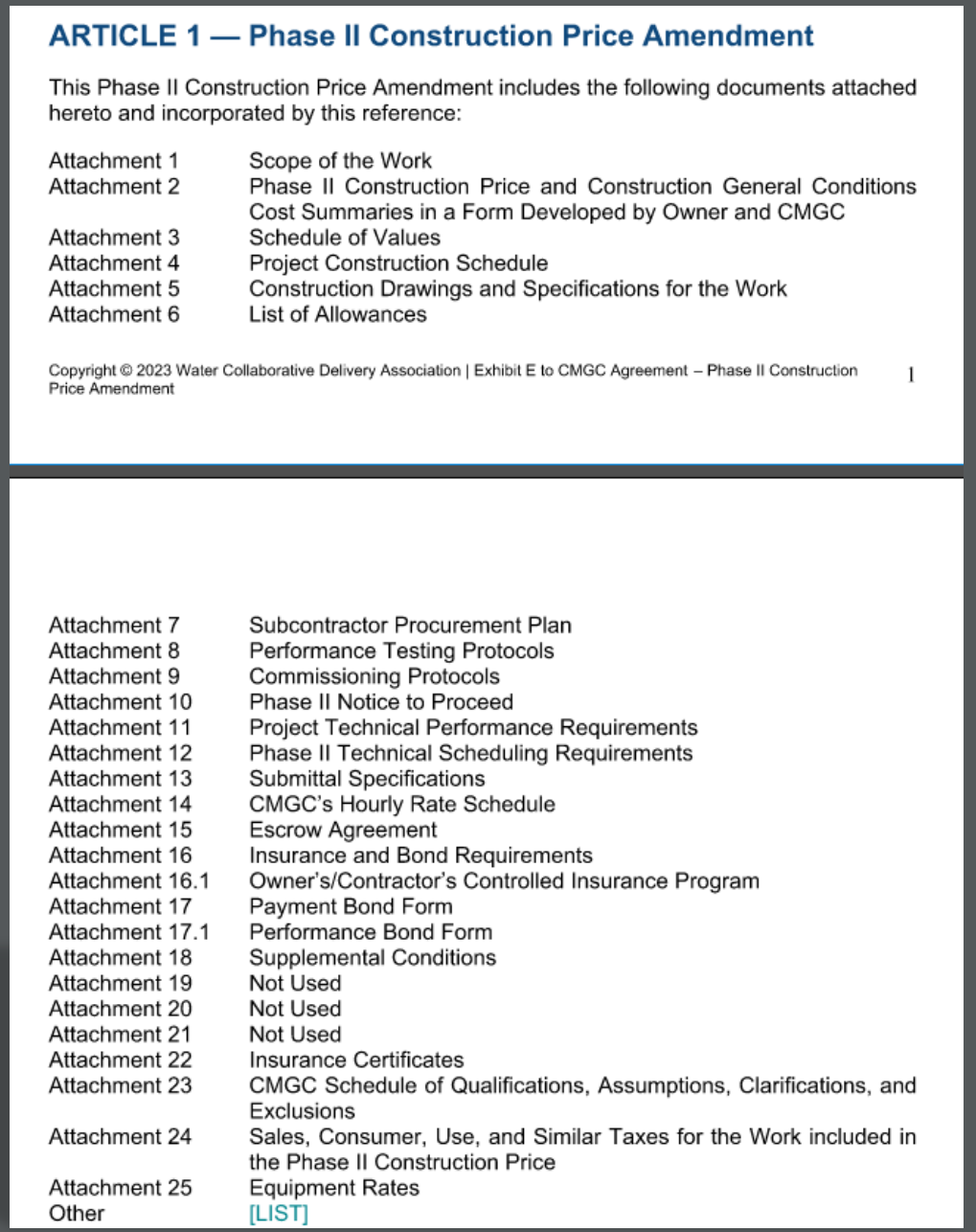
- City was Interested to Learn More
- Presented Various Options
- Agreed that CM/GC Approach Made Sense
- Amended the Engineer Scope of Work for CM/GC Collaboration

CM/GC Model



CM/GC Challenges
<John>

- Assembling, Tailoring, and Conforming CM/GC Documents
- Incorporating Disparate Needs including Funding and Legal Elements
- Defining Guaranteed Maximum Price (GMP) or Lump Sum Approach and Payment
- Funding and Budgeting Contingencies



ARTICLE 1 — Phase II Construction Price Amendment

This Phase II Construction Price Amendment includes the following documents attached hereto and incorporated by this reference:

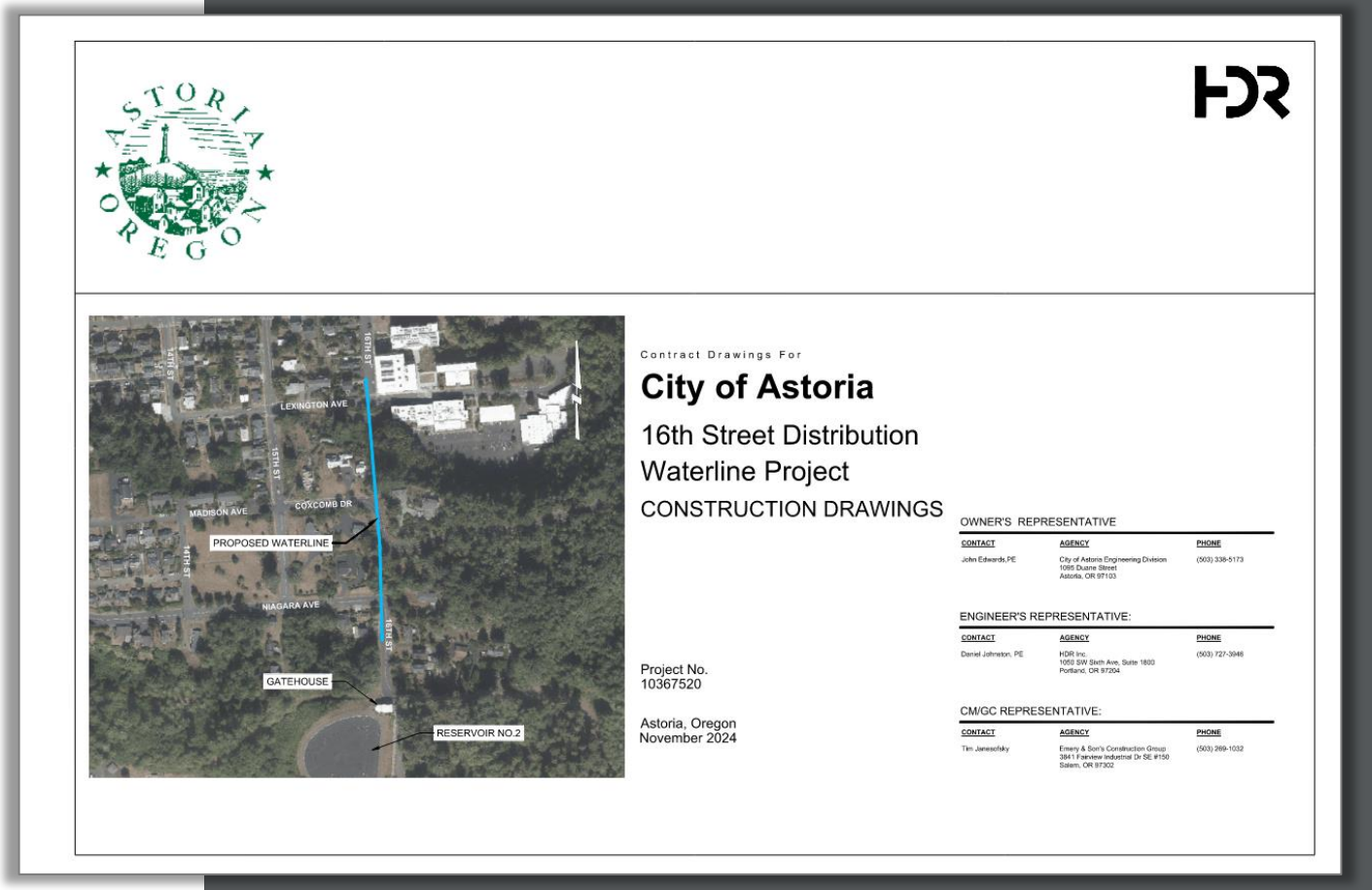
Attachment 1	Scope of the Work
Attachment 2	Phase II Construction Price and Construction General Conditions Cost Summaries in a Form Developed by Owner and CMGC
Attachment 3	Schedule of Values
Attachment 4	Project Construction Schedule
Attachment 5	Construction Drawings and Specifications for the Work
Attachment 6	List of Allowances

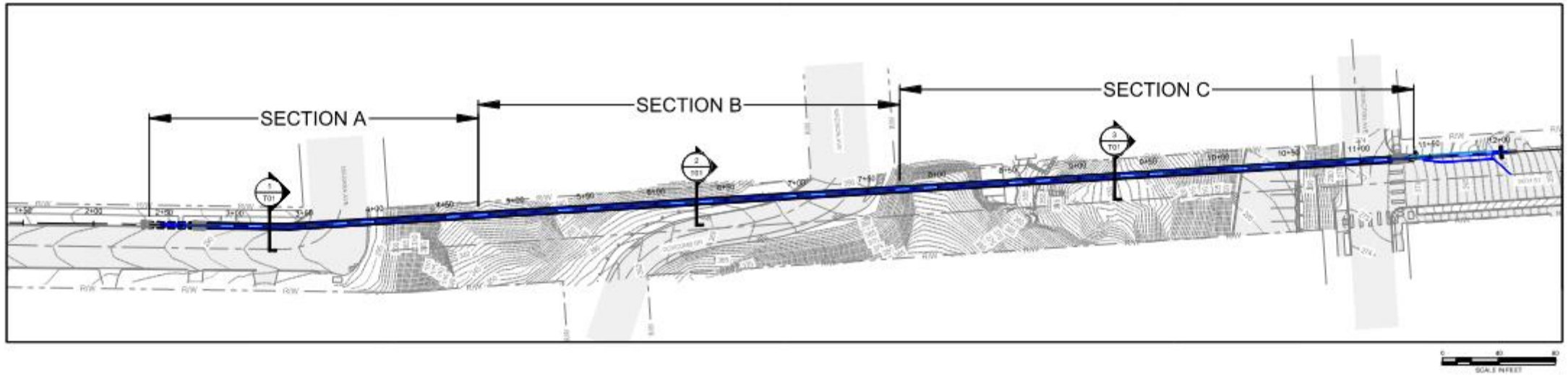
Copyright © 2023 Water Collaborative Delivery Association | Exhibit E to CMGC Agreement – Phase II Construction Price Amendment

Attachment 7	Subcontractor Procurement Plan
Attachment 8	Performance Testing Protocols
Attachment 9	Commissioning Protocols
Attachment 10	Phase II Notice to Proceed
Attachment 11	Project Technical Performance Requirements
Attachment 12	Phase II Technical Scheduling Requirements
Attachment 13	Submittal Specifications
Attachment 14	CMGC's Hourly Rate Schedule
Attachment 15	Escrow Agreement
Attachment 16	Insurance and Bond Requirements
Attachment 16.1	Owner's/Contractor's Controlled Insurance Program
Attachment 17	Payment Bond Form
Attachment 17.1	Performance Bond Form
Attachment 18	Supplemental Conditions
Attachment 19	Not Used
Attachment 20	Not Used
Attachment 21	Not Used
Attachment 22	Insurance Certificates
Attachment 23	CMGC Schedule of Qualifications, Assumptions, Clarifications, and Exclusions
Attachment 24	Sales, Consumer, Use, and Similar Taxes for the Work included in the Phase II Construction Price
Attachment 25	Equipment Rates
Other	[LIST]

Final Design

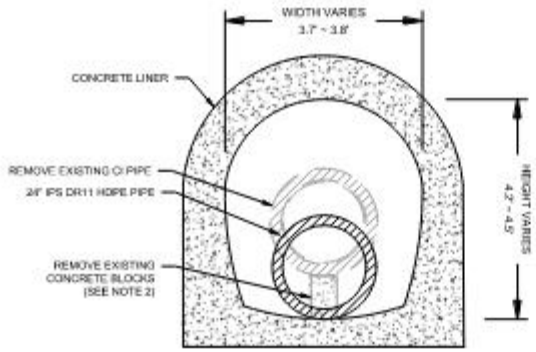
- Tunnel Condition - Stable
- Safety Approach – Contractor Strategy
- Sliderail for Deep Shafts
- Cut and Remove Cast Iron Pipe
- Sleeve New 24” HDPE on Tunnel Floor
- New Manhole Accessways



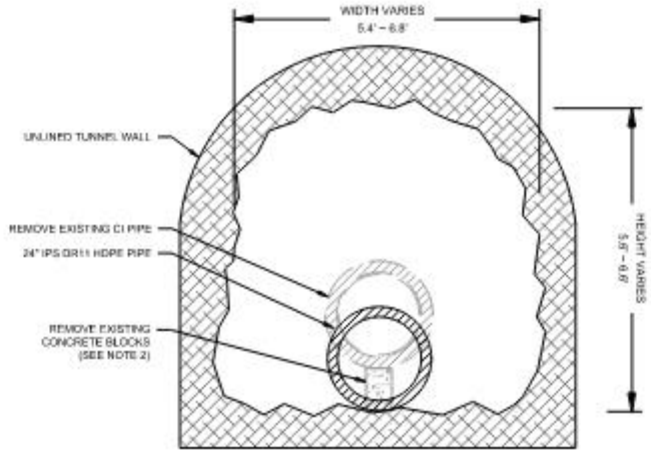


NOTES:

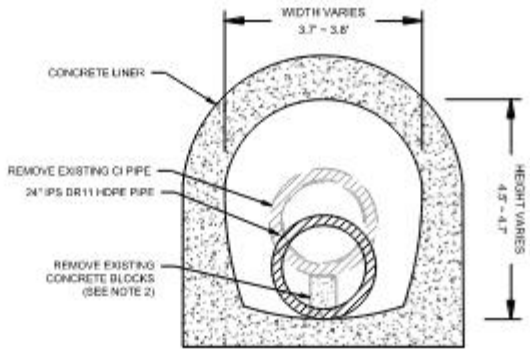
1. THE PROPOSED HDPE PIPELINE SHALL BE SLEEVED THROUGH THE TUNNEL ON A ROLLER SYSTEM OR SKID SYSTEM IN SUCH A MANNER AS TO PREVENT DAMAGE TO THE PIPELINE. THE FINISHED PIPELINE MAY LAY DIRECTLY ON THE TUNNEL FLOOR WHEN COMPLETE.
2. THE SIZE AND LOCATION OF THE EXISTING CONCRETE BLOCKS VARIES THROUGHOUT THE TUNNEL. REMOVE THE EXISTING BLOCKS (APPROX 72 TOTAL) AFTER THE EXISTING 16" CI PIPELINE IS REMOVED.
3. THE INTERIOR DIMENSIONS OF THE TUNNEL VARIES.
4. THE SECTION LIMITS ARE APPROXIMATE. CONTRACTOR TO FIELD VERIFY.



TUNNEL SECTION A (1 / -)
NTS



TUNNEL SECTION B (2 / -)
NTS



TUNNEL SECTION C (3 / -)
NTS

Pre-Construction Phase

- City Negotiates GMP Price and Schedule
- Reviewing Workplans and Submittals
- Early Work Package for PRV Connection to reduce risk during shutdown
- Mainline Construction by End of 2025 required by funding

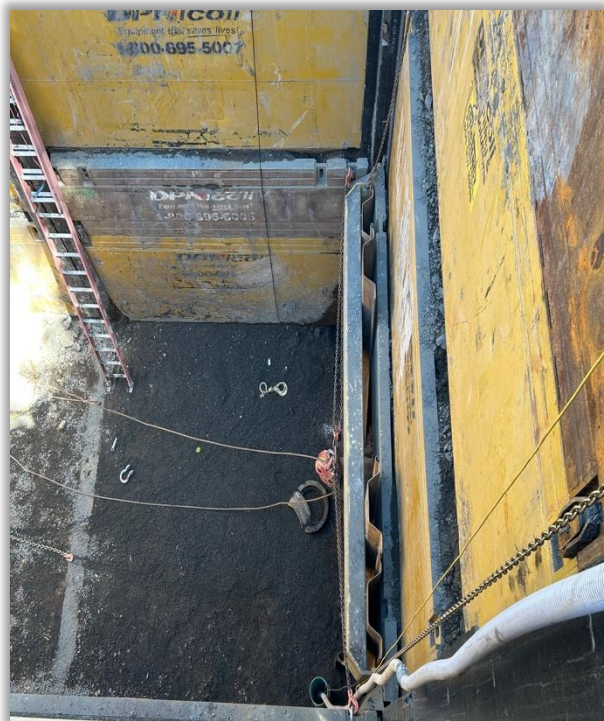


Shaft Construction and Dewatering

- Utility Relocations
- Property and Traffic Impacts
- Unknown Dewatering Volumes
- Potential Settlement Issues







Demolition of 18” CI Pipe and Pulling New 24” HDPE into Tunnel

- Removed CI pipe by cutting into segments
- Used large excavator with rigging to remove existing pipe
- Fused and staged HDPE pipe for pulling
- Used marine winch to pull HDPE through







Inspection and Preparation of Tunnel <John>

- Unlined section had loose rocks and sharp edges which were previously hidden under silt
- Original intent was to install HDPE pipe on rollers in tunnel
- Infeasible to monitor during pulling
- Prepped unlined section of tunnel floor with flowable fill
- Inspected after placement of fill and marked remaining sharp edges







Before and After Inside
<John>

- Less clearance on sides of new pipe
- Unlined section is easier to traverse
- Jointless non-corrosive pipe should reduce maintenance concerns
- Inspected pipe for gouging or other signs of damage



DI Pipe and Tunnel Connections

- Height adjustments between manhole and tunnel
- Transition couplings to CI pipe
- Concrete encasement and CLSM backfill
- HDPE fusion coupling







Backfill and Restoration

- Extensive site disturbance from shafts, connections, and 600 series excavator
- Backfill and compaction challenging with slide-rail
- Restoring sidewalks, driveways, and roadway







Take-Aways
<John>

- Constructability Risks can Drive Project Approach
- CM/GC Documents aren't Boilerplate
- Quality and Expertise of CM/GC Contractor Very Important
- CM/GC allows for Deep Collaboration and Problem Solving
- With Constructability Addressed – Construction Changes Minimized
- Relationships and Trust are Paramount to Delivery

