

1 Make this section a part of the Standard Specifications:
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4 **“SECTION 652 – HORIZONTAL DIRECTIONAL DRILLING**
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7 **652.01 Description.** This work shall consist of furnishing and installing
8 underground pipelines using the horizontal directional drilling (HDD) method of
9 installation, also commonly referred to as directional boring or guided horizontal boring.
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11 **652.02 Materials.** Materials shall be approved by the Engineer prior to use.
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13 (A) **HDD Pipe.** HDD pipe shall be high density polyethylene (HDPE) pipe
14 meeting the requirements of Subsection 706.10 High Density Polyethylene Pipe.
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16 **652.03 Construction** The requirements set forth herein specify a wide range of
17 procedural precautions necessary to ensure that the very basic, essential aspects of a
18 proper directional bore installation are adequately controlled. Strict adherence is
19 required under specifically covered conditions outlined in this specification. Adherence
20 to the specifications contained herein, or the Engineer's approval of any aspect of any
21 directional bore operation covered by this specifications, shall in no way relieve the
22 Contractor of their ultimate responsibility for the satisfactory completion of the work
23 authorized under the Contract.
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25 (A) **Qualification.** HDD installer shall have demonstrated by previous
26 experience ability to do the work. The required previous experience of the
27 Contractor shall consist of having performed a minimum of five horizontal
28 directional drill installations of 200 feet or more using 6" or greater diameter pipe.
29 The Supervisor must have at least two years directional drilling experience. A
30 competent and experienced supervisor representing the Drilling Contractor shall
31 be present at all times during the drilling operations.
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33 (B) **Submittals**

34 (1) **Work Plan.** Prior to beginning work, the Contractor shall submit to
35 the Engineer a general work plan outlining the procedure and schedule to
36 be used to execute the work. The work plan shall include a list of
37 subcontractors, a safety plan, a traffic control plan, an environmental
38 protection plan and contingency plans for possible problems.
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40 (2) **Equipment.** The contractor shall submit specifications on all
41 directional drilling equipment to be used to ensure that the equipment will
42 be adequate to complete the work.
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44 (3) **Materials.** Specifications on material to be used, including pipe and
45 method(s) for joining pipe, shall be submitted to the Engineer.
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48 (4) **Qualifications.** The Contractor shall submit information to verify that
49 the HDD installer meets the required qualifications specified in

CONSTRUCTION – QUALIFICATION 652.03(A) of this Section. As part of the bid submission, include contact information of the responsible party for each installation listed.

(5) 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 pipe bell and barrel diameters, bore path inside diameter, entry and exit points of tangent and curvature, vertical radii, and the depth of the bore along the alignment.

(6) All submittals shall be in accordance with Section 105 Control of Work.

(C) Equipment Requirements.

(1) 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.

(2) Drilling System.

(a) 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. There shall be a system to detect electrical current from the drill string and an audible alarm, which automatically sounds when an electrical current is detected.

(b) Drill Head. The drill head shall be steerable by changing its rotation and shall provide the necessary cutting surfaces and drilling fluid jets.

(c) Mud Motors. Mud motors (where required) shall be of adequate power to turn the required drilling tools.

99 (d) Drill Pipe. Drill pipe shall be constructed of high quality 4130
100 seamless tubing, Grade D or better, with threaded box and pins. Tool
101 joints should be hardened to 32-36 RC. Submit certified statement that
102 the drill pipe has been inspected and is in satisfactory condition for its
103 intended use.

104
105 (3) Guidance System. The guidance system shall be of a proven type
106 (walkover guidance systems are not acceptable for this project) and shall
107 be set up and operated by personnel trained and experienced with the
108 system. If using a magnetic system, the operator shall be aware of any
109 magnetic anomalies and shall consider such influences in the operation of
110 the guidance system. The guidance system shall be capable of knowing,
111 at all times during the drilling operations, the exact location (vertical,
112 horizontal, and degree of inclination) of the drill head. The guidance
113 system shall be accurate to 2% of the vertical depth of the borehole at
114 sensing position at depths up to one hundred feet and accurate within 1.5
115 meters horizontally.

116
117 (4) Drilling Fluid (Mud) System.

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119 (a) Mixing System. A self-contained, closed, drilling fluid mixing
120 system shall be of sufficient size to mix and deliver drilling fluid composed
121 of bentonite clay, potable water, and appropriate additives. The mixing
122 system shall be able to molecularly shear individual bentonite particles
123 from the dry powder to avoid clumping and ensure thorough mixing. The
124 drilling fluid reservoir tank shall be of sufficient size for the work. The
125 mixing system shall continually agitate the drilling fluid during drilling
126 operations.

127
128 (b) Drilling Fluid. Drilling fluid shall be composed of clean water and an
129 appropriate additive. Water shall be from a clean source with a pH of 8.5-
130 10. Water of lower pH or with excessive calcium shall be treated with the
131 appropriate amount of sodium carbonate or equal. The water and
132 additives shall be mixed thoroughly and be absent of any clumps or clods.
133 No hazardous additives may be used. Drilling fluid shall be maintained at
134 a viscosity sufficient to suspend cuttings and maintain the integrity of the
135 bore wall. All materials, including any additives used to make up the
136 drilling fluid, shall be approved by the Engineer prior to use.

137
138 (c) Delivery System. The mud pumping system shall have sufficient
139 capacity and be capable of delivering the drilling fluid at a constant
140 pressure to meet the needs of the work. The delivery system shall have
141 filters in-line to prevent solids from being pumped into the drill pipe.
142 Connections between the pump and drill pipe shall be relatively leak-free.
143 Used drilling fluid and drilling fluid spilled during drilling operation shall be
144 contained and properly disposed of. A berm, minimum of 12" high, shall
145 be constructed and shall be maintained around drill rigs, drilling fluid
146 mixing system, entry and exit pits, drilling fluid recycling system, and
147 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.

(5) Other Equipment.

(a) 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.

(b) Pipe Rammers. Hydraulic or pneumatic pipe rammers may only be used if necessary and with the authorization of Engineer.

(c) 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.

(D) Construction Requirements.

(1) 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. The Contractor is responsible for damages to utilities and repairs for such damages, at no cost to the State.

(2) Personnel. All personnel shall be fully trained in their respective duties as part of the directional drilling crew and in safety.

(3) Drilling Procedure.

(a) 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. The Contractor is responsible for design and construction of the drill entrance and exit pits. 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 drill rig to the ground, the Contractor shall confirm locations of all underground utilities in the area of the drilling rig.

(b) 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.

(c) 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. Disposal of fluids is the responsibility of the Contractor. 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.

(d) 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 written record of attendance and topic submitted to the Engineer.

(e) 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. In the event the pilot hole does deviate from the bore path more than 5% of depth in 100', 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 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. Return the surface area to its original condition.

(f) 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.

(g) Pull-Back. After successfully reaming the bore hole to the required diameter, the Contractor will pull the pipe through the bore hole. Pipe lengths shall be connected together in one length, if space permits. Pipe shall be placed on rollers with rollers spaced close enough to prevent excessive sagging of pipe. 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 pipe manufacturer's 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.

(h) Inlet Grouting. Upon completion of installation, the excess pipe shall be removed, and the bore hole shall be filled with flowable fill or cement grout as directed by the Engineer.

(E) Site Restoration. Following drilling operations, the Contractor will demobilize equipment and restore the work-site to original condition. All excavations will be backfilled and compacted to 95% of the maximum dry unit weight determined in accordance with AASHTO T 180. Landscaping will be restored to original to the satisfaction of the Engineer.

(F) Record Keeping, As-Built. 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.

652.04 Method of Measurement. The Engineer will measure Horizontal Directional Drilling per linear foot of pipe installed, as measured along the flow line of the pipe in accordance with the contract documents.

652.05 Basis of Payment. The Engineer will pay for Horizontal Directional Drilling per linear foot. Payment shall be full compensation for furnishing all labor, tools, equipment, and materials; for excavation, sheeting and bracing, de-watering, and backfilling; for furnishing and installing the HDD pipe and carrier pipe utilizing horizontal directional boring method of installation; for furnishing and installing pipe 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.

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The Engineer will pay for the following pay item when included in the proposal schedule:

Pay Item	Pay Unit
Horizontal Directional Drilling	Linear Feet"

END OF SECTION 652