SECTION 02160 – HORIZONTAL DIRECTIONAL DRILLING

PART 1 – GENERAL

1.01 DESCRIPTION

A. Work described in this Section includes the furnishing of all labor, materials, equipment, procedures and supplies necessary for installation of below grade sewage force main under existing Right of Ways by the approved construction methods, procedures and materials for Horizontal Directional Drilling (HDD) to the approval of the New York State Department of Transportation (NYSDOT), Suffolk County Department of Public Works (SCDPW), Suffolk County Department of Health Services (SCDHS), Town of Islip, the Owner and Engineer.

1.02 GENERAL

A. HDD is a trench-less method for installing a casing and/or carrier pipe without excavation of soil or disturbance of surface conditions. It is a multi-stage process consisting of site preparation and restoration, equipment setup, and drilling a pilot bore along a predetermined path and then pulling the sleeve and/or the carrier pipe (s) back through the drilled space. When necessary, enlargement of the pilot bore hole may be necessary to accommodate the casing or carrier pipe (s) larger than the pilot bore hole size. This process is referred to as back reaming and is done at the same time the casing and/or carrier pipe is being pulled back through the pilot bore hole.

B. Accomplish alignment of the bore by proper orientation of the drill bit head as it is being advanced into the ground. Determine orientation and tracking of the drill bit by an above ground radio detection device which will pick up a radio signal generated from a transmitter located within the drill bit head. Electronically translate the radio signal into depth and alignment. Introduce a soil stabilizing agent or drilling mud into the annular bore space from the trailing end of the drill bit to minimize friction and prevent collapse of the bore hole so that the rotation of the bit in the soil wetted by the drilling fluid creates a slurry to act as a stabilizer for the surrounding soil and prevent collapse of the bore hole as well as providing lubrication.
C. Select or design drilling mud for the site specific soil and groundwater conditions. Confine free flowing slurry or drilling mud at the ground surface during pull back or drilling, by creating sump areas or vacuum operations to prevent damage or hazardous conditions in surround areas. Remove all residual slurry from the surface and restore the site to preconstruction conditions.

PART 2 – PRODUCTS

2.01 GENERAL

A. Materials are defined as casing pipe that becomes the installed casing into which a carrier pipe is subsequently installed. The use of casing pipes will only be necessary if required by the road authority. Unless otherwise required casing pipes will not be required for this project.

B. Incidental materials that may or may not be used to install the casing pipe will depend on field requirements and if required will be paid for separately and are not to be included in the cost of the installation of the required 6” diameter sewage force main carrier pipe.

2.02 MATERIALS

A. The following material standards are to be interpreted as the minimum “in place” standards. Use materials that are appropriate for the stresses generated by the selected equipment and field conditions. It is not intended to portray that the use of materials with these minimum material standards will retain their required properties if the stress limits for which they were designed are exceeded during installation. Ensure that the appropriate material is used to retain compliance once it is installed.

Material Standards for HDD Casing and Carrier Pipe Installation

<table>
<thead>
<tr>
<th>Material Type</th>
<th>Non-Pressure</th>
<th>Pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polyethylene (PE)</td>
<td>ASTM D 2447</td>
<td>ASTM 2513</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ASTM D 2447</td>
</tr>
<tr>
<td>High Density Polyethylene (HDPE)</td>
<td>ASTM D 3350</td>
<td>ASTM D 3350</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ASTM F 714</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ASTM F 714</td>
</tr>
</tbody>
</table>
PART 3 – EXECUTION

3.01 SITE REQUIREMENTS

A. Legal Provisions: The Contractor shall comply with the following site condition provisions:

1. Request utility companies to mark our existing underground utilities at least one (1) week prior to commencement of construction.

2. Americans with Disabilities Act (ADA) when and where installations are temporarily allowed to be exposed through roadways or sidewalk areas provide temporary trench crossing bridges that meets the approving entities requirements.

B. Site Conditions:

1. Carry out excavation for entry, exit, recovery pits, slurry sump pits, or any other excavation. Sump pits are required to contain drilling fluids if vacuum devices are not operated throughout the drilling operation.

2. Within 48 hours of completing installation of the casing and/or carrier pipe(s), clean the work site of all excess slurry or spoils. Take responsibility for the removal and final lawful disposition of excess slurry or spoils. Ensure that the work site is restored to pre-construction conditions.

3. All pits, trenches and other excavations shall be covered at the end of each work day with a minimum of 1” thick steel plates, securely anchored to existing pavements with railroad spikes or other approvable anchors.
C. **Damage Restoration**

1. Contractor shall be responsible for the cost of restoration for any damage caused by heaving, settlement, separation of pavement, escaping drilling fluid, etc.

D. **Remediation Plans:**

1. When required by any of the approving entities, provide detailed plans which show how damage to any roadway will be remediated. These details will become part of the As-Built Plans Package. Remediation Plans must follow the same guidelines for development and presentation of the As-Built Plans. When remediation plans are required, they must be approved by the Engineer, the SCDPW and the NYSDOT before any work proceeds.

3.02 **QUALITY CONTROL**

A. **General:**

1. Contractor shall be responsible for the control of the operation at all times. Contractor shall have a representative who is thoroughly knowledgeable of the equipment, boring and SCDPW, SCDHS and the NYSDOT procedures, requirements and permit conditions. The representative shall be present at the job site during the entire installation and available to address immediate concerns and emergency operations. Notify the Engineer 48 hours in advance of starting work. Do not begin installation until the Engineer and the inspectors of the Town, County and State are present at the job site and agrees that proper preparations have been made.

2. **Casing and Carrier Pipe Testing:**

When there is any indication that the installed casing and or carrier pipes have sustained damage and may leak, stop all work, notify the Engineer and investigate the damage. Pressure tests shall be conducted on both the casing and carrier pipes in the presence of the SCDPW, SCDHS, the NYSDOT, Town Engineer, and Owner’s Engineer. Perform pressure tests within 24 hours after completion of the installations unless otherwise approved by the Engineer.
Furnish a copy of test results to SC DPW, SC DHS, NYSDOT, Town Engineer and the Owner’s Engineer for approval. The Engineer will notify the contractor within 72 hours if the installations are not in compliance with the specifications. The Engineer will require non-compliant installations to be filled with excavatable flowable fill and the installation abandoned and reconstructed at the cost of the contractor.

3. Testing Methods:

Testing may consist of one of the following methods and must always meet or exceed the NYSDOT, SC DPW, SC DHS and Engineer’s testing requirements:

a. Follow the SC DPW and SC DHS pressure testing requirements.

b. Ensure that the carrier pipe or pipes installed within the casing pipe meet the pressure and leakage requirements set by the SC DPW, SC DHS and Engineer’s specifications.

c. Water tight casing and carrier pipes and joint configuration will be required. When casing pipes are required, and unless otherwise specified on the construction plans, conduct casing pipe joint integrity tests for a minimum of two (2) hours at a sustained pressure of 5 PSI. Carrier pipe pressure and leakage testing shall be specified under SC DPW and SC DHS testing specifications included on the construction plans.

4. Failed Bore Path:

a. If conditions warrant removal of any materials installed in a failed bore path, as determined by the SC DPW, SC DHS, NYSDOT and or the Engineer it will be at no cost to the Owner. Promptly fill all voids by injecting all taken out of materials with excavatable flowable fill.
B. Product Locating and Tracking

1. The method of locating and tracking the drill head during the pilot bore are subject to the review and approval of the SCDPW, SC DHS and the Engineer. Acceptable methods include walkover, wire line and wire line with surface grid verification, or any other system as approved by the SCDPW, SC DHS and the Engineer. Use a locating and tracking system capable of ensuring that the proposed installation is installed as intended.

2. The locating and tracking system must provide information on:
   
   a. Pitch information
   b. Depth
   c. Transmitter temperature
   d. Battery status
   e. Position (x,y)
   f. Azimuth where direct overhead readings (walkover) are not possible (i.e. sub aqueous or limited access transportation facility).
   g. Ensure proper calibration of all equipment before commencing directional drilling operation.
   h. Take and record alignment readings or plot points such that elevations on top of and offset dimensions from the center of the casing pipe to a permanent fixed feature are provided. Such 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 50 feet, unless otherwise restricted by access. Provide a sufficient number of elevations and offset distances to accurately plot the vertical and horizontal alignment of the installed casing pipe.
i. Install all facilities such that their location can be readily determined by electronic designation after installation. For non-conducive installations, attach a minimum of two separate and continuous conducive tracking (tone wire) materials, either externally, internally or integral with the product. Use either a continuous green sheathed solid conductor copper wire line (min. #12 AWG for external placement or min. #14 AWG for internal placement) in the casing pipe or a coated conductive tape. Conductors must be located on opposite sides when installed externally. 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.

B. Casing Bore Hole Diameter

1. Minimize potential damage from soil displacement / settlement by limiting the ratio of the bore hole to the casing pipe size. The size of the back reamer bit or pilot bit, if no back reaming is required, will be limited relative to the product diameter to be installed as follows:

Maximum Pilot or Back-Reamer Bit Diameter When Rotated 360 Degrees

<table>
<thead>
<tr>
<th>Nominal Inside Casing Pipe Dia. (Inches)</th>
<th>Bit Dia. (Inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>6</td>
</tr>
</tbody>
</table>
C. Drilling Fluids

1. Use a mixture of bentonite clay or other approved stabilizing agent mixed with potable water with a minimum pH of 6.0 to create the drilling fluid for lubrication and soil stabilization. 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 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 a potable water may require a pH test.

D. Equipment Requirements

1. Ensure that appropriate equipment is provided to facilitate the installation as follows:

**HDD Equipment**

<table>
<thead>
<tr>
<th>System Description</th>
<th>Pipe Dia. (Inches)</th>
<th>Bore Length (Feet)</th>
<th>Torque (Ft-Lbs)</th>
<th>Trust/Pullback (Lbs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maxi-HDD</td>
<td>18</td>
<td>&gt;1,000</td>
<td>&gt;10,000</td>
<td>&gt;70,000 &amp; greater</td>
</tr>
<tr>
<td>Midi-HDD</td>
<td>Up to 16</td>
<td>Up to 1,000</td>
<td>1,900 to 9,999</td>
<td>20,001 to 69,999</td>
</tr>
<tr>
<td>Mini-HDD</td>
<td>Up to 61</td>
<td>Up to 600</td>
<td>Up to 1,899</td>
<td>Up to 20,000</td>
</tr>
</tbody>
</table>

For the above, multiple pipe or conduit installations must not exceed the total outside pipe diameters stated above.
Match equipment to the size of pipe being installed. Obtain Engineer’s approval for installations differing from the above chart. Ensure that the drill rod can meet the bend radius required for the proposed installation.

E. Thrust/Pullback Requirements

Unless approved by the Engineer, limit use of HDD equipment to installing the following product sizes and lengths based on the following product size, force and length relationships.

HDD Bore Equipment Thrust/Pullback Capacity

<table>
<thead>
<tr>
<th>Pull Back Capacity (Pounds)</th>
<th>Size Pipe size less than (in)</th>
<th>Distance Less than Distance (Ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5,000 to 7,000</td>
<td>4</td>
<td>400</td>
</tr>
<tr>
<td>7,001 to 12,000</td>
<td>6</td>
<td>600</td>
</tr>
<tr>
<td>12,001 to 16,000</td>
<td>8</td>
<td>800</td>
</tr>
<tr>
<td>16,001 to 25,000</td>
<td>10</td>
<td>1,000</td>
</tr>
<tr>
<td>25,001 to 40,000</td>
<td>12</td>
<td>2,000</td>
</tr>
</tbody>
</table>

3.03 DRILLING OPERATIONS

A. Installation Process

1. Ensure adequate removal of soil cuttings and stability of the bore hole by monitoring the drilling fluids such as the pumping rate, pressures, viscosity and density during the pilot bore, back reaming and pipe installation. Relief holes can be used as necessary to relieve excess pressure down hole. Obtain Engineer’s approval of the location and all conditions necessary to construct relief holes to ensure the proper disposition of drilling fluids is maintained and unnecessary inconvenience is minimized to other facility users.

2. To minimize heaving during pull back, the pull back rate is determined in order to maximize the removal of soil cuttings without building excess down hole pressure. Contain excess drilling fluids at entry and exit points until they are recycled or
removed from the site or vacuumed during drilling operations. Ensure that entry and exit pits are sufficient size to contain the expected return of drilling fluids and soil cuttings.

3. Ensure that all drilling fluids are disposed of or recycled in a manner acceptable to the appropriate local, state or federal regulatory agencies. When drilling in suspected contaminated ground, test the drilling fluid for contamination and appropriately dispose of it. Remove any excess material upon completion of the bore. If in the drilling process it becomes evident that the soil is contaminated, contact the Engineer and road authority immediately. Do not continue drilling without the Engineer’s approval.

4. The timing of all boring processes is critical. Install a product into a bore hole within the same day that the pre-bore is completed to ensure necessary support exists.

B. Boring Failure:

1. If an obstruction is encountered during boring which prevents completion of the installation in accordance with the design location and specification, the pipe may be taken out of service and left in place at the discretion of the Engineer and Road Authority. Immediately fill the carrier pipe left in place with excavatable flowable fill. Submit a new installation procedure and revised plans to the Engineer for approval before resuming work at another location. If, during construction, damage is observed to the road surface, cease all work until resolution to minimize further damage and a plan of action for restoration is obtained and approved by the Engineer.

3.04 DOCUMENTATION REQUIREMENTS

A. Boring Path Report:

1. Furnish a Bore Path Report to the Engineer within seven (7) days of the completion of each bore path. Include the following in the report:

   a. Location of project, Owners name, Project Name and Road Authority Permit Number.
b. Name of person collecting data, including title, position and company name.

c. Investigation site location (construction plans, station number or reference to a permanent structure within the project right-of-way).

d. Identification of the detection method used.

e. Elevations and offset dimensions

B. As-Built Plans:

1. Provide the Engineer, a complete set of As-Built Plans showing all bored (successful and failed) within 30 calendar days of completing the work. Ensure that the plans are dimensionally correct copies of the construction plans and include roadway plan and profile, cross-section, boring location and subsurface conditions as directed by the Engineer. The plans must show appropriate elevations and be referenced to a USGS or project bench mark. Plans must be prepared in AutoCAD format to the same scale as the construction plans. Specific plans content requirements include but may not be limited to the following:

a. The construction plan view shows the center line location of each casing pipe installed to an accuracy of 1 inch at the ends and other points physically observed in accordance with the bore path report.

b. As directed by the Engineer provide either a profile plan for each bore path, or a cross-section of the roadway at a station specified by the Engineer, or a roadway centerline profile. Show the ground or pavement surface and crown elevation of each facility installed, or installed and placed out of service, to an accuracy within 1 inch at the ends and other exposed locations. On profile plans for bore paths crossing the roadway show stationing of the crossing on the construction plans. On the profile plans for the bore paths paralleling the roadway, show the construction plan stationing. If the profile plan for the bore path is not made on a copy of one of the construction profile
or cross-section plans, use a 10 to 1 vertical exaggeration.

c. If, during boring, an obstruction is encountered which prevents completion of the installation in accordance with the design location and specification, and the casing pipe is left in place, show the failed bore path along with the final bore path on the plans. Note the failed bore path as “Failed Bore Path”. Also show the name of the utility owner, location and length of the drill head and any drill stems not removed from the bore path.

d. Show the top elevation, diameter and material type of all utilities encountered and physically observed during the subsoil investigation. For all other obstructions encountered during a subsoil investigation or the installation, show type of material, horizontal and vertical location, top and lowest elevation observed, and note if obstruction continues below the lowest point observed.

e. Include bore notes on each plan stating the final bore path diameter, casing pipe diameter, drilling fluid composition, composition of any other materials used to fill the annular void between the bore path and the casing pipe. Note the casing pipe size as well as the size and type of carrier pipe placed within the casing pipe.

END OF SECTION