

SECTION 818
HORIZONTAL DIRECTIONAL DRILLING FOR SEWERS

818-1 DESCRIPTION: This construction method involves the controlled directional drilling of a pilot bore/hole, back reaming/hole, enlargement and pull back of the specified sewer pipe to line and grade as shown on the drawings. The drilling process utilizes drill pipes, drill bits and reamers in conjunction with an engineered drilling fluid solution.

818-2 SCOPE OF WORK: Horizontal Directional Drilling (HDD) installations shall be constructed with High Density Polyethylene pipe (HDPE) or Polyvinyl Chloride pipe (PVC). The pipe must be complete with ASTM Designation and SDR number.

818-2.1 Definitions:

- a. Horizontal Directional Drilling (HDD): A method of installing buried piping by controlled, (guided within specified limits) horizontal drilling.
- b. Pilot Hole: The initial controlled drilled horizontal shaft used to guide the enlargement to design size and eventual installation of the pipe.
- c. Reaming: The back reaming hole opener is attached to the drill pipe and rotated and pulled back through the pilot hole to enlarge the bore in one or more passes to the size for pipe installation (the final bore diameter, in most cases is selected by the Contractor, consistent with his experience).
- d. Pullback: The pipe installation pulled back by a swivel/pulling head connected behind the reamer, which pulls the prepared pipe into place.
- e. Drilling Fluids: Fluids consisting of water, bentonite, and any approved additives such as environmentally safe polymers, lubricants, and viscosifiers.
- f. Bore-tracking Equipment: Methods and systems generally defined as a walk over or non walkover. To be specified by the Contractor and used to measure the actual accuracy of the bore to the specific line and grade. The bore path is monitored during the pilot bore by taking periodic readings of the inclination and azimuth of the probe located within the drive bit.
- g. Zone of Active Excavation: Area located within a radial distance about a surface point immediately above the face of excavation equal to the depth to the bottom of the excavation.
- h. Bore-tracking Pit: An excavated area for entry, exit, slurry sump pits or any other excavation. It will also be used to manage, control and track the progress of the bore.
- i. Critical Structure: Any pipeline, utility, building, structure, bridge, pier, or similar construction partially or entirely located within a zone of active excavation.

818-2.2 Qualifications:

- a. Horizontal Directional Drilling Contractors shall have actively engaged in the installation of pipe using HDD for a minimum of three (3) years, during which time the Contractor will have completed at least 15,000 linear feet of HDD installations and must include at least three projects of the same pipe material proposed, length, and diameter (or larger) installed, using the same size of HDD equipment proposed.

- b. Field supervisory personnel employed by the HDD Contractor will have at least three (3) years' experience in the performance of the work and tasks as stated in the Contract Documents. The field supervisory personnel shall be on-site at all times drilling operations are being conducted.

818-2.3 Submittals:

- a. **Qualifications:** Submit written documentation showing that the Contractor and personnel meet the minimum required qualifications stated in Section 818-2.2. Information must include, but not be limited to date and duration of work, location, pipe information (i.e. length, diameter, depth of installation, pipe material, etc.), project owner information (i.e. name, address, telephone number, contact person), and the contents handled by the pipeline (water, wastewater, etc.). **The apparent low bidder shall complete and submit the required qualifications to the Engineer within ten (10) days after the bid opening.**
- b. Horizontal Directional Drilling Methodology: A written description, together with supporting documentation that defines the Contractor's plans (including HDD plan, profile, and calculations) and procedures for proposed operations, surface equipment layout, area requirements, and a description of the sequence of proposed pipe installation. The description shall convey the following:
 - 1. The Contractor's method of following the proposed drilling alignment (both horizontal and vertical surveyed or instrument plotted) as shown on the Contract Documents.
 - 2. A preliminary drilling plan and profile with all calculations and drawings describing the pilot hole, hole enlargement pullback procedures, pre-pull pipe layout, required reamer upsizing, location and depth of all utility crossings, number of pulling interruptions for fusing, estimated pullback forces/pressures, location of streets, driveways, and entrances, locations where the pre-pull alignment will stray from the public ROW or servitude, and setbacks and descent and exit angles. Pre-pull alignment shall be straight unless approved otherwise by Engineer. Pipe strings shall be fused full length for an uninterrupted pull unless otherwise approved by Engineer.
 - 3. Manufacturer, type and size of HDD drilling equipment proposed; size and type of any auxiliary systems proposed, including any supporting equipment and/or storage areas.
 - 4. Sequence and schedule of operations.
 - 5. HDD Site layout and size of access shafts, pits and work site, including support equipment.
 - 6. Method of spoil transportation from the entry and exit pits. Cleaning equipment including surface storage and disposal methods proposed.
 - 7. Proposed drilling fluids to be used and expected quantities to be used, to be collected for disposal and expected amounts to be lost. Drilling fluid properties, mix design, manufacturer instructions, MSDS sheets, down hole pressures, viscosities, and flow rate (See 818-4.7 for details). Contractor shall maintain copies of the MSDS sheets on site for distribution to the public upon request. Contractor shall prepare a Frac-out mitigation plan to include procedures in the

event of inadvertent frac-out. This Frac-out mitigation plan shall be submitted and approved prior to any HDD operations and shall be on-site at all times.

8. Drilling fluid ratio design information based on soils report and geotechnical information, including any requirements for additives.
 9. Capacity and type of all boring equipment, specs of drilling pipe, drill bits, swivels, and reaming equipment and all other support equipment as well as support equipment.
 10. Identify critical utility crossings and special precautions proposed. Contractor shall conform to requirements of Section 818-4.1g.
 11. Specify type of tracking equipment, operation range and degree of accuracy during drilling of the bore hole, taking into consideration depth and length of bore and external interferences. Also, tracking of the reamer during hole enlargement operations.
 12. At completion of the pilot hole, Contractor shall submit plotted on a profile drawing tracked points of the drill rod location. This shall be reviewed prior to any back reaming operations. In the event that pilot hole deviates from design bore path more than allowed by Section 818-4.4c, Contractor shall notify Engineer and Engineer may require Contractor to pull-back and re-drill from the location along bore path before the deviation
 13. Road Closures, Driveway, and Entrance Closures: Road closures shall be approved by the Jurisdiction Having Authority (JHA) over the public ROW. Contractor shall obtain permission to close driveways and entrances from property owners and/or tenants. This information shall be submitted on a Traffic Control Plan, specific to the HDD operations.
- c. Drawings and Calculations: Submit for record purposes, drawings and calculations for any systems designed by the Contractor. Drawings shall be adequate for construction and include installation details. For pullback operations, specify pipe and pipe joint detail. Documents must be signed and sealed by a Professional Engineer registered in the State of Louisiana. Calculations shall include a clear statement of criteria used for the design as described in Subsection 818-2.4, Design Criteria.
- d. Quality Control: Submit a brief description of the quality control methods for review including:
1. Method and frequency of survey control.
 2. Example of all boring and installation operations daily log.
- e. Geotechnical Investigation: When geotechnical investigations are conducted by the Contractor, submit results to the Engineer as soon as available, but prior to beginning drilling operations.
- f. Monitoring Plans: The Contractor shall provide monitoring plans per Subsection 818-4.5 for assessing ground movement (settlement or heave) due to drilling operations as follows:

1. Instrumentation Monitoring Plan: Submit for review, prior to construction, a monitoring plan that includes a schedule of instrumentation design, layout of instrumentation points, equipment installation details, manufacturer's catalog literature, and monitoring report forms.
 2. Surface Settlement Monitoring Plan: Submit a settlement monitoring plan for review prior to construction. Refer to 818-4.5f for details.
 3. Frac-Out and Surface Spill Contingency Plan detailing how Contractor shall control operational pressures, drilling fluid weights, drilling speeds, and any other operational factors required to avoid hydrofracture fluid losses to formations, and control drilling fluid spillage. This includes any spillages or returns at entry and exit locations or at any intermediate point. Also describe Contractor's plan to contain and cleanup drilling fluid losses in the event they do occur. It shall specify the required on-site equipment capable of such cleanup and include contact information for Engineer, Owner, and regulatory agencies. Contractor's plan shall conform to requirements of Section 818-4.7. This plan shall be submitted to the Engineer for informational purposes.
- g. Structures Assessment: Preconstruction and post-construction assessment reports shall be provided for critical structures, namely those located within the zone of active excavation measured from the proposed tunnel centerline. Photographs or a video of existing/preconstruction damage to structures in the vicinity of the sewer alignment shall be included in the assessment reports.
- h. The readings of all monitoring shall be submitted to the Engineer.
- i. Daily Reports: The shift log as defined in Subsection 818-4.3, and work progress data as kept by the Contractor shall be made available to the Engineer on request. Contractor shall complete a "HDD Survey Tabulation Report" for pilot bores and a "HDD Field Engineering Report" for pullback procedures on a daily basis and submit copies to the Engineer for informational purposes. Copies of these required reports can be obtained by the Contractor at the following website:
- <http://www.brprojects.com/SSOProgram/ConstructionForms.aspx?grpID=cc>
- j. Pipe Manufacturer Recommendations: Documents showing standards compliance, material certifications, and handling instructions, including any pipe fusing. These recommendations shall include any special considerations and/or requirements for HDD operations and shall be on-site at all times.

818-2.4 Design Criteria:

- a. Unless otherwise specified on the Contract Documents, the Contractor is responsible for selection of the appropriate pipe SDR as stated in Section 818-2, to carry all construction loads in combination with overburden, earth and hydrostatic loads. Design of any pipe indicated on the Drawings considers in-place loads only and does not take into account any construction loads. The criteria for longitudinal loading on the pipe and joints shall be determined by the Contractor, based on the selected method of construction.
- b. The pipe shall be designed to withstand all construction and handling forces and pipe advance without damage or distortion. The connection equipment shall be selected so that the pull/push loads are uniformly distributed and will not damage or distort the pipe.

- c. Take into account loads from handling and storing.
- d. If a railroad crossing is required the Contractor shall obtain the appropriate permits and insurance as required by the owner of the railroad at no additional cost to the Owner.
- e. Criteria to be used for truck loading shall be HS-20 vehicle loading distributions in accordance with AASHTO.
- f. Provide pipes with the inside diameter shown on the Contract Documents regardless of pipe material.

818-3 MATERIALS:

818-3.1 Sewer Pipe:

- a. Acceptable materials used for HDD Sanitary Sewers are as follows:
 - 1. Polyethylene (HDPE) and fusible PVC butt-welded and fused joints to be in accordance with Section 1016-1.1.2 and 1016-2.2 for gravity and force main applications respectively.
 - 2. Pipe material for HDD operations shall be as shown on the construction drawings.
 - 3. Fusible PVC will be allowed for HDD operations in diameters up to and including 16" if identified on the construction drawings.

818-3.2 Equipment:

- a. Minimum equipment required:
 - 1. Horizontal Directional Drilling Rig – to be specified by the Contractor.
 - 2. Drill pipe and trail stem – to be specified by the Contractor.
 - 3. Drill bits and reamers – Contractor specified – generally based on the soils and drilling conditions to be encountered.
 - 4. Drilling fluid mixing tanks, holding tanks, cleaning systems, recirculation containment, collection and disposal.
 - 5. Freely operating swivels – size and type appropriate for the expected loading.
- b. Pipe pulling operations shall have a dedicated pipe handler during any pipe operations.
- c. Full directional guidance of the pilot hole drilling operation to line and grade is a prerequisite of this method of construction. Wireline or wireline with grid is acceptable.
- d. The Contractor shall be responsible for selection of all drilling and auxiliary equipment which, based on past experience, has proven to be satisfactory for excavation of the soils to be encountered.

- e. Pumps and/or vacuum truck(s) of sufficient size shall be in place to convey excess drilling fluid from containment areas to storage facilities.
- f. Pipe rollers shall be of sufficient size, spacing, and in good working condition (as determined by the pipe manufacturer) 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 sagging of pipe. Pipe roller spacing shall not exceed 20 feet. Pipe shall not come in contact with ground surface during pull back operations.
- g. The Contractor shall provide drilling equipment of the size and power so that the pilot hole can be drilled along the path shown on the plan and profile drawings within specified tolerances.
- h. Deviations between the recorded position of the drill string and the plan and profile drawings shall be documented and immediately brought to the attention of the Engineer.

818-4 EXECUTION:

818-4.1 Construction Operations Criteria:

- a. Use methods for HDD operations that will minimize ground settlement. Select methods, which will control flow of water and prevent loss of soil into the bore and provide stability in all operating conditions. The Contractor shall be responsible for damage due to settlement, and frac-outs due to any construction-induced activities.
- b. Conduct all operations in accordance with applicable safety rules and regulations, OSHA standards and Contractor's safety plan. Use methods, which include due regard for safety of workmen, adjacent structures, utilities, and the public.
- c. The pipe shall be handled in accordance with manufacturer's instructions. Any cracks, gouges, scratches, distorted lengths, or other damage shall be repaired per the manufacturer's instructions.
- d. Contractor shall utilize a trailing stem (a drill rod on the trailing end of the reaming operation) during backreaming of the bore hole.
- e. Maintain clean working conditions.
- f. If crossing under railroad embankments, highways, or streets, perform the installation to avoid interference with the operation of the railroads, highways, or streets, except as approved by the owner of the facility.
- g. Utility Crossings:
 1. The Contractor shall field verify the location and depth of all existing utilities, including service connections, to be paralleled or crossed prior to the start of directional drilling operations in accordance with Louisiana law. The Contractor, with approval of the Engineer, shall modify alignment, depth or grade as necessary to avoid utilities and minimize the number of peaks and valleys along the alignment.
 2. The Contractor shall expose all utilities that they will be crossing with horizontal directional drilling. All major utilities (high pressure gas, fiber optic, high voltage

electric, major pipe lines, water and sewer lines, etc.) should be exposed every 100 feet at minimum, if parallel within 5 feet horizontally to verify depth and location of the utility. If the location is not accurate, the utility owner shall be contacted immediately.

- h. Exit and entry angles shall be between 8 and 12 degrees. Once the Contractor has begun the HDD pipe installation process, operate without intermission, including 24-hour working, weekends and holidays, until pipe segment is completed. Pipe pulling shall immediately follow bore hole drilling, reaming, and swabbing. Pipe pulling through collapsing bore hole is prohibited.
- i. The installed pipe shall be allowed to relax and cool following installation, for a minimum twelve (12) hours, prior to any reconnection of service lines or backfilling of the insertion pit.
 - 1. If HDPE pipe is used, sufficient excess length of new pipe, not less than six (6) inches, shall be allowed to protrude into the manhole to provide for further length reduction with the use of electrofusion flex restraints.
- j. The replacement pipe in the manhole shall be sealed and restrained before proceeding on to the next manhole section. All manholes shall be individually inspected for replacement pipe cut-offs, benches, sealing, restraints, and dye tested.
- k. Following the relaxation period, a tight fitting seal with the existing or new manhole shall be installed with a flexible rubber connector as specified in Section 802-6, non-shrink grout and electrofusion flex restraints (in the case of HDPE pipe) and then dye tested.

818-4.2 Ground Water Control:

- a. Provide ground water control measures in conformance with Section 801, when necessary to perform the work.

818-4.3 Directional Drilling Data:

- a. Maintain shift logs of construction events and observation. The HDD supervisory personnel (superintendent) shall be on-site at all times any drilling operations are being conducted. The operator shall clearly print and sign their name. The Engineer shall have access to the Contractor's daily logs with regard to the following information:
 - 1. Location of drill head and progress of drilling operation during shift.
 - 2. Hours worked per shift during drilling operations.
 - 3. List of Crew Names, including full and last names, title, and hours worked for each day.
 - 4. Completed forms or computer print outs for checking line and grade of the drilling operation, showing achieved tolerance relative to design alignment.
 - 5. Maximum pipe loads per pull back including but not limited to torque and fluid pressures.

818-4.4 Control of Line and Grade:

- a. Construction Control: Contractor shall check baselines and benchmarks shown on the Contract Documents at the beginning of the Work and report any errors or discrepancies to the Engineer. The Contractor shall use the baselines and benchmarks to establish and maintain construction control points, reference lines and grades for locating, boring, reaming, and in relationship to existing pipelines, utilities and structures. Establish construction control points sufficiently far from the work to avoid being affected by any ground movements caused by HDD operations.
- b. Temporary Bench Mark Movement: The Contractor shall ensure that if settlement of the ground surface occurs during construction which affects the accuracy of the temporary benchmarks, the Contractor shall detect and report to the Engineer such movement and reestablish temporary bench marks.
- c. Line and Grade:
 1. Check and record the survey control for the boring operations against an aboveground undisturbed reference as required to accurately guide and monitor the constructed length (± 20 feet).
 2. At a minimum of every drill rod connection or a maximum of every 5 feet, record the position of the drill bit, then make immediate corrections to alignment position before allowable tolerances are exceeded.
 3. When drill is off line or grade make, ongoing alignment corrections to avoid major changes and keep within specified tolerances. For gravity pipe installations, a belly in the bore that will hold water and/or a reverse grade is not acceptable and shall be replaced at no additional cost to the Owner. Replacement shall include removal and replacement of the bellied pipe length by open cut or by re-drilling on a parallel alignment as directed by Engineer.
 4. Vertical Tolerance:
 - i. Gravity sewer pipe (in the plan direction of flow) shall be a maximum deviation of 6 inches in downward vertical alignment for any 100-foot section from plan grade but no more than 12 inches (1 foot) down in a 500-foot section. Deviation of grade (in the plan direction of flow) in the upward direction is allowed only for corrective means; however, a minimum absolute grade of 0.15% in the downward direction must be maintained.
 - ii. A variation greater than plus (+) 0.0 feet or minus (-) 5 feet from vertical alignment designated on the Contract Documents may be allowed at the discretion of the Engineer and must be approved prior to installation.
 5. Horizontal Tolerance:
 - i. Gravity sewer pipe deviations in horizontal line shall be a maximum of ± 12 inches in any 100-foot section but no more that ± 24 inches in 500 linear feet. Horizontal offsets from plan line must be corrected at manholes.

- ii. A variation greater than ± 2 feet from horizontal alignment designated on the Contract Documents may be allowed at the discretion of the Engineer and must be approved prior to installation.
6. Outside edge of pipe must not deviate into a 2-foot space inside either edge of the servitude or right-of-way nor should it conflict with any above or below ground obstructions.
7. New pipe installed outside tolerances shall be fully grouted and abandoned or removed and all voids filled as directed by the Engineer at no additional cost to the Owner.

818-4.5 Monitoring:

a. Monitoring Line & Grade:

1. Monitoring of bore, reamer and pipe may be accomplished by manually plotting reference points based on location and depth readings provided by the locating/tracking system. Alternately, computer generated bore logs which automatically map the bore path based on information provided by the locating/tracking system may be used. This information shall be readily available upon request of the Engineer.
2. Before any direction drilling commences, the locating/tracking equipment shall be calibrated.
3. Readings or plot points shall be recorded on every drill rod. Required readings shall be taken every 3 to 5 feet.
4. Refer to Section 818-2.3b for required intermediate pilot hole profile submittal.

b. Instrumentation Monitoring:

1. Install and maintain an instrumentation system to monitor and detect movement of the ground surface and adjacent structures. Establish reference vertical control points in safe locations at a distance away from the construction areas to avoid potential disturbance due to ground settlement.
2. Installation of the instrumentation shall not preclude the Engineer, through an independent contractor or consultant, from installing instrumentation in, on, near, or adjacent to the construction work. Access shall be provided to the work for such independent installations.
3. Instruments shall be installed in accordance with the Contract Documents and the manufacturer's recommendations.

c. The Owner recognizes walkover, wire line, and wire line with surface grid verification, or any other system as approved by the Engineer, as the accepted methods of tracking directional bores. Specific Instrumentation requirements are shown on the Contract Documents. Instrumentation specified shall be accessible at all times to the Engineer. Readings shall be submitted promptly to the Engineer as they are recorded.

d. In any case the Contractor must use a locating and tracking system capable of ensuring that the proposed pipe is monitored and installed as intended.

Consequently, if an area of radio signal interference is expected the Engineer may specify the use of a suitable tracking system. The locating and tracking system must provide information on.

1. Clock and pitch information
 2. Transmitter temperature
 3. Battery status
 4. Position (x,y,z)
 5. Azimuth, where direct overhead readings (walkover) are not possible (i.e. sub aqueous or limited access transportation facility)
 6. Ensure proper calibration of all equipment before commencing directional drilling operation. Calibration shall be witnessed by the Engineer.
 7. Recording: Take and record alignment readings or plot points so that elevations on top of and offset dimensions from the center of the pipe to a permanent fixed feature are provided. Each permanent fixed feature must have prior approval of the Engineer. Provide elevations and dimensions at all bore alignment corrections (vertical and horizontal) with a minimum distance between points of 100 feet. Provide a sufficient number of elevations and offset distances to accurately plot the vertical and horizontal alignment of the installed product. A minimum of three elevation and plot points are required.
- e. Tracing: Install all facilities so their location can be readily determined by electronic designation after installation. For non-conductive installations attach a minimum of two separate and continuous conductive tracking (tone wire) materials, externally or integral with the pipe. Use a continuous green sheathed solid conductor copper wire line (minimum #12 AWG) or a coated conductive tape. Conductors must be located on opposite sides when installed. Connect any break in the conductor line before construction with an electrical clamp, or solder, and coat the connection with a rubber or plastic insulator to maintain the integrity of the connection from corrosion. Clamp connections must be made of brass or copper and of the butt end type with wires secured by compression. Soldered connections must be made by tight spiral winding of each wire around the other with a finished length minimum of 3 inches overlap. Tracking conductors must extend 2 feet beyond bore termini. Test conductors for continuity. Each conductor that passes must be identified as such by removing the last 6 inches of the sheath. No deductions are allowed for failed tracking conductors. Failed conductor ends must be wound into a small coil and left attached for future use.
- f. Surface Settlement Monitoring:
1. Establish monitoring points on all critical structures.
 2. Record location of settlement monitoring points with respect to construction baselines and elevations. Record elevations to an accuracy of 0.01 feet for each monitoring point location. Monitoring points should be established at locations and by methods that protect them from damage by construction operations, tampering, or other external influences.

3. Ground surface elevations shall be recorded on the centerline ahead of the construction operations at a minimum of 100-foot intervals or at least three locations per installed section of pipe. For sewers greater than 60-inch diameter, also record similar data at approximately 20 feet each side of the centerline. Settlement monitoring points must be clearly marked by studs or paint for ease of locating.
 4. Railroads. Monitor ground settlement of track subbase at centerline of each track.
 5. Utilities and Pipelines. Monitor ground settlement directly above and 10 feet before and after a utility or pipeline intersection.
- g. Reading Frequency and Reporting. The Contractor shall submit to the Engineer, records or readings from the various instruments and survey points.
1. Instrumentation monitoring results to be read at the frequency specified and unless otherwise specified, shall be started prior to the zone of active excavation reaching that point, and shall be continued until the zone of active excavation has passed and until no further detectable movement occurs.
 2. Surface settlement monitoring readings shall be taken:
 - i. Prior to the zone of active excavation reaching that point,
 - ii. When the installation operation reaches the monitoring point (in plan), and
 - iii. When the zone of active excavation has passed and no further movement is detected.
- h. All monitoring readings shall be submitted promptly to the Engineer.
- i. Immediately report to the Engineer any movement, cracking, or settlement which is detected.
- j. Following substantial completion but prior to final completion, make a final survey of all monitoring points

818-4.6 Pipe Bore Hole Diameter: Minimize potential damage from soil displacement/settlement by limiting the ratio of the bore hole to the product size. The size of the back reamer bit or pilot bit for gravity sewer installations, if no back reaming is required, will be limited relative to the pipe diameter to be installed as follows:

Maximum Pilot or Back-Reamer Bit Nominal Inside Pipe Diameter Inches	Diameter When Rotated 360 Bit Diameter inches
2	4
3	6
4	8
6	10
8	12
10	14
12 and greater	Maximum Product OD plus 6

The size of the back reamer bit or pilot bit for sewer force main pipe installations over 24" shall be a maximum of 1.25 times the pipe outside diameter to be installed.

818-4.7 Drilling Fluids: Use a mixture of bentonite clay, lubricants, polymers, and viscosifiers mixed with potable water with a minimum pH of 6.0 to create the drilling fluid for lubrication and soil stabilization. Drilling fluid mix design shall be in accordance with component manufacturer instructions and shall be based on the soil conditions. Vary the fluid viscosity to best fit the soil conditions encountered. Do not use any other chemicals or polymer surfactants in the drilling fluid without written consent from the Engineer. Certify to the Engineer in writing by submittal (Section 818-2.3) that any chemicals to be added are environmentally safe and not harmful or corrosive to the facility. Identify the source of water for mixing the drilling fluid. Approvals and permits are required for obtaining water from such sources as streams, rivers, ponds, or fire hydrants. Any water source used other than potable water must be pH tested, hardness tested, chlorine tested, and approved by the Engineer prior to use.

Contractor shall promptly remove from the project site and properly dispose of all drilling fluids and associated cuttings in compliance with all environmental regulations, construction right-of-way and workspace agreements and permit requirements at an appropriate disposal site. Disposal, including hauling, of all drilling fluids and associated cuttings shall be at no additional cost to the Owner.

In the event that a drilling fluid fracture (frac out), inadvertent returns or returns loss occurs during HDD operations, Contractor shall cease operations; notify Engineer and all appropriate regulatory agencies. Contractor shall immediately contain and clean-up drilling fluid loss prior to continuing HDD operations. Contractor shall prevent drilling fluids from entering streets, adjacent properties, streams or other water bodies and municipal storm or sanitary sewer lines. No additional payment shall be made for cleanup costs required by Owner, Engineer, or regulatory agencies due to loss of drilling fluid. If mud fracture or returns loss continues, Contractor will cease operations, notify Engineer to discuss additional options to control or minimize the loss and work will then proceed accordingly.

818-4.8 Disposal of Excess Material: Remove spoil in accordance with Section 801.

818-5 ACCEPTANCE TESTING:

- a. Acceptance testing and inspection is to be carried out by methods described in Section 802 for gravity sewer installations and Section 804 for sewer force main pipe installations.
- b. Post CCTV: A post CCTV inspection of completed pipe lines shall be performed for gravity sewer installations in accordance with Section 815.

818-6 SITE RESTORATION: All surfaces affected by the Work shall be restored to their preconstruction conditions. Performance criteria for restoration work will be similar to those employed in traditional open excavation work.

818-7 POST-CONSTRUCTION EVALUATION:

- a. The Contractor shall provide a set of Field Record Drawings including both alignment and profile to the Engineer. Drawings should be developed from actual field readings. Raw data should be available for submission at any time upon request. As part of the Field Record Drawing, the Contractor shall specify the tracking equipment used, including method of confirmatory procedure used to ensure the data was captured. Field Record Drawings having survey data shall be stamped by a Professional Land Surveyor registered in the State of Louisiana.

- b. All fittings, valves, manholes, connections, etc., including all critical structure monitoring points as shown on the Contract Documents, shall be located by GPS and based on the Louisiana State Plane coordinate system as shown on Contract Documents and shall be provided on the Field Record Drawings. No landmarks shall be used. The record drawings shall be stamped by a registered land surveyor.

818-8 MEASUREMENT: The unit measurement for new gravity sewer pipe installed by HDD shall be in linear feet by the size specified from manhole to manhole measured to the nearest whole foot. The unit measurement for new sewer force main pipe installed by HDD shall be in linear feet by the size specified for the limits shown on the drawings measured to the nearest whole foot.

818-9 PAYMENT: Horizontal Directional Drilling shall include but not limited to all labor, materials, equipment, pipe, flex restraints, monitoring, pits, surface restoration, drilling fluids and disposal thereof, testing, record drawings, and surveying information required in this specification. Any other miscellaneous work not specifically included for payment under any other Items in the Bid Form but obviously necessary to complete the Contract and fulfill all requirements of these Specifications and Contract Documents shall be included.

818-10 PAY ITEM:

Pipe Inner Diameter (I.D.) Schedule
(as Shown on Drawings)

A = 4" Pipe	N = 27" Pipe
B = 6" Pipe	O = 30" Pipe
C = 8" Pipe	P = 32" Pipe
D = 10" Pipe	Q = 36" Pipe
E = 12" Pipe	R = 42" Pipe
F = 14" Pipe	S = 48" Pipe
G = 15" Pipe	T = 54" Pipe
H = 16" Pipe	U = 60" Pipe
I = 18" Pipe	V = 64" Pipe
J = 20" Pipe	W = 66" Pipe
K = 21" Pipe	X = 72" Pipe
L = 24" Pipe	Y = 76" Pipe
M = 26" Pipe	Z = 80" Pipe

<u>Item No.</u>	<u>Item</u>	<u>Unit</u>
818100_	Horizontal Directional Drilling (diameter)	Linear Foot
818200_	Horizontal Directional Drilling Sewer Force Main (diameter)	Linear Foot