



SUBSURFACE PIPE INSTALLATION

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There are a number of different types of subsurface pipeline construction methods that may be employed to avoid or minimize surface disturbances. The potential application for each of these construction methodologies varies greatly depending upon the project scope, but generally these options include convention boring, horizontal directional drilling (HDD) and direct pipe installation methods.



Conventional Bore



Horizontal Directional Drill



Direct Pipe

CONVENTIONAL BORING

- **Typical length: 50 to 100 feet**
- **Typical uses: Road and railroad crossings**
- **Minimum workspace: 50 x 100 feet at entry/exit points**

Conventional boring consists of creating a shaft/tunnel for a pipe or conduit to be installed to minimize surface disturbance. This is accomplished by first excavating a bore pit and a receiving pit. The bore pit is excavated to a depth slightly deeper than the depth of the associated trench and is graded such that the bore will follow the proposed angle of the pipe. A boring machine is then lowered to the bottom of the bore pit to install a tunnel using a cutting head mounted on an auger. The auger rotates through a bore tube, both of which are pushed forward as the hole is cut. The pipeline is then installed through the bored hole and welded to the adjacent pipeline. The typical workspace configurations required for boring operations consists of approximately two, 50 foot by 100 foot staging areas for boring machine setup, cuttings/return settlement and storage pits, pipe storage, entrance and exit pit spoil storage and construction equipment necessary to support the operation.

Major factors limiting the success of a boring operation include the crossing distance, subsurface soil and geologic conditions, and existing topography. Boring operations typically occur over crossing distance of 50 to 60 feet. The maximum length a bore could achieve in ideal soil conditions typically does not exceed 400 feet. Subsurface soil and geologic conditions must be conducive to establishing and maintaining a safe bore pit excavation, as well as provide the capabilities for the boring equipment to conduct a successful bore. Loose packed sediment, free of

rock material is preferred when conducting boring operations. The topographic conditions at a site may also limit the use of this method, as preferred locations are generally consistent with level terrain, such that the depth of the bore pit does not present concerns relative to constructability or safety constraints.

HORIZONTAL DIRECTIONAL DRILLING

- **Typical length: 500 to 3,000 feet**
- **Typical uses: Stream and river crossings**
- **Minimum workspace: 200 x 250 feet at entry/exit points**

Unlike boring, an HDD can be used to install subsurface pipe over great distances. The longest successful land-based 30-inch HDD is just under 7,000 feet in length. However, a greater amount of equipment staging is required for HDD than for the open cut crossing method, and typical installation of an HDD segment generally occurs at durations two to three times slower than a conventional open cut crossing.

A minimum workspace footprint of 200 feet wide by 250 feet long is required at the entry and exit points to support the drilling operation. The amount of workspace required can vary significantly from site to site based on site specific conditions. The entry-side equipment and operations typically will include the drilling rig and entry hole, control cab, drill string pipe storage, site office and tool storage trailers, power generators, bentonite storage, bentonite slurry mixing equipment, slurry pump, cuttings separation equipment, cuttings return/settlement pit, water trucks and water storage, and the heavy construction equipment necessary to support the operation.

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(continued from front)

Factors which affect the success of an HDD operation include crossing distance, subsurface soil and geologic conditions, and existing topography. Risks associated with a HDD crossing technique include potential inadvertent returns of fluids during HDD drilling operations and potential hole collapse during construction. The longer the length of the HDD, the more forces are applied to the pipe and the larger potential for failures.

DIRECT PIPE®

- **Typical length: 100 to 800 feet**
- **Typical uses: Highway crossings, river crossings, sensitive environmental areas**
- **Minimum workspace: 20 x 80 feet at one entry point**

Direct Pipe is a trenchless method that combines the advantage of established pipeline installation methods of microtunnelling and HDD. Direct Pipe installations may be much shorter and shallower than HDD installations because the excavation is continuously cased, reducing the risk of hole collapse and subsequent settlement. Additionally the external fluid pressures of the excavation slurry system and bentonite lubrication system are much lower than a typical HDD thereby reducing the

relative risk of hydraulic fracture and inadvertent returns. The length limitation for the Direct Pipe technology (for a 30-inch pipe) is approximately 900 feet due to the requirements of the hydraulic motors in the smaller diameter tunneling machines. Soils with abundant, strong, and/or abrasive boulders or other large obstructions present risk to the Direct Pipe method.

Direct Pipe can be more sensitive to soil conditions than HDD, as it cannot tunnel through rocky substrate that the cutter head cannot pass through. Direct Pipe also requires construction personnel to periodically enter pipe to monitor and adjust settings underground. This presents additional safety risks, and requires a specialized team of individuals to always be on site in the event that an incident occurs. While Direct Pipe has been used overseas, this trenchless installation method is relatively new to the United States. Also, Direct Pipe is typically used for much larger applications, (42-inches and larger). The equipment associated with this method has undergone recent modification to allow for smaller diameter drills (30-inches or less) but this diameter is not common with use of the majority of Direct Pipe applications which have occurred overseas.

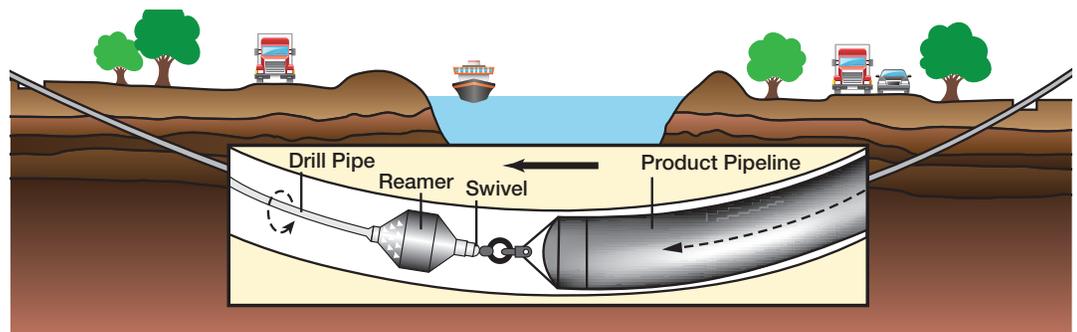


Illustration showing typical horizontal directional drill crossing under water body.

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