HORIZONTAL HAMMER BORING - HHB

An alternate solution for new installations

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Horizontal Hammer Boring

- Horizontal Hammer Boring (HHB) is a trenchless method for new installations, often deployed in ground with cobbles, boulders, bedrock, and differing conditions.
- HHB Utilizes a pneumatic hammer **at the front** of the installation. The hammer accelerates a face breaking assembly at the leading edge of the installation.
- The breaking assembly consists of a Pilot (center) bit and Ring (peripheral) bit which act as one unit to both fragment the subgrade and advance the installation.
- The cutting action is linear with the installation. Rotation is utilized to re-position carbide breaking buttons, but the forward action performs the cutting. Release of compressed air with each cycle of the hammer clears cuttings from the face and back into the casing.
- As material is cleared from the face, shoulders on the pilot bit engage an internal collar within the lead casing pipe which advances the casing along the bore path, dragging the rest of the casing in behind the hammer.

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HORIZONTAL HAMMER BORING

Down-Hole Tooling
Left to Right: Auger – Hammer – Pilot Bit

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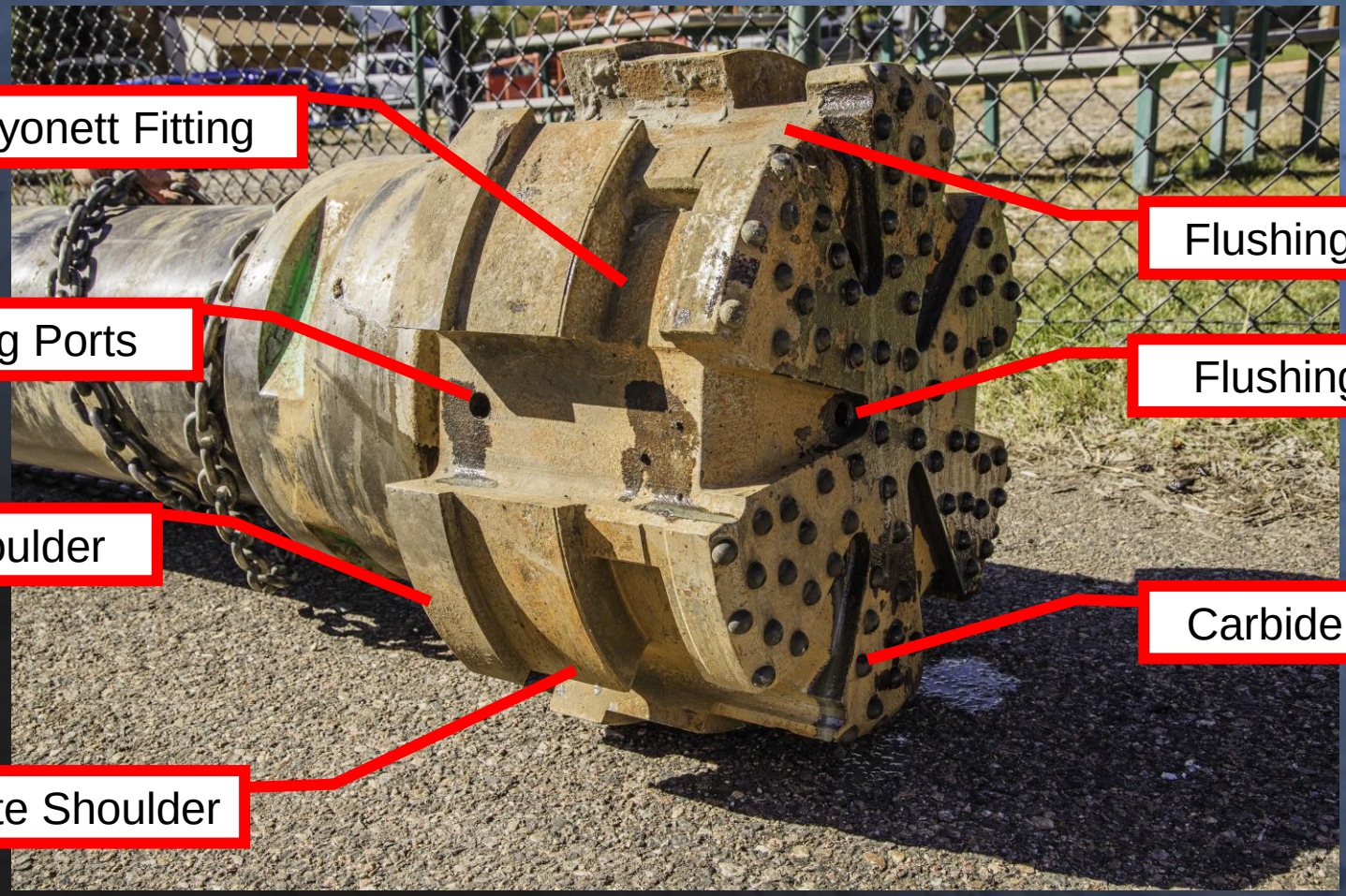

Pilot (Center) Bit

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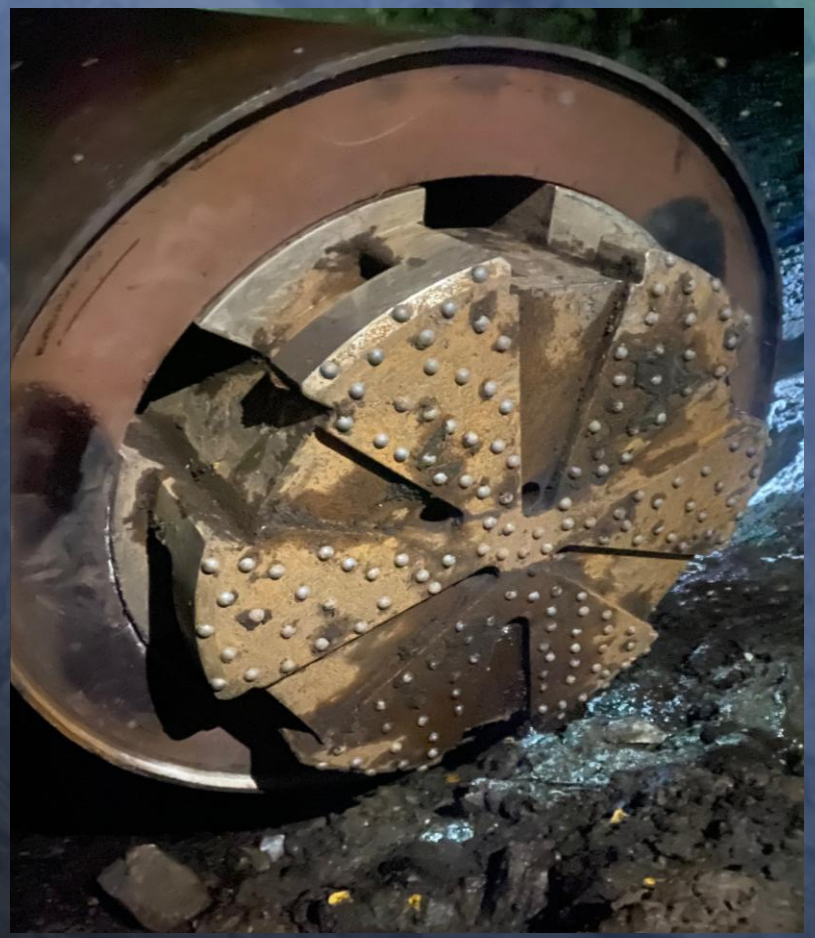
Ring (Peripheral) Bit .



Pilot Bit protruding through start casing. Intermediate Shoulder resting on internal Collar of start casing.

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Cutting Head Action

Complete cutting head of pilot bit and ring bit locked together, ready for installation.

Results

FROM THIS

24” Steel pipe placed over cobble pile excavated from launch pit.

TO THIS

24” Steel pipe placed over cuttings removed during installation

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Mountain Valley Pipeline

Location: Ripplemeade VA
Product: Natural Gas
Date: March 2024
Trenchless Contractor: Atlantic Underground Inc.
Diameter: 42”
Length: 340 LF
Installation Duration: 7 days

Mountain Valley Pipeline

Installation required crossing an existing railway and crossing the Stoney Creek. The creek serves as a protected habitat for small fish which limited the ability to utilize bentonite for fear of inadvertent returns. The ground consisted of large boulders and cobbles intermixed with clays.

Initial attempts with auger boring were unsuccessful due to the cobbles rolling around with the rotational cutting. Additionally, due to the hardness of the material excessive wear occurred on the cutting face. Utilization of an SBU head was also prohibited.

Several attempts at pipe ramming were performed however these were unsuccessful due to deviation during installation. Additionally, pipe ramming provided no release of compressed air from the casing installation which elevated concerns for creating turbidity in the sensitive habitat.

Atlantic Underground Inc. recommended to the Pipeline use of the Horizontal Hammer Boring method which would allow for direct installation of 42” temporary casing which could then be pushed out via pipe ramming to install the final 42” product pipe.

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Mountain Valley Pipeline

Aerial view of the bore path looking from the exit pit toward the launch pit.

Example of encountered boulders.

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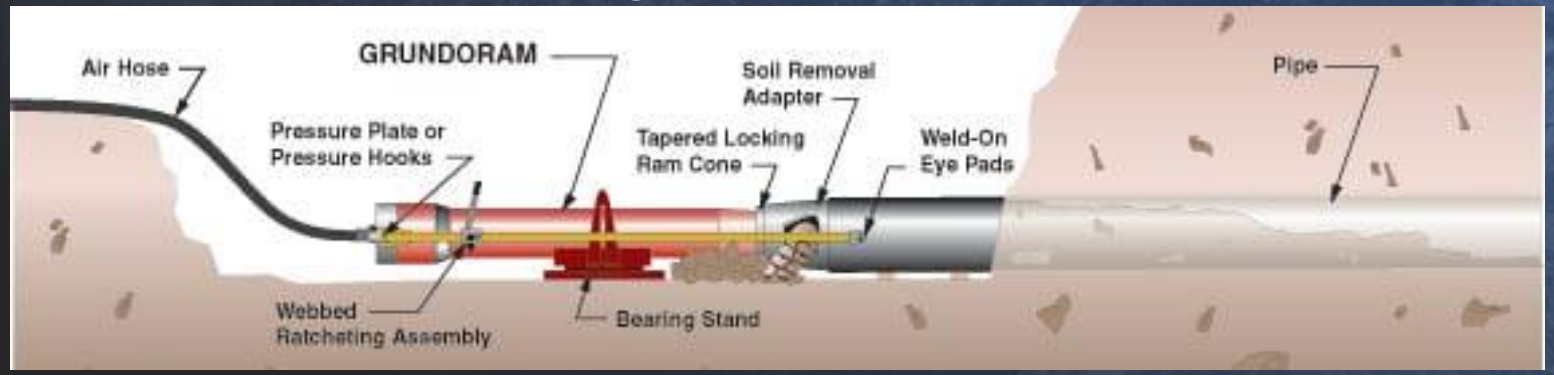
Pipe Ramming vs. Horizontal Hammer Boring

- Pipe Ramming utilizes a pneumatic hammer at the tail or rear of the steel casing. As the hammer fires, the casing is pushed forward into the ground.
- The lead edge of the casing is reinforced to prevent collapse of the casing. Overcoming the length, material weakness of the steel, and ground conditions proved problematic.
- With pipe ramming, the material collects within the casing. The method also has a tendency to displace material which can increase external pressures on the pipe.
- Pushing from the rear is also troublesome because the casing will take the path of least resistance when encountering harder material.



Traditional Pipe Ram diagram

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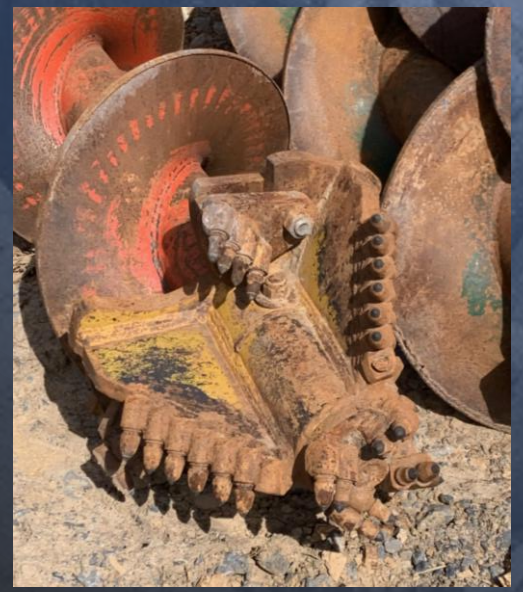
Horizontal Hammer Boring vs. Auger Boring

- The rotational cutting action of auger boring in cobble ground can “roll” the cobbles instead of cutting them and removing them..
- Anticipated cobble size should not exceed 1/3 diameter of the casing. For Mountain Valley that would be 1/3 x 42” = 14” Cobbles to prevent jamming of cobbles in the auger.
- Auger Boring is susceptible to damage if water is anticipated to flow from the installation into the launch pit and can halt an installation.
- Pushing from the rear is also troublesome because the casing will take the path of least resistance when encountering harder material.



Various auger Boring cutting heads
L. Disc Cutter
C. Christmas Tree
R. Roller-Cones

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Mountain Valley Pipeline

Example of Cobble encountered
During excavation

A worker shovels fragmented rock from the launch pit removed along the bore path by HHB operations.

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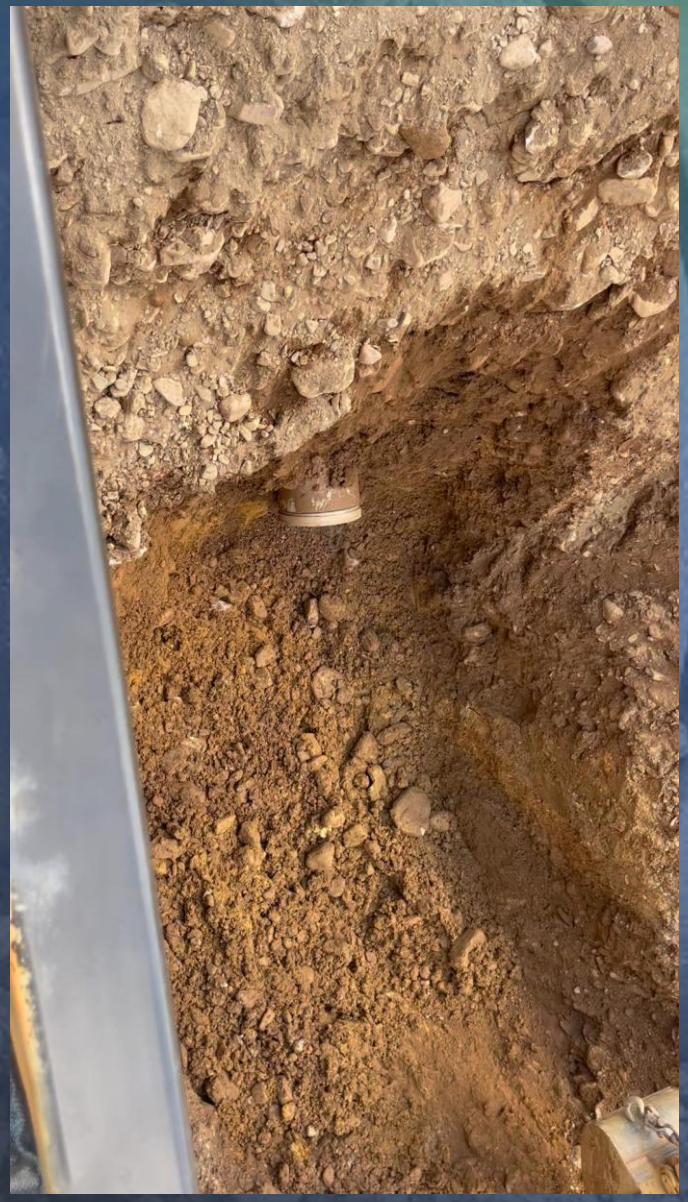
Mountain Valley Pipeline

Ground water Infiltration, the Boring continued



The installation reaches the receiving pit after 7 days of boring operations.

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Champlain-Hudson Power (CHP) Express

Horizontal Hammer Boring for HDD surface casing

Location: Congers NY
Product: Electrical Transmission
Date: July 2024
Trenchless Contractor: JAG Companies (Huxted Trenchless)
Diameter: 36”
Length: 340 LF
Installation Duration: 8 days per installation.

CHP Express

Horizontal Hammer Boring for HDD surface casing

- The HDD method relies upon bentonite slurry to convey cuttings from the bore hole to the entry and exit pits. The bore hole must be able to contain the pressures of the bentonite slurry. Failure to do so can result in an inadvertent return (“frac out”), collapse of the bore hole, or getting stuck.

- Sealing the bore hole from infiltration of underground water sources is therefore also critical.

- In July 2023 Huxted Trenchless encountered ground conditions during completion of their HDD Pilot hole that required installation of surface casing to a depth of approximately 340 LF along the bore path.

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CHP Express

Horizontal Hammer Boring for HDD surface casing

- Initial attempts utilizing traditional pipe ramming resulted in a maximum 24” surface casing installation length of only 120 feet.
- Two attempts were made with 24” casing, one for each of the parallel HDD bores. Huxted turned to their sister company Northeast Remsco Construction who recently purchased a GEONEX HZR1200 Horizontal Hammer Boring unit capable of installing 340’ of 36” diameter casing in the encountered conditions and do so at the desired 14 degree entry angle.
- With similar site requirements to that of a large HDD rig, the HHB equipment was able to be placed on the site with minimal disturbance to the HDD layout
- Both 340’ long installations were completed successfully.

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CHP Express - Congers NY

Congers NY Site aerial with equipment layout and bore path

Typical Site Layout for Surface Casing Installation

CHP Express – Surface Casing Installation

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CHP Express – Surface Casings Installed

Removal of Auger String from Casing

Completed installations

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Jersey City NJ – Substation

Horizontal Hammer Boring alternate for Micro-Tunnel

Location: Jersey City, NJ
Product: Electrical Transmission
Date: June 2024
Trenchless Contractor:
JAG Companies (Northeast Remsco Construction)
Diameter: 36”
Length: (8) Casings, 80 LF each

Jersey City NJ – Substation

Horizontal Hammer Boring alternate for Micro-Tunnel

- Northeast Remsco was contracted to install (8) Parallel 36” diameter casings for electrical conduits to feed a new substation.

- The project explicitly prohibited the use of auger boring. The (8) installations were located in downtown Jersey City, below active commuter railway and adjacent to high rise structures. The soft and wet ground conditions of the area were considered too risky for auger boring.

- Micro-tunneling appeared to be the best trenchless option for this project at the time of design. The method would allow the contractor to control the amount of excavated material with regard to the length of casing installed and mitigate the risk of subsidence and/or heaving of the railway, as well as provide steering capabilities for the installation.

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Jersey City NJ – Substation

Horizontal Hammer Boring alternate for Micro-Tunnel

- Upon site preparations and further investigation several obstacles were revealed along the proposed bore paths that would prove problematic for the soft ground MTBM selected for the installations.
  - Abandoned concrete electrical duct bank.
  - Abandoned cast iron water main
  - Presence of cobbles and boulders

- Northeast Remsco began evaluating other trenchless technologies that could overcome the various obstacles but still provide a level of risk mitigation acceptable to the project owner.

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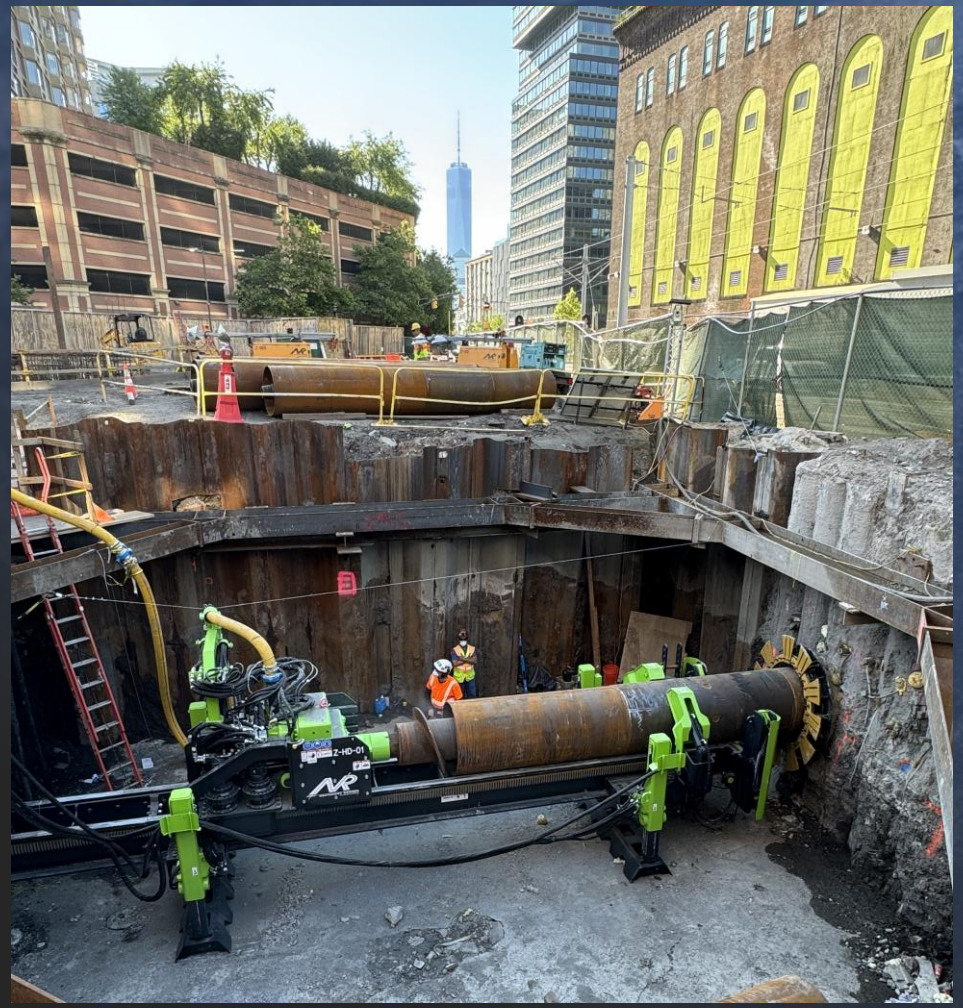
Jersey City NJ – Substation

Horizontal Hammer Boring alternate for Micro-Tunnel



Launch Pit , the first section of casing is installed 10’

A new casing is aligned and ready to be welded.

Jersey City NJ – Substation

Horizontal Hammer Boring alternate for Micro-Tunnel

- Due to the unfamiliarity with the method, educating the designers on the Horizontal Hammer Boring method was required to satisfy their concerns.

- As a safety precaution, a variety of control and observation measures were put into place.
  - A requirement to perform the work during scheduled track shut-downs to avoid risk to commuters on the train.
  - Vibration monitoring was performed adjacent to critical infrastructure that supported the existing substation.

- The ability to control air flow, forward thrust, and rotational pressures further enabled the 8 installations to be successfully installed along the proposed bore paths and overcome the varying conditions encountered.

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Jersey City NJ – Substation

Horizontal Hammer Boring alternate for Micro-Tunnel

- Installation of the first Surface casing was completed in a continuous, round the clock work schedule to further mitigate risk, and ensure completion prior to the commuter use of the train on Monday morning.
- The soft ground enabled pushing with periodic activation of the hammer when harder material was encountered.
- A spike in vibration monitoring readings correlated to the hammer firing when the concrete duct bank was encountered. The technician adjusted operation to mitigate vibration while maintaining the ability to break through the duct bank.
- The 2nd and 3rd installations were performed in the same schedule, and upon repetition of results and monitoring data, the project was permitted to proceed with normal work-day schedules.

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Jersey City NJ – Substation

Horizontal Hammer Boring alternate for Micro-Tunnel

Launch Pit, looking West
8 casings installed

Receiving pit, looking North
8 casings installed within tolerance

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Take aways:

- Horizontal Hammer Boring advances installation primarily by forces at the front of the installation, not through jacking or pushing from the rear.
- Horizontal Hammer Boring breaks the subgrade instead of clawing or cutting.
- Horizontal hammer is a fast and efficient method for new installations in high strength rock in diameters up to 48”.
- Horizontal Hammer boring is a proven method being implemented across North America as an alternate to other traditional methods for new installation.
- Horizontal Hammer Boring can be successfully utilized in installations with high ground water, bedrock, cobbles, boulders and varying ground conditions along the same bore path.

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QUESTIONS / COMMENTS?

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