

HORIZONTAL DIRECTIONAL DRILLING (HDD)

****From Rockingham STP GMRC(1)**

- xx. DESCRIPTION. This work shall consist of furnishing and installing underground utilities using the horizontal directional drilling (HDD) method of installation, also commonly referred to as directional boring or guided horizontal boring.
- xx. MATERIALS. Materials shall be approved by the Engineer prior to use.
- (a) Casing Pipe. Casing pipe shall be smooth-walled, new plain steel pipe conforming to ASTM A 252 with a 9.53 mm (0.375 inches) wall thickness and minimum yield strength of 241 MPa (35,000 psi) or high density polyethylene (HDPE) pipe meeting the requirements of Subsection 752.08(b).
- A Type A Certification shall be furnished in accordance with Subsection 700.02.
- (b) Carrier Pipe. Carrier pipe shall meet the requirements of Section 605 and be rated to carry the cover indicated in the Plans.
- xx. QUALITY ASSURANCE. The requirements set forth herein specify a wide range of procedural precautions necessary to ensure that the very basic, essential aspects of a proper directional bore installation are adequately controlled. Strict adherence shall be required under specifically covered conditions outlined in this specification. Adherence to the specifications contained herein, or the Engineer's approval of any aspect of any directional bore operation covered by this specification, shall in no way relieve the Contractor of their ultimate responsibility for the satisfactory completion of the work authorized under the Contract.
- (a) Qualifications. HDD installer shall have demonstrated by previous experience ability to do the work. The required previous experience shall consist of having performed a minimum of five horizontal directional drill installations of 500 feet or more using 6" or greater diameter pipe.
- xx. SUBMITTALS.
- (a) Work Plan. Prior to beginning work, the Contractor shall submit to the Engineer a general work plan outlining the procedure and schedule to be used to execute the work.
- (b) Equipment. The Contractor shall submit specifications on directional drilling equipment to be used to ensure that the equipment will be adequate to complete the work.
- (c) Materials. Specifications on material to be used, including pipe and method(s) for joining pipe, shall be submitted to the Engineer.

10/5/2011

- (d) Qualifications. The Contractor shall submit information to verify that the HDD installer meets the required qualifications specified in QUALITY ASSURANCE of this Section. Include contact information of the responsible party for each installation listed.
- (e) Detailed Bore Plan. Following completion of the required field exploratory work and prior to HDD installation, the Contractor shall submit for approval a detailed bore plan. At a minimum, the bore plan shall include entry and exit points, entry and exit angles, any horizontal bend radii, and a profile showing points of tangent and curvature, vertical radii, and the depth of the bore along the alignment.
- (f) All submittals shall be in accordance with Section 105.

xx. EQUIPMENT REQUIREMENTS.

- (a) Work Included. The directional drilling equipment shall consist of a directional drilling rig of sufficient capacity to perform the bore and pull-back the pipe, a drilling fluid mixing and delivery system of sufficient capacity to successfully complete the work, a guidance system to accurately guide boring operations, and trained and competent personnel to operate the system. Equipment shall include a vacuum trailer to withdraw excess drilling fluid and a drilling fluid cleaning system truck for mixing and recycling bentonite. All equipment shall be in good, safe, operating condition with sufficient supplies, materials, and spare parts on hand to maintain the system in good working order for the duration of the work.
- (b) Drilling System.
 - (1) Drilling Rig. The directional drilling machine shall consist of a hydraulically powered system to rotate, push, and pull hollow drill pipe into the ground at a variable angle while delivering a pressurized fluid mixture to a guidable drill (bore) head. The machine shall be anchored to the ground to withstand the pulling, pushing, and rotating pressure required to complete the crossing. The hydraulic power system shall be self-contained with sufficient pressure and volume to power drilling operations. The hydraulic system shall be free of leaks. The rig shall have a system to monitor and record maximum pull-back pressure during pull-back operations, and shall be grounded during drilling and pull-back operations.
 - (2) Drill Head. The drill head shall be steerable by changing its rotation and shall provide the necessary cutting surfaces and drilling fluid jets.
 - (3) Mud Motors. Mud motors (where required) shall be of adequate power to turn the required drilling tools.

- (4) Drill Pipe. Drill pipe shall be constructed of high quality 4130 seamless tubing, Grade D or better, with threaded box and pins. Tool joints should be hardened to 32-36 RC.
- (c) Guidance System. The guidance system shall be of a proven type and shall be set up and operated by personnel trained and experienced with the system. If using a magnetic system, the operator shall be aware of any magnetic anomalies and shall consider such influences in the operation of the guidance system. The guidance system shall be capable of knowing, at all times during the drilling operations, the exact location (vertical, horizontal, and degree of inclination) of the drill head. The guidance system shall be capable of accurately monitoring the location of the drill head beneath a reinforced concrete floor slab.
- (d) Drilling Fluid (Mud) System.
- (1) Mixing System. A self-contained, closed, drilling fluid mixing system shall be of sufficient size to mix and deliver drilling fluid composed of bentonite clay, potable water, and appropriate additives. The mixing system shall be able to molecularly shear individual bentonite particles from the dry powder to avoid clumping and ensure thorough mixing. The drilling fluid reservoir tank shall be of sufficient size for the work. The mixing system shall continually agitate the drilling fluid during drilling operations.
- (2) Drilling Fluid. Drilling fluid shall be composed of clean water and an appropriate additive. Water shall be from a clean source with a pH of 8.5-10. Water of a lower pH or with excessive calcium shall be treated with the appropriate amount of sodium carbonate or equal. The water and additives shall be mixed thoroughly and be absent of any clumps or clods. No hazardous additives may be used.

Drilling fluid shall be maintained at a viscosity sufficient to suspend cuttings and maintain the integrity of the bore wall. All materials, including any additives used to make up the drilling fluid, shall be approved by the Engineer prior to use.

- (3) Delivery System. The mud pumping system shall have sufficient capacity and be capable of delivering the drilling fluid at a constant pressure to meet the needs of the work. The delivery system shall have filters in-line to prevent solids from being pumped into the drill pipe. Connections between the pump and drill pipe shall be relatively leak-free. Used drilling fluid and drilling fluid spilled during drilling operations shall be contained and properly disposed of. A berm, minimum of 12" high, shall be

constructed and shall be maintained around drill rigs, drilling fluid mixing system, entry and exit pits, drilling fluid recycling system, and environment. Pumps and/or vacuum truck(s) of sufficient size shall be in place to convey excess drilling fluid from containment areas to storage facilities.

(e) Other Equipment.

- (1) Pipe Rollers. Pipe rollers, if required, shall be of sufficient size to fully support the weight of the pipe while being hydro-tested and during pull-back operations. Sufficient number of rollers shall be used to prevent excess sagging of pipe.
- (2) Pipe Rammers. Hydraulic or pneumatic pipe rammers may only be used if necessary and with the authorization of Engineer.
- (3) Restrictions. Other devices or utility placement systems for providing horizontal thrust other than those previously defined shall not be used unless approved by the Engineer prior to commencement of the work. Consideration for approval will be made on an individual basis for each specified location. The proposed device or system will be evaluated prior to approval or rejection on its potential ability to complete the utility placement satisfactorily without undue stoppage and to maintain line and grade within the tolerances prescribed by the particular conditions of the project.

xx. CONSTRUCTION REQUIREMENTS.

- (a) General. The Engineer must be notified 48 hours in advance of starting work. The directional bore shall not begin until the Engineer is present at the job site and agrees that proper preparations for the operation have been made. The Engineer approval for beginning the installation shall in no way relieve the Contractor of the ultimate responsibility for the satisfactory completion of the work as authorized under the Contract.
- (b) Personnel. All personnel shall be fully trained in their respective duties as part of the directional drilling crew and in safety.
- (c) Drilling Procedure.
 - (1) Site Preparation. Prior to any alterations to the work site, the Contractor shall photograph or video the entire work area, including entry and exit points, one copy of which shall be provided to the Engineer and one copy to remain with the Contractor for a period of 1 year following the completion of the project.

Work site as indicated on the Plans, within right-of-way, shall be graded or filled to provide a level working area. No alterations beyond what is required for operations are to be made. The Contractor shall confine all activities to designated work areas.

Prior to anchoring the drilling rig to the ground, the Contractor shall confirm locations of all underground utilities in the area of the drilling rig.

- (2) Drill Path Survey. The entire drill path shall be accurately surveyed, with entry and exit stakes placed in the appropriate locations within the areas indicated on the Plans. If the Contractor is using a magnetic guidance system, the drill path will be surveyed for any surface geo-magnetic variations or anomalies.
- (3) Environmental Protection. The Contractor shall place silt fence between all drilling operations and any drainage, wetland, waterway, or other area designated for such protection by the Contract Documents or state, federal, and local regulations. Additional environmental protection necessary to contain any hydraulic or drilling fluid spills shall be put in place, including berms, liners, turbidity curtains, and other measures. The Contractor shall adhere to all applicable environmental regulations. Fuel or oil may not be stored in bulk containers within 200 feet of any water body or wetland.
- (4) Safety. The Contractor shall adhere to all applicable state, federal, and local safety regulations and all operations shall be conducted in a safe manner. Safety meetings shall be conducted at least weekly with a written record of attendance and topic submitted to the Engineer.
- (5) Pilot Hole. The pilot hole shall be drilled on the bore path with no deviations greater than 5% of depth over a length of 100 feet; the Contractor will notify the Engineer and the Engineer may require the Contractor to pull-back and re-drill from the location along the bore path before the deviation.

In the event that a drilling fluid fracture, inadvertent returns, or returns loss occurs during pilot hole drilling operations, the Contractor shall cease drilling, wait at least 30 minutes, inject a quantity of drilling fluid with a viscosity exceeding 120 seconds as measured by a Marsh funnel, and then wait another 30 minutes. If mud fracture or returns loss continues, the Contractor will cease operations and notify the Engineer. The Engineer and the

Contractor will discuss additional options and work will then proceed accordingly.

- (6) Reaming. Upon successful completion of the pilot hole, the Contractor will ream the bore hole to a minimum of 25% greater than the outside diameter of the pipe using the appropriate tools. The Contractor will not attempt to ream at one time more than the drilling equipment and mud system are designed to safely handle.
- (7) Pull-Back. After successfully reaming the bore hole to the required diameter, the Contractor will pull the pipe through the bore hole. In front of the pipe will be a swivel. Once pull-back operations have commenced, operations must continue without interruption until the pipe is completely pulled into the bore hole. During pull-back operations, the Contractor will not apply more than the maximum safe pipe pull pressure at any time.

In the event that the pipe becomes stuck, the Contractor will cease pulling operations to allow any potential hydro-lock to subside and will commence pulling operations. If the pipe remains stuck, the Contractor will notify the Engineer. The Engineer and the Contractor will discuss options and then work will proceed accordingly.

- (8) Inlet Grouting. Upon completion of installation, the inlet of the casing shall be grouted with a bentonite and cement grout as directed by the Engineer.

- xx. SITE RESTORATION. Following drilling operations, the Contractor will de-mobilize equipment and restore the work-site to original condition. All excavations will be backfilled and compacted to 95% of original density. Landscaping will be restored to original to the satisfaction of the Engineer.
- xx. RECORD KEEPING, AS-BUILTS. The Contractor shall maintain a daily project log of drill operations and a guidance system log with a copy given to the Engineer at completion of the work. As-built drawings shall be certified as to accuracy by the Contractor.
- xx. METHOD OF MEASUREMENT. The quantity of Special Provision (Horiz. Directional Drilling) of the type and size specified to be measured for payment will be the number of meters (linear feet) of pipe installed in the complete and accepted work, as measured along the flow line of the pipe.
- xx. BASIS OF PAYMENT. The accepted quantity of Special Provision (Horiz. Directional Drilling) of the type and size specified will be paid for at the Contract unit price per meter (linear foot). Payment shall be full compensation for furnishing all labor, tools, equipment, and materials; for excavation, sheeting and bracing, dewatering, and backfilling; for furnishing and installing the casing pipe and carrier pipe utilizing horizontal

10/5/2011

directional boring method of installation; for furnishing and installing casing spacers and end seals; for restoration of physical features; and for all work required for a complete installation of the highway crossing including clearing, grubbing, erosion control, excavation, excavation support, dewatering, drilling, removal of tailings, backfilling, compaction, and flushing; for preparing and furnishing required submittals, reports, and as-built drawings; and for furnishing all labor, materials, tools, equipment, and incidentals necessary to complete the work.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
900.640 Special Provision (Horizontal Directional Meter Drilling) (X mm (X") Sch. XX Steel Casing Pipe w/X mm (X") Carrier Pipe)	(Linear Foot)