Lessons Learned Installing a Critical Large Diameter Spiral Welded Steel Water Pipe under New York Harbor

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National Welding Corporation.

Ronald S. Brown, Senior Technical Sales Representative Northwest Pipe Company.

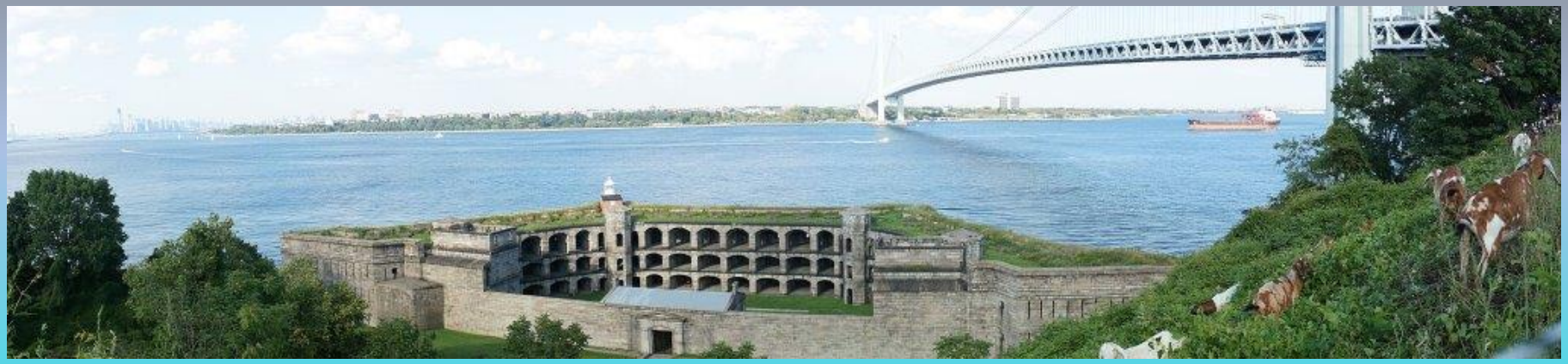
Presentation Breakdown

Manufacturer's Perspective-Presented by Ronald S. Brown

Installation Perspective and Closing-Presented by Gedas Grazulis

Q & A-Both Presenters

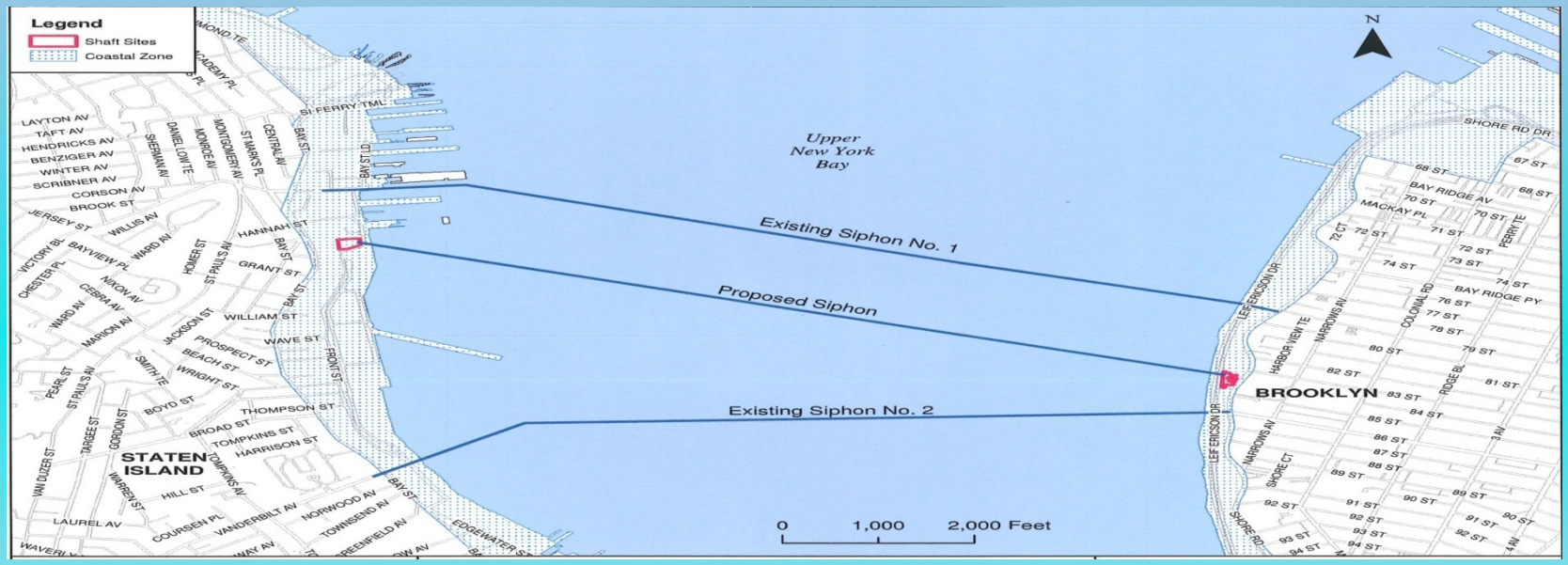
VERRAZANO BRIDGE/NARROWS

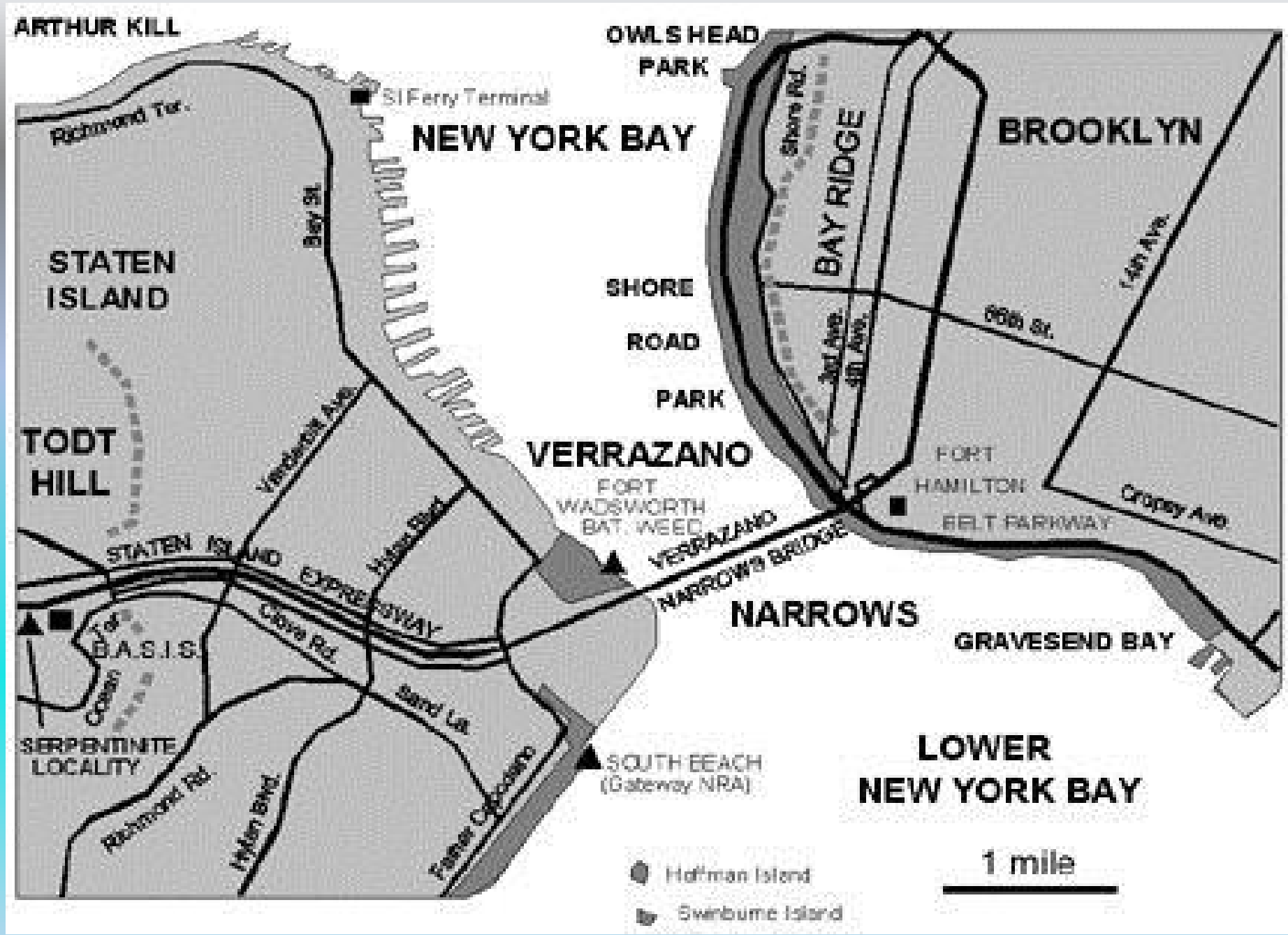


- ANCHORAGE CHANNEL
- Port Authority of New York/New Jersey
- Owns this “Roadway” and all Ports in NY & NJ metro area
- Takes in nearly 1/3 of all goods entering Eastern U.S.
- $125 Billion Dollars worth of goods and Commodities

PROJECT HISTORY

- Two water main siphons built in 1917 & 1925 in Channel
- Supplied NYC Reservoir Water from Brooklyn to Staten Island—50 feet deep.
- 1970 10 FT Diameter Richmond Tunnel built as main supply
- Siphon #1 and #2 became important redundancy lines




ARTHUR KILL
OWLS HEAD PARK
SI Ferry Terminal
NEW YORK BAY
BROOKLYN
Richmond Ter.
Bay St.
Shore Rd.
BAY RIDGE
STATEN ISLAND
SHORE ROAD PARK
3rd Ave.
4th Ave.
65th St.
14th Ave.
TODT HILL
Verrazano Ave.
VERRAZANO
FORT WADSWORTH BAT. WEED
FORT HAMILTON
BELT PARKWAY
Gravesend Ave
Hylan Blvd.
STATEN ISLAND EXPRESSWAY
VERRAZANO NARROWS BRIDGE
NARROWS
GRAVESEND BAY
Clove Rd.
B.A.S.I.S.
Sand Ln.
SERPENTINITE LOCALITY
SOUTH BEACH (Gateway NRA)
LOWER NEW YORK BAY
Richmond Rd.
Hylan Blvd.
Fresh Creek
Hoffman Island
Swinburne Island
1 mile

With new mega ships coming through the Narrows—siphons need to be removed and replaced with new larger and deeper 72” siphon

- TIMELINE FOR PROGRESS
- New York City EDC and DEP joined forces with Port Authority
- Mott Macdonald & CDM commissioned to provide Engineering and Design Services for new 72” Potable Water Trans Siphon Main

STUDIES COMPLETED TO EVLAUATE

- How to cross the Narrows?
- Options and Issues:
- Dredging, Coffer Dams, Micro tunnel, HDD, Conventional TBM
- Schedules, Constructability, Risk, Environmental Impacts, Cost of Construction & Navigational Impacts
- Outcome: Utilization of Conventional TBM approach

Study to Evaluate Carrier Pipe System

- Pipe Material Options: Prestressed Concrete Cylinder Pipe, Fiberglass Reinforced Pipe, Spiral Weld Steel Pipe per AWWA C200
- Evaluation considered: Price of Material, Construction Costs, Long Term Life Cycle Costs and History Performance, Maintenance and Operational Needs
- AWWA C200 Spiral Weld Steel Pipe Selected

RATIONALE FOR SELECTION OF AWWA C200 SPIRAL WELD STEEL PIPE

- TENSILE STRENGTH
- INHERENT TOUGHNESS COMPARED TO OTHER MATERIALS
- DUCTILITY
- FLEXBILITY
- LONG TERM CORROSION RESISTANCE WITH BONDED COATINGS AND CATHODIC PROTECTION
- SUPERIOR BOTTLE TIGHT LAP WELDED JOINT
- EXCELLENT HISTORY IN NYC—GO TO PRODUCT FOR DIRECT BURY FOR TRUNK MAINS 36” AND UP

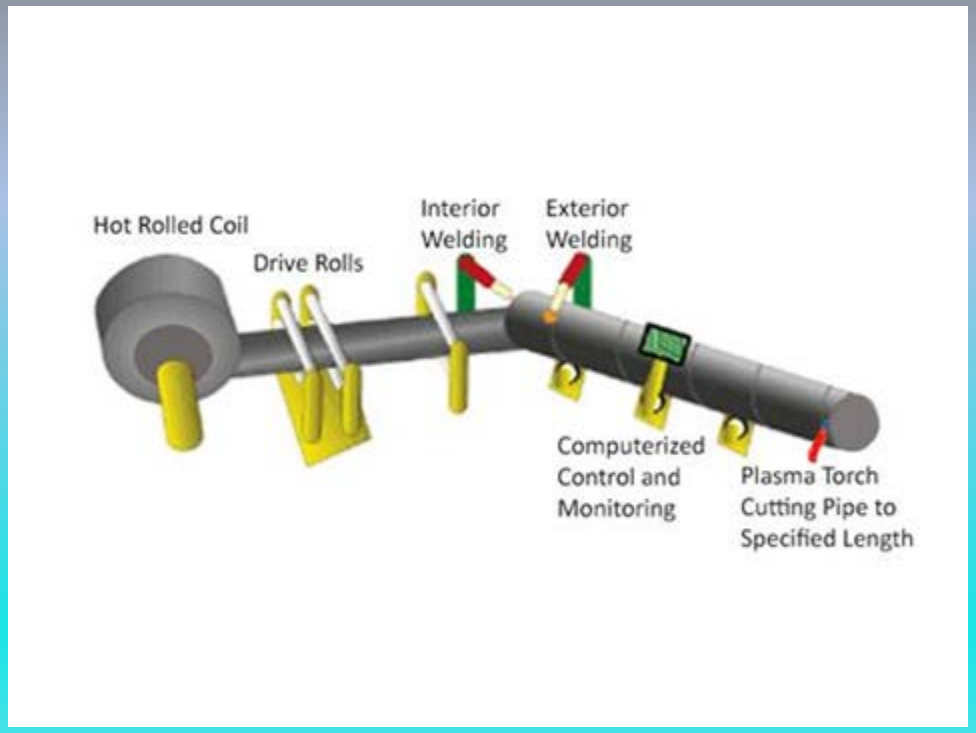
AWWA SPIRAL WELD STEEL WATER PIPE PARTICULARS IN NYC

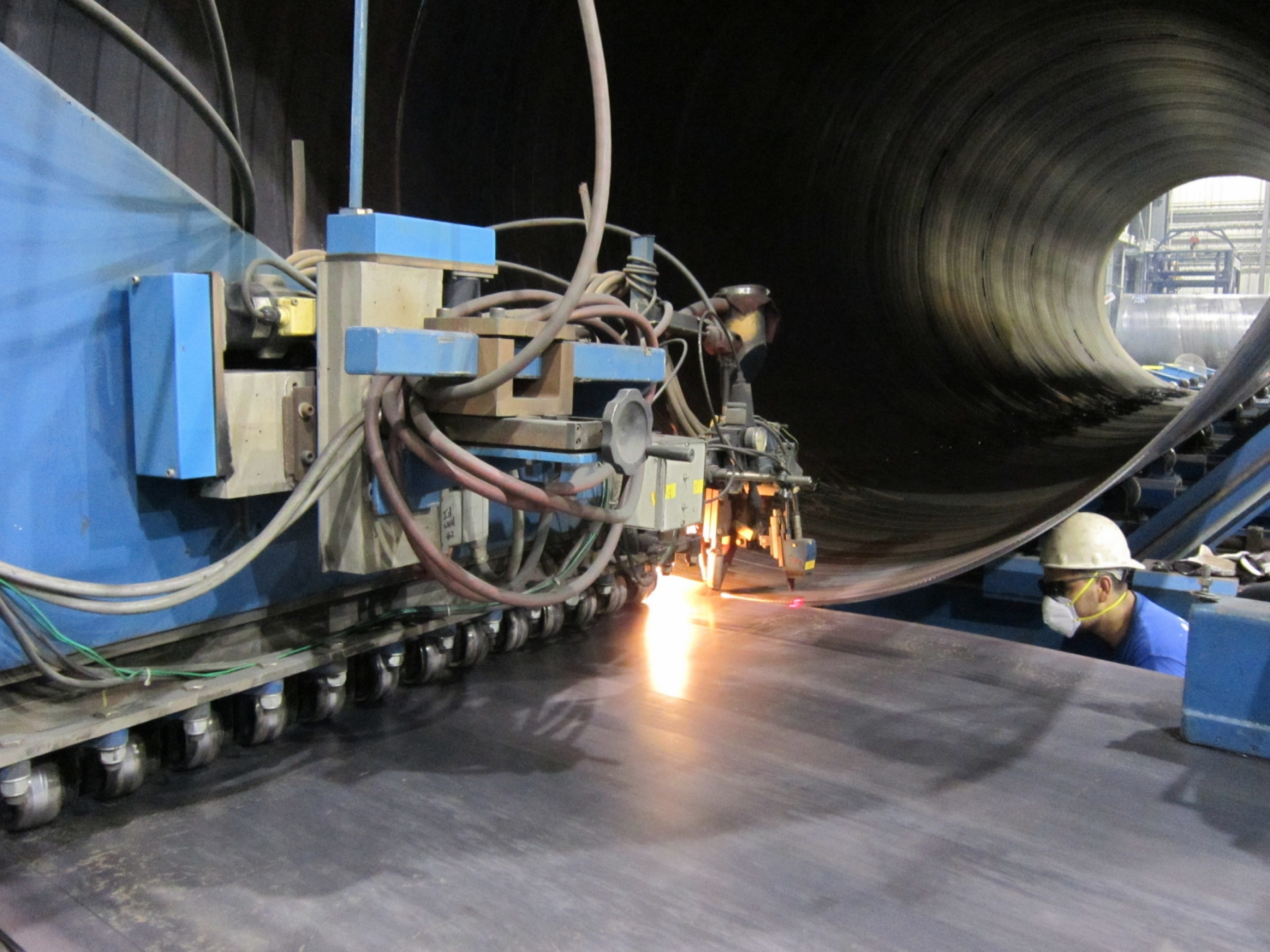
- NYC DEP –50 year history with spiral weld steel water pipe bell by spigot lap welded joints in tunnels and direct bury
- Steel Water Pipe Use in NYC--- 125 year successful history
- Bell by spigot ends allow for angular joint deflection
- Bell by spigot ends allow for easy fit up compared to butt weld type joints
- Lap weld bell by spigot joints are structurally adequate to resist anticipated loadings from thrust from max pressures, thermal cycling and bending issues.

DESIGN AND PIPE MANUFACTURE

- NYC DEP and DDC finalized approval of Hatch Mott and CDM steel pipe design
- Design Considerations: Pressure, Surge, Thrust and Thermal loadings, Grouting pressures, External Unconstrained Loads
- 73.25” OD
- .625 wall thickness –beyond basic design criteria
- Single lap weld bell by spigot
- Northwest Pipe Company manufactured all Pipe

AWWA C200 SPIRAL WELD MANUFACTURING PROCESS





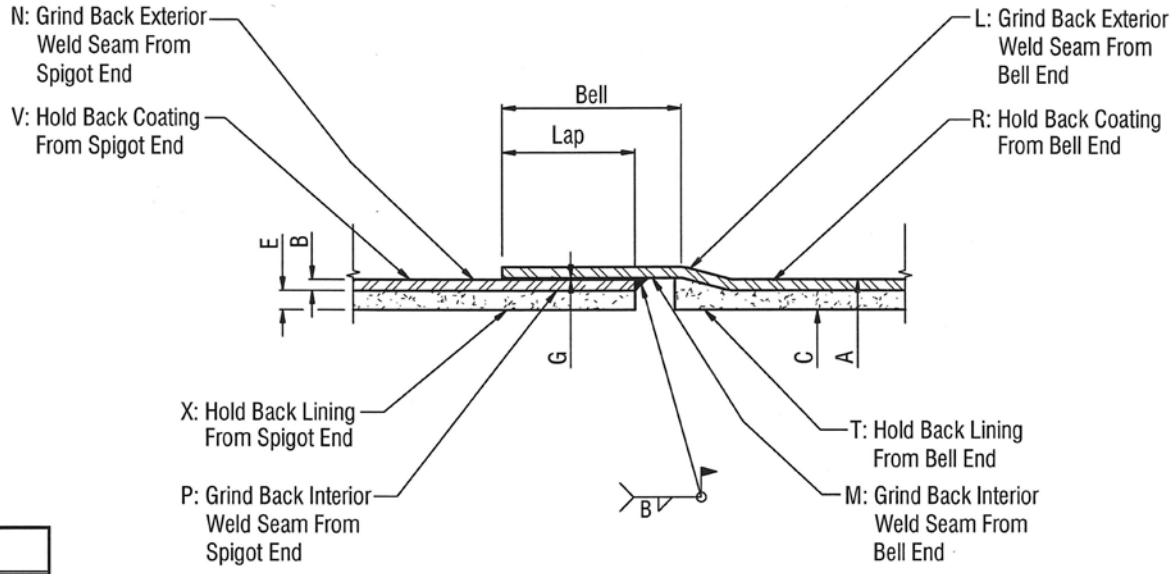

Safety is My Responsibility

Joint: WB x WS, CML, Bare

RUN PIPE				L/C THICKNESS		JOINT					GRIND BACK				HOLD BACK			
A	B	C	D	E	H	Type	Bell	Lap	G Min	G Max	L-Ext	M-Int	N-Ext	P-Int	R-Coat	T-Line	V-Coat	X-Line
97.25	0.625	95.00	97.25	0.50	0.00	WB	6.00	2.50	0.01	0.063	0.00	6.00	6.00	0.00	0.00	6.00	0.00	0.00
73.25	0.625	71.00	73.25	0.50	0.00	WB	6.00	2.50	0.01	0.063	0.00	6.00	6.00	0.00	0.00	6.00	0.00	0.00

Notes:

- All dimensions are in inches unless otherwise specified.
- See specification sheet for material specifications.
- All fillet welds to be the size of the thinner of the two materials being welded.



Pipe Lining and Coating

LINING	Cement Mortar Lining, AWWA C205
COATING	Bare

NORTHWEST PIPE COMPANY
183 Northwest Drive Washington, WV 26181-3511 (304) 863-3316

Siphon Replacement Project, Shafts and Tunnel
Judlau Contracting Inc., GE-343

BY: RLF | DATE: Feb 09, 2012
DRAWING #: PK-11-545-Z-9001

REV

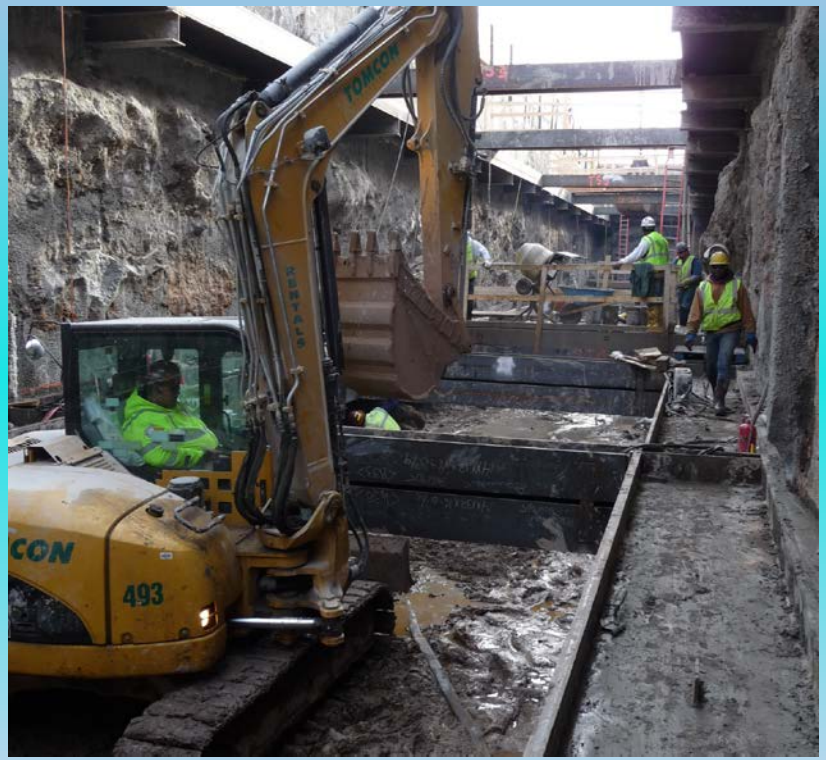
Installation Perspective by Gedas Grazulis

Launch Pit Construction, Excavation and Welding

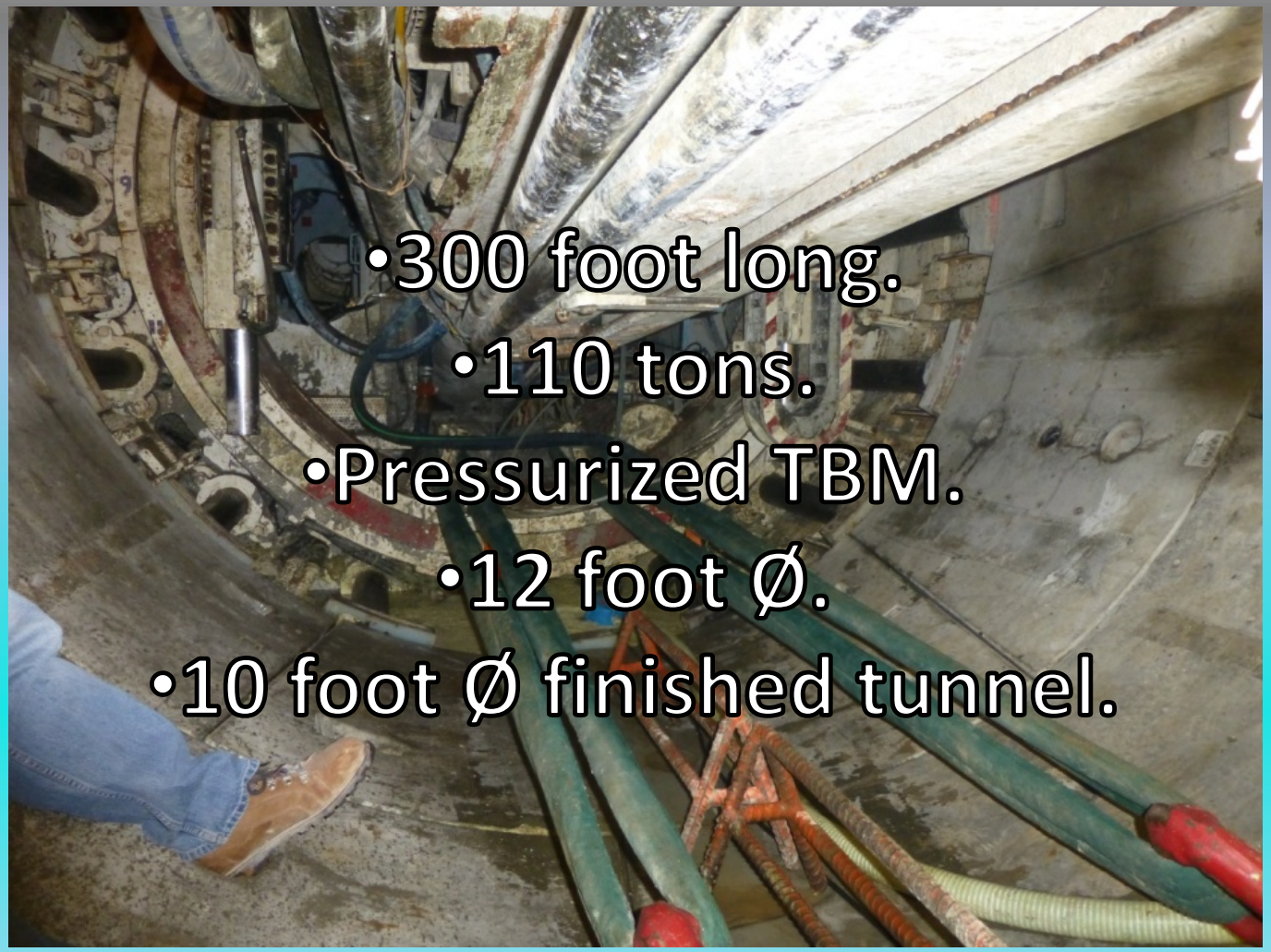
Two shafts were designed for the project.

- Launch pit/shaft on a vacant lot in Staten Island.
- Receiving shaft across New York Harbor in a Brooklyn Park.

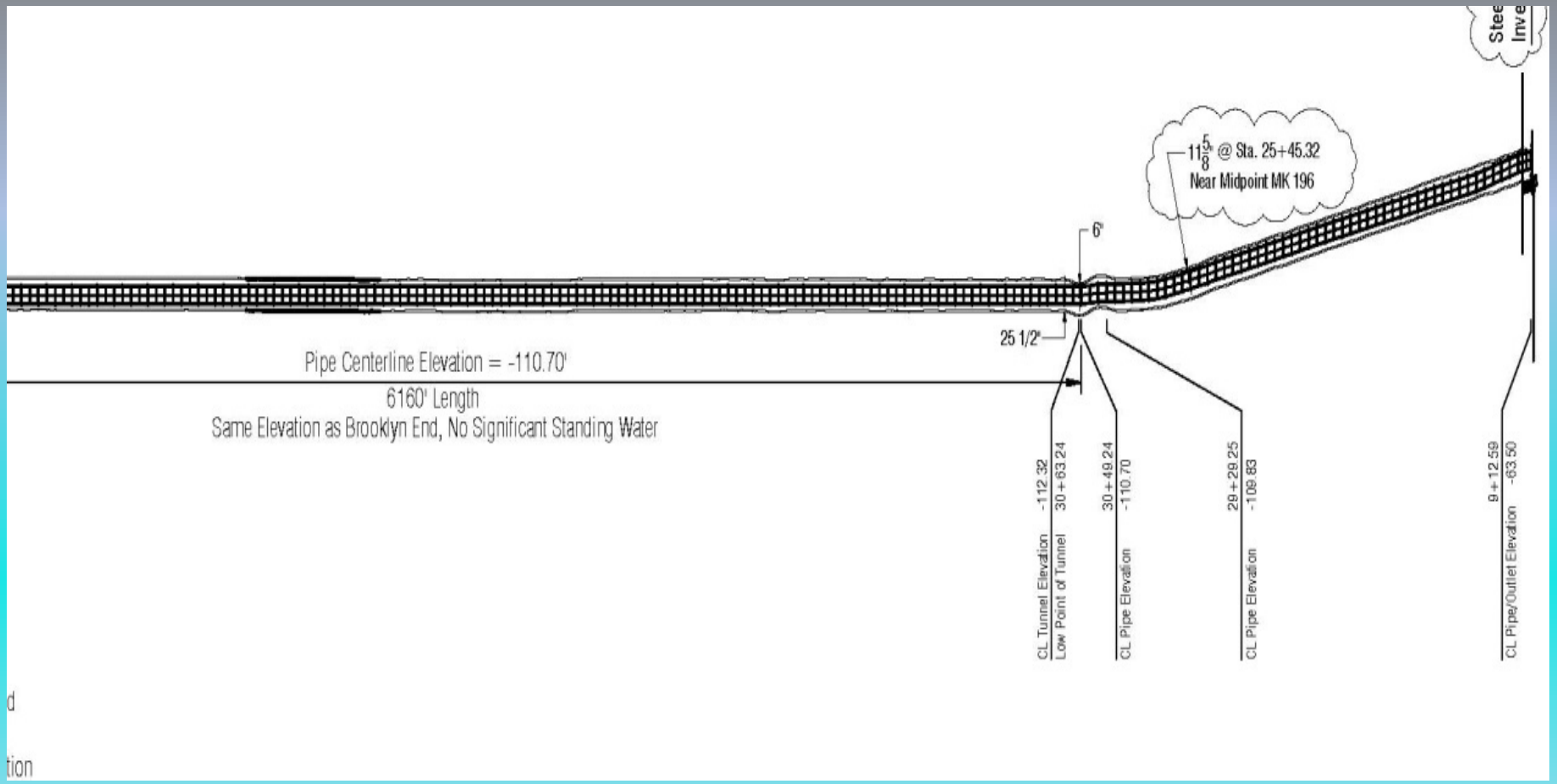
Construction began with a slurry wall and welding of the shaft whalers in August 2011.


TOMCON
493

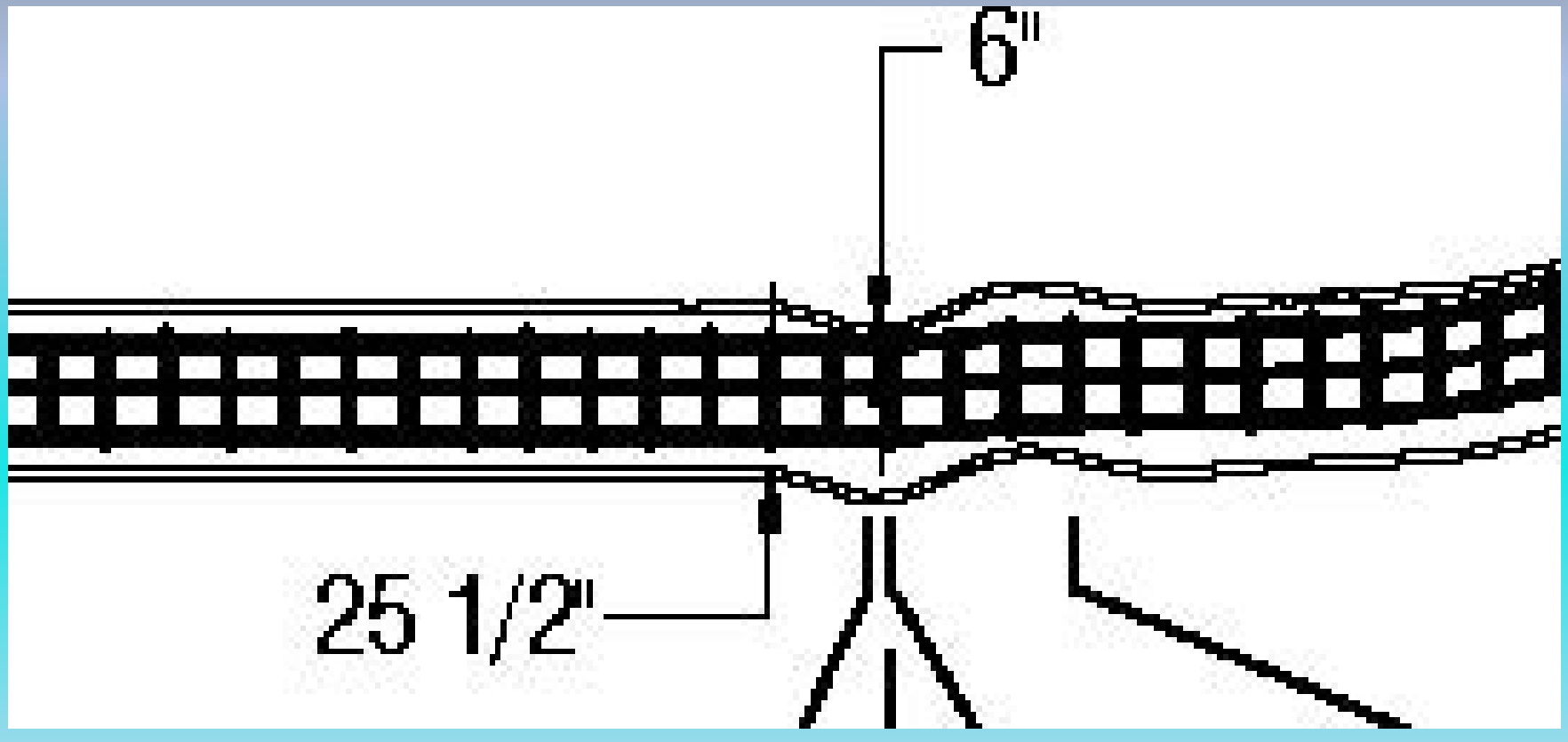
Tunnel Boring Machine Begins Mining



TBM descends to 100 feet



Liquefiable Soil Conditions Create “The Dip”



Problems Begin to Multiply

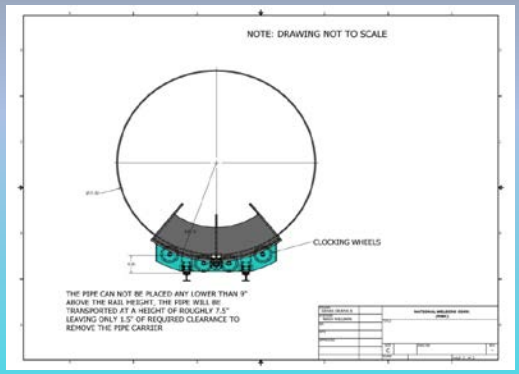
- On October 28, 2012 in advance of Hurricane Sandy ,tunneling was suspended.
- The historic storm surge flooded the Staten Island Shaft and filled the tunnel with sea water.
- After remaining submerged in sea water for several months the tunnel was dewatered, the damaged assessed and months of repairs and testing followed.
- Tunneling resumed on April 14, 2014

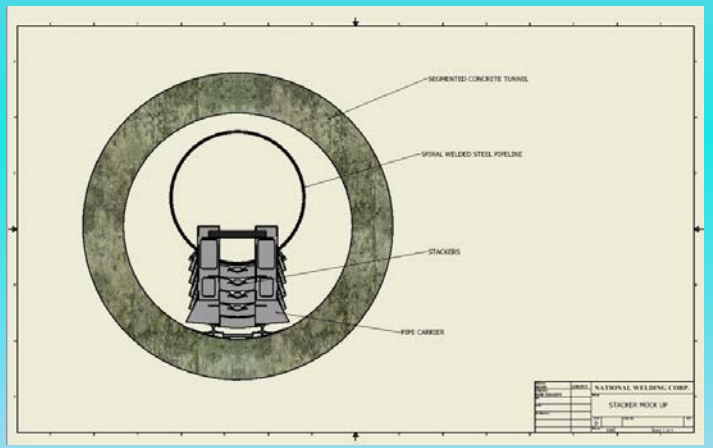
without incident until the last 700 feet when soil conditions again caused the front of the TBM to dip on two occasions creating the 2nd and 3rd dip.

- Tunneling was completed in February of 2015 almost 3 years behind schedule.

Evolution of Pipe Carrier Design

- The pipe carrier was designed in 2012 with the expectation of setting pipe at a height of 17 to 25 inches from the invert of the tunnel.
- The installation height for the final product now varied from 17 to 43 inches in height due to the variations of the mined tunnel .

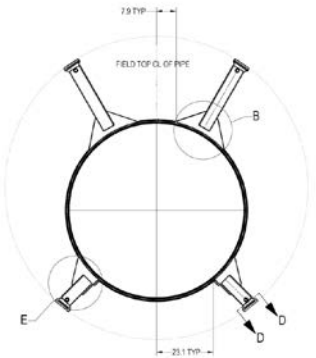


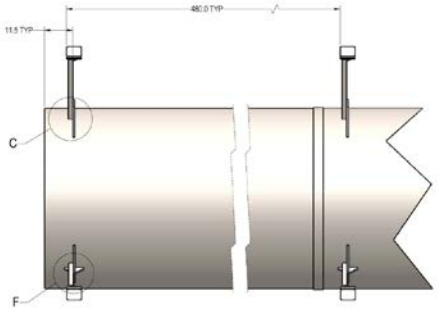


Pipe Bracing

The pipe bracing design needed to allow for:

- Retraction of the pipe carrier.
- Support of pipe dead load and buoyant forces during grouting operations.
- Quick adjustments for varying pipe elevations.
- Support of the pipe at just one end.





PIPE SHOWN IN LOW POSITION OF TUNNEL

Welding and Inspection

•Field adapted high production welding processes were needed to deposit over 4,000 pounds of required weld metal.
•Flux Core Arc Welding (FCAW) was selected due to its high deposition rate and low fume emission characteristics.
•A high voltage cable transmitted 13,700 volts to a mobile step down transformer to supply a welding cart with 480 volt 3 phase power.

•Step down transformer to power small hand tools and workspace lighting.
•Four Inverter type welding power sources.
•Shielding gas supplied via 3/8”Ø pressure hose.
•All girth welds subject to 100% Magnetic Particle (MT) inspection per AWS D1.1 Table 6.1 by a third party inspection company.

Accelerated Installation and Welding

- With the project being so far behind crews worked day and night 6 days a week to complete the installation and welding within 9 weeks.

- Installation was halted several times due to flooding, inadequate ventilation and power issues.

Conclusion

- This project showcased the adjustability of bell and spigot welded joints.
- This adjustability frequently becomes a necessity as mining or excavations deviate from the planned alignment.
- Since pipe is usually manufactured well before completion of tunneling numerous headaches and delays can be avoided with adjustable joint designs, installation methods, bracing and a team willing to adapt to changing conditions.
- Even with all the difficulties experienced, the pipe installation and welding was completed within the 9 week window.
- The entire run of pipe under New York Harbor passed the pressure test on January 22,2016.

Questions???

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NATIONAL WELDING CORP.

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Northwest Pipe Company