

SECTION 33 05 07.13

UTILITY HORIZONTAL DIRECTIONAL DRILLING (HDD)

PART 1 GENERAL

1.1 SCOPE

A. Scope:

1. Design, furnish and install the proposed piping alignment by horizontal directional drilling (HDD) construction methods, as shown on the drawings and in conformance with this specification. The work includes, but is not limited to, survey, design, excavation, dewatering, removal of all materials encountered in the horizontal directional drilling operations, disposal of all material not required in the work, testing, cleaning, restoration, and incidentals as shown on the drawings and as specified herein.
2. The HDD method shall consist of directing a string of small pipe, known as a drill string, along a pre-determined profile to drill a pilot hole, enlarge the pilot hole, and pull the pipe into place. In general, the process uses a machine to rotate, advance and retract the drill string; a cutterhead for drilling the pilot hole; a backreamer to enlarge the pilot hole to the required diameter; a pulling head and bearing swivel to pull the pipe into place; a drill string head locating and guidance system; and drilling fluid to provide lubrication, remove the cuttings and spoil and maintain the integrity of the hole. The operations are to be completed while simultaneously providing ground stabilization techniques. The method shall include provisions for preventing uncontrolled inflow of loose or saturated soils.
3. Contractor is responsible for completing any additional geotechnical/subsurface investigations required to identify and confirm the location of existing utilities along the proposed HDD alignment, and establish the appropriate parameters (i.e., limiting pressures, setback distances, depth of cover, etc.) for completing the design of the alignment, prior to the start of construction. Previously completed geotechnical/subsurface investigation reports are available as noted in the Contract Documents.
4. Owner is responsible for obtaining the required general construction permits, easements and approvals, from the NCDOT, State, and/or railroad agency. Permit documents are available as noted in the Contract Documents and Contractor shall follow the guidelines as stated within the permits.

B. General:

1. Be responsible for the final design and constructed product, furnishing the design data, obtaining approval from agencies and for the safety of the operations and for personnel engaged in the work.
2. Be responsible for furnishing the qualified labor and superintendence necessary for this method of construction.
3. Furnish all items necessary to perform the HDD as shown on the drawings.
4. Installation of all jointing and gasketing materials, specials, flexible couplings, mechanical couplings, harnessed and flanged adapters, sleeves, tie rods, and all other Work required to complete the HDD installations.

5. Any modifications, damages or detrimental consequences to the existing ground conditions, structures, facilities or utilities as a result of the Contractor's Work, shall be repaired and restored to its original condition as directed by the Engineer at no additional cost to the owner.

C. Coordination:

1. Review installation procedures under other Sections and other contracts and coordinate with the Work that is related to this Section.
2. Be responsible for coordinating construction activities with the respective authorities.

D. Related Sections:

1. Section 32 92 01 – Seeding and Sodding.
2. Section 31 23 34 – Excavation, Trenching, Dewatering, and Backfilling.
3. Cape Fear Materials Specification Manual for the following materials:
 - a. HDPE
 - b. Fusible PVC

1.2 REFERENCES

A. Standards referenced in this Section are:

1. NUCA, HDD Installation Guidelines.
2. American Railway Engineering Association: Specifications, Part 5; Pipeline – Crossings Under Tracks or Located on Railroad Property – For Flammable and Nonflammable Substances.
3. ASTM F1962: Standard Guide for Use of Maxi-Horizontal Directional Drilling for Placement of Polyethylene Pipe or Conduit Under Obstacles, Including River Crossings

1.3 SUBMITTALS

A. The Contractor must submit a Work Plan to the Engineer at least 20 days prior to start of HDD detailing the procedure and schedule to be used to execute the Project. The Work plan should include:

1. Qualification evidence as noted in Article 1.5A Quality Assurance.
2. HDD Operation Plan which shall include:
 - a. Material and equipment list: Submittal shall include detail information on drill rig, pilot tube, slurry treatment plants, drill path monitoring system, pipes, fittings, and drilling fluids.
 - b. Detailed information on tracking/steering tools and surface monitoring system, including detail plan and procedure on calculating and correcting drill path and azimuth.
 - c. Drilling fluids: Submittal shall include mix designs, QA/QC procedures, and criteria for mud rejection based on anticipated ground behavior and HDD operation requirements. The Contractor shall verify ground conditions prior to planning and designing drill fluids with the information contained in the report.
 - d. Construction schedule.
 - e. Documentation showing proper calibration of all measuring or monitoring devices including, but not limited to, pressure gauges, flow meter, load cells, steering/tracking devices.

- f. Site layout plan for rig side and pipe lay-down area, including list of equipment to be used.
 - g. Shop drawing for the breakaway swivel, including set up detail in accordance to pipe manufacturer's setting for recommended pullback force.
3. Boring Plan which shall include:
- a. Detail description and sequence of the work plan for the entire HOD operation, including entry and exit point site preparation and restoration.
 - b. The anticipated number of reams and detail information of each reamer to be used.
 - c. Detail on drill rig, pilot hole, and steering/tracking system to be used, including rig pulling capacity and torque.
 - d. Drilling rod length in feet.
 - e. The anticipated drill rate for pilot tube boring, reaming, and pipe pull back, including correction plan for buoyancy.
 - f. Drilling fluid pumping capacity.
 - g. Details of pipe fusion methodology.
 - h. Drill mud mixing and treatment procedure.
 - i. Borehole cuttings handling and disposal procedure.
 - j. Plans for protection of existing utilities or facilities.
 - k. Pipe assembly procedure on pipe lay-down area, including pipe support method and design to optimize pipe pull-back operation and prevent excessive sagging of pipes.
 - l. Calculation showing the maximum anticipated pullback load and stress on pipe during pull-back. The calculation shall be prepared and certified by a registered Professional Engineer in the State of North Carolina.
 - m. Calculation of anticipated maximum and optimum drill mud pressure during the entire HDD operation. The calculation shall be prepared and certified by a registered Professional Engineer in the State of North Carolina.
 - n. Contingency plan for mud frac-out, excessive settlement or heaving, major equipment failure, any other unanticipated advertent situations, and situations from unexpected ground conditions e.g. boulders or artesian condition.
 - o. Daily report providing the details of monitoring to include, but not limited to the following:
 - 1) Pilot hole data showing pilot hole and its deviation from the original path.
 - 2) Steering data showing progress made every day.
 - 3) A summary report or graphic showing desired and true alignments.
 - p. Daily progress report, including advance rate, quantity of material used, observed pull-back load, and drilling fluid pressure.
 - q. Plan for containment of residuals and water for installation of sewer force mains.
 - r. Procedures including, but not limited to, monitoring for gases encountered shall be submitted.
 - s. Hazardous chemical list as well as all MSDS and technical data sheets.
- B. Contractor must demonstrate expertise in "trenchless" methods by providing a list of five (5) utility references for which similar work has been performed in the last two years. The references should include a name and telephone number where contact can be made to verify the Contractor's capability. The Contractor must provide documentation showing successful completion of the projects used for reference. Conventional trenching experience will NOT be considered applicable.

- C. Have completed HDD pipe installations of same size diameter or larger and have successfully completed lengths as shown on drawings or longer, crossings of railroads, major state roads, or bodies of water. Provide documentation in qualification submittal.
- D. Contractor is required to bring to the attention of the Engineer any known discrepancies with actual HDD methods that the Contractor will be performing. This shall be stated, in writing, to Engineer no later than the pre-construction meeting.
- E. Submit daily reports to the Engineer, following completion of the pilot bore hole, separately for each HDD operation. At minimum, the report shall include the following:
 - 1. Project information
 - 2. Name of data collector
 - 3. Site photos during operation
 - 4. Steering and tracking data log
 - 5. Deviations between the desired and the true alignments
- F. Submit a separate Bore Path Report to the Engineer within seven days upon completion of each HDD operation. At a minimum, the report shall include the operation. At minimum, the report shall include the following:
 - 1. Project information
 - 2. Name of data collector
 - 3. Site photos during operation
 - 4. Date wise steering and tracking data log, including summary of desired and true alignments. Include horizontal and vertical alignments. Collected data points shall be provided in MS Excel format.
 - 5. Record drawings of the installed pipeline, including plan and profile of theoretical alignment
 - 6. Observed pullback force (pound-force) vs. pipeline in borehole (feet), data recorded at 5-ft intervals.

1.4 DESCRIPTIONS AND INCIDENT REPORTS FOR DISRUPTION OR UNEXPECTED STOPPAGE, IF ANY.

- A. QUALITY ASSURANCE
 - 1. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
 - 2. American Railway Engineering Association: Specifications, Part 5; Pipeline – Crossings Under Tracks or Located on Railroad Property – For Flammable and Nonflammable Substances.
 - 3. ASTM F1962.
 - 4. NUCA, HDD Installation Guidelines.
- B. All pipes and fittings shall be designed and provided by a single manufacturer to maximize reliability and compatibility. The drilling supervisor must be adequately trained to operate the specific equipment to be used on the project and will have at least ten years of experience in HDD operations. The supervisor shall remain on the project site during the entirety of the HDD program. Contractor shall submit the names and resumes of all supervisory field personnel to the Engineer for review and approval prior to the start of construction.

- C. Pipe fusion shall be performed by qualified and trained personnel or agency that is certified by the pipe manufacturer. Qualifications of the HDD pipe fuser shall be submitted and subject to review and approval by the Engineer.
- D. The qualifications of the drilling fluid specialist and drill path tracking specialist shall be submitted to the Engineer for review and approval. Work being performed within the North Carolina Department of Transportation's (NCDOT) right-of-way shall be done in accordance with the latest NCDOT Standard Specifications and Drawings.
- E. Work being performed at river crossings shall be done in accordance with USACE/NCDEQ regulations.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to the site to ensure uninterrupted progress of the Work.
- B. Handle all pipe, fittings, specials and accessories carefully with approved handling devices. Handling devices shall include ropes, fabric, or rubber-protected slings and straps. Chains, cables, or hooks inserted into the pipe ends shall not be used. Two slings spread apart shall be used for lifting each length of pipe. Do not drop or roll material off trucks.
- C. Store pipes and fittings on heavy wood blocking or platforms so they are not in contact with the ground. Pipe supports shall be spaced suitably and of such widths as not to allow deformation of the pipe at the point of contact with the supports.
- D. Stacking of pipe shall be limited to a height that will not cause deformation of the bottom pipes under anticipated temperature conditions.
- E. All ends of stored piping shall be securely capped/plugged to prevent entry of debris.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Materials Specification Manual
 - 1. Refer to the CFPUA Materials Specification Manual for the following materials:

A	High-Density Polyethylene Pipe (HDPE).
A	PVC Pipe Fusible C-900 - Potable Water (4" thru 12").
A	PVC Pipe Fusible C-900 - Sewer Force Main (4" thru 12").
A	PVC Pipe Fusible C-905 - Potable Water (14" thru 36").
A	PVC Pipe Fusible C-905 - Sewer Force Main (14" thru 36").
L	HDD Tracer Wire

2.2 EQUIPMENT

A. General

1. The directional drilling equipment, as a minimum, shall consist of a directional drilling rig of sufficient capacity to perform the bore(s) and pull-back of the pipe(s), a drilling fluid mixing & delivery system of sufficient capacity to successfully complete the crossing, a guidance system to accurately guide boring operations, and trained and competent personnel to operate the system. 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 this project. All required equipment shall be included in the contingency plan as submitted per these specifications. Incidental materials that may or may not be used to install the product depending on field requirements are not paid for separately and will be included in the cost of the installed product.

B. Drilling Rig

1. The directional drilling machine shall consist of a hydraulically powered system to rotate, push and pull drill pipe while delivering a pressurized fluid mixture to a drill head. The machine shall be anchored to withstand the pulling, pushing and rotating forces required to complete the project.
2. The drilling rig hydraulic system shall be of sufficient pressure and volume to power drilling operations. The hydraulic system shall be free from leaks.
3. The drilling rig shall have a system to monitor pull-back hydraulic pressure during pull-back operations.

C. Drill Head

1. The horizontal directional drilling equipment shall produce a stable fluid lined tunnel with the use of a steerable drill head and any subsequent pre-reaming heads.
2. The system must be able to control the depth and direction of the drilling operation.
3. Drill head shall contain all necessary cutters and fluid jets for the operation, and shall be of the appropriate design for the ground medium being drilled.

D. Drilling Fluid System

1. Drilling Fluid (Drilling Mud)
 - a. Drilling fluid shall be composed of clean water and the appropriate additive(s) for the fluid to be used. Water shall be from a clean source and shall meet the mixing requirements of the mixture manufacturer(s). The water and additives shall be mixed thoroughly to assure the absence of any clumps or clods. No hazardous additives may be used.
 - b. Drilling fluid shall be maintained at a viscosity sufficient to suspend cuttings and maintain the integrity of bore wall(s), while minimizing the likelihood of ground fracture causing frac-out. The Contractor shall be able to modify the mix design for anticipated ground conditions. Only environmentally compatible or bio-degradable mix designs are to be used. No additional chemicals or polymer surfactants shall be allowed to be added to the drilling fluid unless they have been submitted per this specification.
 - c. The density, viscosity, pH value, circulation, volume, and solid content of the fluid are to be tested and considered to assure compatibility between the drilling fluid mixture and native soil after proper identification and characterization.

- d. Drilling fluid shall be disposed of off-site in accordance with local, state and federal requirements and/or permit conditions.
- 2. Mixing System
 - a. A drilling fluid mixing system shall be of sufficient size to mix and deliver drilling fluid for the project.
 - b. The mixing system shall be able to ensure thorough mixing of the drilling fluid. The drilling fluid reservoir tank shall be sized for adequate storage of the fluid.
 - c. The mixing system shall continually agitate the drilling fluid during drilling operations.
- 3. Drilling Fluid Delivery and Recovery System
 - a. The drilling fluid pumping system shall have a minimum capacity to supply drilling fluid in accordance with the drilling equipment pull-back rating at a constant required pressure.
 - b. The delivery system shall have filters or other appropriate in-line equipment to prevent solids from being pumped into the drill pipe.
 - c. Used drilling fluid and drilling fluid spilled during drilling operations shall be contained and properly disposed of. The use of spill containment measures shall be maintained around drill rigs, drilling fluid mixing system, entry and exit pits and drilling fluid recycling system (if used) to prevent spills into the surrounding environment. Pumps, vacuum truck(s), and/or storage of sufficient size shall be in place to contain excess drilling fluid.
 - d. A closed-loop drilling fluid system and a drilling fluid cleaning system should be used to whatever extent practical, depending upon project size and conditions. Under no circumstances shall drilling fluid that has escaped containment be reused in the drilling system.

E. Drilling Control System

- 1. Calibration of the electronic detection and control system shall be verified prior to the start of the bore.
- 2. The drilling head shall be remotely steerable by means of an electronic or magnetic detection system and be able to control depth and direction of the pipe accurate to a window of ± 2 inches. The steering and tracking system must provide the following information, and shall be calibrated before use:
 - a. Roll and pitch angles
 - b. Depth and length
 - c. Transmitter temperature
 - d. Battery status
 - e. Coordinates
 - f. Azimuth
 - g. Correction for azimuth
- 3. Point of rotation of the head shall also be monitored.
- 4. Horizontal and vertical alignment shall be plotted at 10-ft intervals.
- 5. Borehole alignment tolerance:
 - a. Vertical:
 - 1) 2.0 feet in 100 linear feet.
 - 2) No reverse curvature.
 - 3) Total deviation not to exceed 5.0 feet.
 - b. Horizontal:
 - c. 2.0 feet in 200 linear feet.
 - d. No reverse curvature.

- e. Total deviation not to exceed 7.0 feet.
- F. Pipe Pull Heads
 - 1. Pipe pull heads shall be utilized that employ a positive through-bolt design assuring a smooth wall against the pipe cross-section at all times.
 - 2. Pipe pull heads shall be specifically designed for use with the various types of pipe, and shall be as recommended by the pipe supplier.
 - 3. Pipe pull heads shall be equipped with a data logger to record pipe pullback force vs. pipe length during all pipe installations.
- G. Pipe Rollers
 - 1. Pipe rollers, if required, shall be of sufficient size to fully support the weight of the pipe during handling and pullback operations.
 - 2. A sufficient quantity of rollers and spacing, per the pipe supplier's guidelines shall be used to assure adequate support and excessive sagging of the product pipe.
- H. Tracer Wire
 - 1. Two tracer wires shall be installed and taped to the drill host pipe at 10' intervals.

PART 3 EXECUTION

3.1 INSTALLATION

- A. The Contractor shall notify the Engineer at least three (3) working days prior to start of construction. Drilling or installation work shall not begin until the Engineer or Engineer's Representative is present at the job site and agrees that prior preparations for the operation have been made.
- B. Contractor shall:
 - 1. Be responsible for carrying out all HDD work in strict conformance to the requirements specified in the contract drawings, specifications, and permits from all applicable agencies. This includes being in compliance with the lawful requirements and permits of the NCDOT, Cape Fear Public Utility Authority, public agencies, and owners of public utilities or other facilities respecting the safeguarding of structures, air, ground, water, and other improvements that might be endangered by the HDD.
 - 2. All personnel shall be fully trained in safety according to OSHA 1926 and equipped in their respective responsibilities.
 - 3. Perform the HDD simultaneously and continuously until the pipe is in final position.
 - 4. Be responsible for means and methods of HDD, and shall ensure the safety of the Work, the Contractor's employees, the public, and adjacent property, whether public or private.
 - 5. Maintain traffic flow at all times during the progress of the Work. Provide adequate signs, barricades, flag persons, lights and other control devices in accordance with the provisions and requirements of the NCDOT standards. No lanes of traffic shall be closed without prior approval.
 - 6. Provide erosion and sediment control to minimize erosion and the transport of sediment beyond the limits of the work area.

7. Anticipate that portions of the HDD will be below the groundwater table and dewatering will be required.
8. Verify site conditions and access prior to any preparation or mobilization work to ensure on-time and prior delivery of pipes, material and equipment. Work performed for such purposes shall be incidental to the Work.
9. Request instructions from Engineer in writing, before proceeding, if there is a conflict between manufacturer's recommendations and the Drawings or Specifications.
10. Be responsible for all testing, survey, and documentation of the pre/post construction site conditions, to provide as a basis of comparison for the post construction conditions to be evaluated.
11. Carry out excavation for entry, exist, recovery pits, slurry sump pits, or any other excavation as specified in the Contract documents. Drill mud shall be contained in the sump pit and hauled offsite.
12. Provide all necessary adapters, specials and connection pieces required when connecting different types and sizes of pipe or connecting pipe made by different manufacturers.

C. HDD Operations:

1. Pilot Hole Bore:
 - a. Pilot hole shall be drilled along bore path. In the event that the pilot bore does deviate from the bore path, it may require Contractor to pull-back and re-drill from the location along bore path before the deviation.
 - 1) For mains, pilot hole shall have a tolerance of +2 feet horizontal and vertical along bore path, but in no case, shall depth of bury be less than the minimum specified.
 - 2) Determine and document cutterhead location every 25 feet.
 - b. The Contractor shall limit curvature in any direction to reduce force on the pipe during pull-back. The minimum radius of curvature shall be no less than that specified by the pipe supplier and as indicated on the drawings.
2. Reaming:
 - a. After successfully completing the pilot hole, the bore hole shall be reamed to a diameter which meets the requirements of the pipe being installed.
 - b. Perform pre-reaming operations as necessary for proper pipe installation.
 - c. In the event of a drilling fluid fracture, returns loss or other loss of drilling fluid, the Contractor shall be responsible for restoring any damaged property to original condition and cleaning up the area in the vicinity of the damage or loss.
3. Pipe Pull-Back and Insertion:
 - a. Pipe shall be fused prior to insertion, if the site and conditions allow, into one continuous length.
 - b. Contractor shall handle the pipe in a manner that will not over-stress the pipe prior to insertion. Vertical and horizontal curves shall be limited so that the pipe does not bend past the pipe supplier's minimum allowable bend radius, buckle, or otherwise become damaged. Damaged portions of the pipe shall be removed and replaced.
 - c. The pipe entry area shall be graded as needed to provide support for the pipe and to allow free movement into the bore hole.
 - 1) The pipe shall be guided into the bore hole to avoid deformation of, or damage to, the pipe.

- 2) The pipe may be continuously or partially supported on rollers or other Owner and Engineer approved friction decreasing implement during joining and insertion, as long as the pipe is not over-stressed or critically abraded prior to, or during installation.
- 3) A swivel shall be used between the reaming head and the pipe to minimize torsional stress on the pipe assembly.
- d. Contractor to monitor and control the pressure/force applied to ensure that pipe manufacturer's recommended limits are not exceeded.
- e. Once pull-back operations have commenced, the operation shall continue without interruption until the pipe is completely pulled through the bore hole.
- f. Removal of soil cuttings and pull back shall be closely monitored to minimize frac-out and ground surface movement. Any damages caused by the Contractor's operations shall be corrected by the Contractor.
- 4. Slurry Removal and Disposal:
 - a. Handling and disposal of soil cuttings shall be in accordance with regulations of the state and local government agencies, permit requirements, and Contractor's approved plan.
 - b. Contain excess drilling fluids at entry and exit points until recycled or removed from site. Provide recovery system to remove drilling spoils from access pits.
 - 1) Remove, transport and legally dispose of drilling spoils off site.
 - a) Do not discharge drilling spoils in sanitary sewers, storm sewers, or other drainage systems.
 - b) When drilling in suspected contaminated soil, test drilling fluid for contamination before disposal.
 - 2) When drilling fluid leaks to surface, immediately contain leak and barricade area from vehicular and pedestrian travel before resuming drilling operations.
 - 3) Complete cleanup of drilling fluid at end of each work day.

3.2 FIELD QUALITY CONTROL

- A. Furnish, operate and maintain instrumentation that will accurately locate the pilot hole, measure drilling fluid flow discharge rate and pressure, and measure stresses on pipe during installation.
- B. Engineer shall have access to instruments, gages, and readings at all times.
- C. Maintain drilling logs including dates, times and locations, soil condition, drilling data such as depth, angle and rate of penetration, and utility crossings.
- D. Monitor and record use of drilling fluid.
- E. Monitor and record stresses imposed on pipe during pulling.

3.3 TESTING OF PIPING

- A. General:
 - 1. Refer to Section 33 05 05.31 – Hydrostatic Testing of Water Distribution and Sanitary Sewer Force Mains, for hydrostatic/pressure testing specifications.

Prior to pullback, perform an allowable leakage test on the full length of pipe after all sections have been welded or fused.

3.4 CLEANING AND DISINFECTION

A. General:

1. Refer to Section 33 14 20 – Disinfection of Water Distribution Mains, for pipe cleaning, flushing, and disinfecting specifications.

3.5 SITE RESTORATION

- A. Any damage or detrimental consequences resulting from ground heaving, subsidence, frac-out, structural or support failure, or excessive loss of water in relation to HDD or other works by the Contractor shall be repaired at no additional cost to the Owner.
- B. Plan for restoration and repair shall be in accordance with the approved submittal. Remediation plan and documentation of the repair and restoration works process shall be completed and submitted for record to the Engineer.
- C. Following drilling operations, Contractor will demobilize equipment and restore the work-site to its pre-construction condition. Any noticeable surface defects due to the drilling operation shall be repaired by Contractor.

3.6 WORK REJECTION

A. The following comprise conditions under which work shall be rejected:

1. When there is any indication that the installed product has sustained damage, stop all work and notify the Engineer immediately. As part of the investigative measure to determine extent of the damage, the pressure and I or mandrel test shall be carried out as directed by the Engineer at no additional cost to the Owner. Perform all testing within 24 hours unless otherwise directed by the Engineer. Furnish a copy of all test results and bore logs to the Engineer for review and determination of conformance of installed product to specifications and performance requirements.
2. If an obstruction is encountered during boring, reaming or pullback, which prevents forward progress of the installation.
3. If the pipe shall fail hydraulic pressure test according to Section 33 05 05.31 – Hydrostatic Testing of Water Distribution and Sanitary Force Mains.
4. Any other defect in material or workmanship which would affect the performance or design life of the installed pipeline.

3.7 RECORD KEEPING

- A. Contractor shall maintain a daily project log of drilling operations and a guidance system log with a copy given to Engineer at completion of boring. Record drawings shall be certified as to accuracy by Contractor as required in Section 01 78 39 – Project Design Drawings Requirements.

END OF SECTION