CONSTRUCTION SPECIFICATIONS FOR
HORIZONTAL DIRECTION DRILL

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SECTION 1 – GENERAL REQUIREMENTS

PART 1 – GENERAL OVERVIEW

1.01 Definitions

For the purpose of these Design Specifications for Sanitary Sewer Facilities ("Design Specifications"), the following definitions shall apply:

A. "HSEU" shall mean Hamilton Southeastern Utilities, Inc., the public utility that provides sanitary sewer service in the Project (as hereafter defined) area. HSEU's address is 11901 Lakeside Drive, Fishers, Indiana 46038, and HSEU's phone number is (317)577-2300.

B. "Engineer" shall mean the engineer for HSEU, which is Sanitary Management & Engineering Company, Inc. ("SAMCO") or SAMCO's engineers. SAMCO's inspector shall be Engineer's representative during construction of the Project. SAMCO's address is 11905 Lakeside Drive, Fishers, Indiana 46038, and SAMCO's phone number is (317)577-1150.

C. "Subscriber" shall mean those signatories identified as Subscribers under a Special Contract for extension of Sewer Mains and Facilities with HSEU through which the Project is being undertaken. Subscriber is generally the Owner under a construction contract. This definition is intended to include all employees and/or agents acting in the interest of Subscriber.

D. "Contractor" shall mean any construction contractor approved by HSEU to construct, install, maintain, repair, and remove public or private sanitary sewer facilities within the HSEU service area. This definition is intended to include all employees, sub-contractors and/or agents acting for or on behalf of Contractor's company.

E. "Design Engineer" shall mean the engineer sealing the Construction Plans, as opposed to Engineer for HSEU who is also defined under these Specifications. This definition is intended to include all employees, sub-contractors and/or agents acting for or on behalf of Design Engineer's company.

F. "Project" shall mean any sanitary sewer facilities constructed under a distinct set of contract documents and shall include all work necessary for the Complete (as hereafter defined) and operable installation of all sanitary sewer infrastructure and appurtenances in conformity with the HSEU approved Construction Plans and the standards, specifications, and details of HSEU.

G. "Sanitary Sewer Facilities" shall mean any pipes, manholes, clean-outs, grease traps, grit traps, oil/water separators, neutralization tanks, wyes, laterals, and any other appurtenances which convey or process sanitary sewage.

H. "Conveyed" with regards to sanitary sewer facilities means Projects for which HSEU has received title.

I. "Private" with regards to Projects shall mean Projects from which sewage flows into HSEU's sanitary sewer facilities, but for which the title for sanitary sewer facilities is not to be Conveyed to HSEU.

J. "Completed" with regards to Projects shall mean any Projects which are acceptably constructed, tested, and through which customer service has been authorized by HSEU, but for which HSEU has not received title. All applicable fees must be paid to HSEU prior to a Project being deemed Completed.

K. "Construction Plans" shall mean primary plats, secondary plats, sets of construction drawings, architectural plans, shop drawings, landscaping plans, record drawings, easements, deeds, covenants

and restrictions, and any other documentation to be submitted under these Specifications and HSEU's "Design Specifications for Sanitary Sewer facilities". Construction Plans must meet the applicable standards in effect at the time the documents are submitted.

L. "Completion Documentation" shall mean record drawings and other documentation to be submitted under HSEU's "Sanitary Sewer Completion Specifications." Completion Documentation must meet the applicable standards in effect at the time the documents are submitted.

M. "Record Drawing Engineer" shall mean the engineer who will certify the record drawings, as opposed to Engineer for HSEU and Design Engineer, both of whom are also defined under these Specifications. Record Drawing Engineer and Design Engineer may be the same person or represent the same company. This definition is intended to include all employees and/or agents acting for or on behalf of Record Drawing Engineer's company.

1.02 Purpose

The purpose of these Specifications is to define the standards for engineering design, construction specifications and construction practices related to the Project which will allow for the orderly and proper installation of sanitary sewer facilities constructed within HSE's service area.

1.03 Applicability

These Specifications are applicable for all Public and Private sanitary sewer facilities which will be connected to HSE's sanitary sewer system. This includes Private Projects which will not initially be connected to HSE's sanitary sewer system but at some future date may be connected to the system.

1.04 Liability and Costs for Project

No direction, field directive or other instruction contemplated by these Specifications and/or conducted by others shall accrue any liability, charge, or cost to HSE, Engineer or Engineer's inspectors.

1.05 Standards, Specifications and Details Sheets

A. HSE's Gravity Sanitary Sewer Details, Gravity Sanitary Sewer Specifications, Lift Station Plans, Lift Station and Force Main Details, Lift Station and Force Main Specifications, Standards for Design and Construction of Building Sewer Laterals, Rules and Regulations, Master Plan, Design Specifications for Sanitary Sewer Facilities, and Sanitary Sewer Completion Specifications are integral parts of these Specifications. Contractor should become familiar with these documents prior to construction of any sanitary sewer facilities within HSE's service area.

B. These Specifications and those identified in 1.05-A above are complementary in nature and should not be interpreted individually.

C. These Specifications, Master Plan, and other standards, specifications and details are subject to revision at any time prior to the start of construction of the Project. These documents are also subject to revision at any time during construction when, in Engineer's opinion, those revisions materially affect the maintenance, operation or life of the Project. All such revised documents must replace the corresponding documents in the Construction Plans at the time provided to Contractor.

D. HSE reserves the right to modify or waive any of these Specifications and/or its Master Plan and other standards, specifications, and details in its best interest.

E. These Specifications are intended to define the construction requirements of sanitary sewer facilities which are constructed and operated under typical conditions in HSE's service area. Depending on field conditions and the composition and characteristics of sanitary sewer flow, different or unusual conditions may occur which cannot be anticipated in a document of this nature. Engineer may impose additional or special construction requirements under these circumstances.

1.06 Drawing Discrepancies and Omissions

A. Prior to the start of construction, Contractor must notify Engineer of any conflicts between the Construction Plans, any supplemental information supplied by HSE, and/or these Specifications. Resolution of any such conflict will be at Engineer's sole discretion.

B. Any items which are not covered in these Specifications, the Construction Plans or HSE's other standards, specifications, and details, but are required for construction of this Project, must be approved by Engineer prior to installation and must be made part of this contract.

C. In the event construction practices are not described, but in Engineer's opinion, will affect the quality of construction or long-term maintainability of sanitary sewer facilities, Engineer must approve any construction practices proposed by Contractor.

1.07 Governing Laws, Codes, and Regulations

A. Construction practices must meet all applicable laws, codes, or regulations and be in accordance with the requirements of all governmental agencies and public entities having jurisdiction.

B. These Specifications shall not be considered as a substitute, nor shall supersede any state or federal law, code, or regulation related to the Project. In the event of a conflict between any state or federal law, code, or regulation governing the Project and these Specifications, the more stringent requirement will apply.

C. All persons on site must abide by all Indiana Occupational Safety and Health Administration (IOSHA) standards including but not limited to "General Construction Practices" and "Trench Safety Standards”.

1.08 Notices

All notices required by these Specifications must be given to both HSEU and Engineer at their respective business offices.

PART 2 - GENERAL CONSTRUCTION REQUIREMENTS

2.01 General

A. These Specifications cover all work necessary for the installation of horizontal directional bore and other miscellaneous infrastructure to convey sewage to the receiving sewer in an acceptable and operable manner.

B. Contractor must provide all necessary work to install infrastructure in a Complete manner in accordance with the Construction Plans.

C. All pipe, fittings, valves, and appurtenances must be the size, type, classification, and grade shown on the Construction Plans and must meet all requirements of these Specifications.

D. Contractor must not substitute materials which differ from the approved Construction Plans unless approved by Engineer.

E. All pipe, fittings, valve sizes, and all references to pipe diameter on the Construction Plans or in these Specifications are intended to be nominal size or diameter and must be interpreted as such.

F. If a material type is shown on the Construction Plans, the material type must describe a general category of materials meeting these Specifications.

2.02 Submittals

A. Contractor must submit only one model number or type per item for approval. Multiple submittals of model number or type for a single item will be cause for rejection of the shop drawing.

B. Before delivery of products to the site (for standard yard stocked items) or before fabrication (for items which are not standard yard stocked items), Contractor must provide submittals to, and obtain acceptance from Engineer. Submittals must be thoroughly reviewed by Contractor and certified to meet these Specifications (with all exceptions explicitly indicated) prior to submission to Engineer.

2.03 Initiation of Construction

A. Plan approval will be an authorization to proceed with construction of the Project, however, it shall not be construed as authority to violate, cancel, or set aside any of HSE's requirements or the laws, codes, regulations, and permit processes of governmental agencies or public entities. Approval will be evidenced by an "Approved Hamilton Southeastern Utilities, Inc." stamp on the Construction Plans.

B. Plan approvals will be valid for a period of six (6) months from the date of approval stamp. Extensions of this time limit may be requested from Engineer if extenuating circumstances exist. Engineer's decision regarding time extensions will be final.

C. Prior to the start of construction, Design Engineer must receive formal written approval from Engineer. At this time, Design Engineer must supply Engineer with a PDF and an AutoCAD file of complete set of Construction Plans.

D. Contractor will not be permitted to initiate construction until Construction Plans are formally approved, and Subscriber has entered into all necessary agreements and authorizations with, and all required fees have been paid to HSE.

E. Contractor will not be permitted to initiate construction until all applicable permits have been approved by and obtained from all affected governmental agencies and public entities. Copies of the permits must be submitted to Engineer for review.

F. Contractor will not be permitted to initiate construction until all off-site easements have been reviewed, approved, and recorded by Engineer.

G. Pipe layers and foreman (superintendent) assigned to the Project must be approved by HSE prior to the start of construction.

H. Notice must be provided to Engineer twenty-one (21) days prior to initiation of construction.

I. A pre-construction meeting is required between Engineer and Contractor prior to initiation of construction. Pre-construction meeting must be completed no more than fourteen (14) days prior to the start of construction.

J. All rough grading (on and off site) must be finished to within one (1) foot of final grade and verified by Engineer prior to the start of construction of Sanitary Sewer Facilities.

2.04 Continuity of Construction

A. Once construction has commenced, the Project must be Completed promptly as directed by Engineer.

B. Contractor cannot discontinue work on the Project, except for weather delays, without written approval from Engineer and in this case no sanitary sewer structures including manholes, clean-outs, grease traps, grit traps, oil/water separators, neutralization tanks, etc. can be left open and incomplete.

2.05 Confined Space Entry

All persons, including but not limited to Subscribers, Contractors, sub-contractors, Design Engineers, and surveyors must abide by HSE's "General Procedures for Manhole Opening and Entry" or the most recent IOSHA confined space entry standards, whichever is more stringent.

2.06 Cleanliness

A. Project site must at all-time be kept free of trash, rubbish, unsightly materials, and other nuisances.

B. All streets, alleys, pavement, parkways, and private property must be thoroughly cleaned each day of all surplus materials, earth and rubbish placed thereon by Contractor.

C. Project site must be cleaned at the end of each workday. Trash receptacles must be provided as necessary to dispose of waste items.

2.07 Product Delivery, Handling, and Storage

A. Contractor is responsible for delivery, handling, and storage of products.

B. Deliver products with manufacturer's tags and labels intact.

C. Handle products in accordance with manufacturer's recommendations and with extreme care to not damage or shock. Load and unload all products by hoists or skidding. Do not drop products. Do not skid or roll products on or against other products. Slings, hooks, and pipe tongs must be padded.

D. Keep stored products safe from damage or deterioration in accordance with manufacturer's recommendations. Keep interior of products free from dirt or foreign matter. Drain and store products in a manner that will protect them from freezing. Store electronics and electrical products in a manner that will protect them from freezing and weather. Do not stack products unless allowed by the manufacturer's requirements. Store gaskets and other products affected by sunlight in a cool location out of direct sunlight. Gaskets must not come in contact with petroleum products. Use gaskets on a first-in/first-out basis.

E. Promptly remove damaged or defective products from the Project site. Replace damaged or defective products with acceptable products.

F. Contractor is responsible for verifying materials are free of defects and are the proper type, classification, grade, etc. complying with the Construction Plans and/or HSE's standards, Specifications, and details.

2.08 Quality Assurance

A. Contractor must test and perform quality assurance requirements on all infrastructure in accordance with these Specifications.

B. Execute work in conformance with applicable sections of the latest published editions of American National Standards Institute (ANSI), American Society of Mechanical Engineers (ASME), American Society for Testing and Materials (ASTM), American Water Works Association (AWWA), American Welding Society (AWS), and National Electrical Manufacturers Association (NEMA) standards or as indicated in these Specifications and/or the Construction Plans, whichever is more stringent.

C. All materials and products installed by Contractor must be approved by the National Electric Code (NEC), Uniform Building Code and Underwriter's Laboratories Inc. (UL).

D. All infrastructure must be new and unused.

E. Line and grade requirements
   1. Contractor must provide assurance to Engineer that the pressure/gravity sewer is laid accurately to required line and grade as shown on the Construction Plans. Contractor must constantly check horizontal alignment of the force main.
   2. Contractor must coordinate verification of the force main with Engineer to provide an as-built record set as described in Section 2.15. Verification is defined as certification by an appropriately registered Indiana Professional as to actual elevation and horizontal location of the force main. Variations from line and grade as shown on the Construction Plans are cause for the force main to be rejected and re-laid in compliance with the Construction Plans.

F. Test Sections
   1. Initial Performance Tests – A hydrostatic pressure test may be required on the first six hundred (600) feet of force main of each size and type of material installed. This test will be required when, in Engineer's opinion, materials or techniques unproven with HSE are proposed, when Contractor cannot show adequate experience with the materials or techniques to be used, or when field conditions warrant. No additional force main can be installed until the first section of each size and type of material has satisfactorily passed initial performance tests or a waiver is received. No initial performance test is done with gravity sewers.
   2. Subsequent Performance Testing – as work progresses, Engineer may designate additional sections for subsequent performance testing as conditions, in his opinion, warrant. Engineer will notify Contractor of where subsequent test(s) are to be required not later than fifteen (15) days after force main is installed. Unless otherwise authorized, Contractor must arrange to commence subsequent performance test(s) within fifteen (15) days after force main has been installed or fifteen (15) days after receiving notification from Engineer, whichever date is later.
   3. Final Performance Testing for Completion – All infrastructure must pass all applicable test requirements of these Specifications.

2.09 Inspection and Rejection of Materials

A. The quality of all materials, process of manufacture, and finished product are subject to inspection and acceptance by Engineer. Such inspection may be made at the place of manufacture and/or on the work site after delivery. Products are subject to rejection at any time for failure to meet any of the manufacturer's specifications even though samples may have otherwise been accepted as satisfactory.

B. Immediately prior to being incorporated into the Project, each product must be carefully inspected, and those not meeting these Specifications and HSE's Detail sheets must be rejected, immediately removed from the site, and replaced at Contractor's sole expense.

C. Contractor must not repair, or permit manufacturer to repair, any pre-cast concrete structures with exposed steel or welded wire fabric reinforcement.

2.10 Relation to Wells and Water Supplies

A. Force Mains must be laid at least ten (10) feet horizontally from any existing or proposed water main. The distance is to be measured edge to edge. Should specific conditions prevent this separation, Contractor must notify Engineer for specific instructions.

B. Where the force main crosses a water main, it should be laid at least eighteen (18) inches below the water main.

C. Sewer/water supply separations and pipe classifications must conform with the latest edition of the Ten States Standards, Indiana State Board of Health's (ISBH) "On-site Water Supply and Wastewater Disposal for Public and Commercial Establishments – Bulletin S.E. 13" and Indiana Department of Environmental Management (IDEM).

2.11 Utilities

A. All existing utility systems which conflict with the construction of the Project, which can be temporarily removed and replaced, must be accomplished at the expense of Subscriber. Work must be done by the respective utility unless the utility approved in writing that Contractor can do the work.

B. Permanent relocation of Utilities

1. Except as otherwise noted on the Construction Plans, it is the responsibility of Subscriber to move or pay for moving all utility appurtenances, including but not limited to, water mains, storm sewer inlets, gas lines, electrical lines, service connections, water and gas meter boxes, water and gas valve boxes, light and traffic standards, cable ways, signals, etc. located in the public right-of-way or private easement which would permanently interfere with the Project.
2. It is understood and agreed that Contractor has considered in his bid all the permanent and temporary utility appurtenances shown or otherwise indicated on the Construction Plans. It is also understood and agreed that when contracted by HSEU, no additional compensation will be allowed for any delays, inconvenience, or damage sustained by Contractor due to any interference from said utility appurtenances or the operation of moving them. Costs incurred due to the respective utility company moving the utilities shall be that of the Subscriber.

C. Contractor must provide, at Contractor's expense, all electrical and gas energy, water service (including water for flushing and testing) and telephone service required for the Project until the Project is Complete.

2.12 Installation Service

Provide services of a factory-trained representative for up to eight (8) hours for the installation of High-Density Polyethylene (HDPE) pipe.

2.13 Product Installation

A. Install all products in strict accordance with manufacturer's recommendations and these Specifications in a neat and workmanlike manner.

B. Bring all conflicts between the manufacturer's recommendations and these Specifications to the attention of Engineer and obtain direction from Engineer as to the resolution of any conflict in installation directives.

2.14 As-Built Record Set

A. Contractor must maintain, throughout the course of the Project, an up-to-date plan set which accurately reflects the actual as-built dimensions (horizontal location and vertical elevation), materials of construction, and other relevant information necessary to develop a set of as-built record drawing.

B. As-built horizontal locations and vertical elevations are required on all fittings (including ells, tees, valves, and adapters), force main (at a maximum separation of 500 feet), top and bottom of the wet well and valve vault and inverts into the wet well, clean-outs and air/vacuum manholes. Engineer will schedule the as-built survey of completed new infrastructure construction and bill Subscriber for the as-built costs.

2.15 Completion Documentation

A. Contractor must provide to HSE and Engineer in Subscriber's name the necessary Completion Documentation for the Project. Costs associated with the final as-built documentation review by Engineer and its inclusion to update HSE's GIS infrastructure database shall be at Subscriber's expense. Any Field Changes made which, in Engineer's opinion, materially affect the project are to be made by Design Engineer and amended digital plan sheets provided prior to completion of sanitary sewer infrastructure installation and operation.

B. Daily inspections?

C. Contractor must complete all outstanding items detailed in Engineer's correspondence and supply all necessary information (including construction cost documentation, with all applicable change orders, Sanitary Sewer Inventory form, etc.) to Engineer in a timely manner.

D. If a manhole top of casting is adjusted after as-builting, Contractor must supply Engineer with a new measure down to the flow line from top of casting. If new measure down is not provided to Engineer, Contractor must pay Engineer, at their current rate, for all time required obtaining this information.

E. Contractor must provide to HSE copies of all contracts, invoices, statements, material lists, payment requests, and all other related documents pertaining to the construction cost of Project. The above documents must be provided monthly, unless otherwise determined by HSE.

F. Submit any other items required by Engineer.

G. Contractor must provide HSEU copies of all contracts, invoices, statements, material lists, payment requests, and all other related documents pertaining to the construction cost of Project. The above documents must be provided monthly, unless otherwise determined by HSEU.

H. Submit any other items required by Engineer.

2.16 Inspection and Reimbursement

A. Full time inspection by Engineer is required for all repairs, maintenance, or construction to infrastructure prior to acceptance of the facilities by HSE as owner. Engineer must approve, in writing, all methods of repair to infrastructure as recommended by Contractor and manufacturer. Failure to comply will be grounds for removal from HSE Approved Contractor List.

B. Contractor must pay Engineer for all inspector's overtime cost. Contractors will be charged overtime costs at the prevailing rate per hour outside SAMCO's normal business hours on weekdays and all day on Saturdays. The hourly rate for Sundays and holidays will be twice the hourly rate. Rates are subject to change without notice, contact Engineer prior to starting construction for current rates.

C. If, at sole discretion of Engineer, construction volume is less than what is deemed acceptable, Contractor may be required to pay for additional inspection services.

D. Engineer's decision on field changes or construction practices is final. Failure to comply is grounds for removal from the HSE Approved Contractor List.

PART 3 – GENERAL

3.01 Work Included

A. Furnish all labor, materials, and equipment required to install the required potable water main, sanitary force main pipe and laterals using directional drilling method of installation, all in accordance with the requirements of the Contract Documents. Pipe size, type and length shall be as specified in the Detailed Specifications and as shown on the drawings. Work shall include, and not be limited to, proper installation, testing, restoration of underground utilities, and environmental protection and restoration.

B. The directional drill shall be accomplished by first drilling a pilot hole as shown on the approved pilot bore plan, then enlarging the pilot hole to no larger than 1.5 times the outer diameter to accommodate the pull back of the pipe through the enlarged hole.

C. Soil borings as required for certain subsurface soil conditions shall be provided by Direction Drill Contractor within the scope of the Project.

D. Work shall include all pressure main and lateral installation using the directional drilling method, clearing and grubbing, valve pit excavation, removal and disposal of any rock and water, disposal of excess excavated material, fittings, thrust blocking, granular backfill, any saw cutting of permanent pavement surfaces for boring and receiving pits to install pressure mains, replacement/repair of any landscaping, sidewalks, fences, curbs, guttering, cable basins, drainage pipes, field tiles and other surface or sub-surface structures, pipes, conduits, cable, etc. sheeting and shoring, protection of existing structures, trees, shrubs, bushes, clean up, and all other operations necessary to complete work as shown on the plans as specified.

3.02 Scope

This Specification covers the use of HDPE and thrust-restrained Polyvinyl Chloride (PVC) pipe.

3.03 Reference Documents

American Society for Testing and Materials (ASTM)

1. ASTM F1962: Use of Maxi-Horizontal Directional Drilling for Placement of Polyethylene Pipe or Conduit Under Obstacles, Including River Crossings
2. ASTM D1784: Standard for Rigid PVC Compounds and Chlorinated PVC Compounds
3. ASTM D2837: Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials
4. ASTM D3139: Standard Specification for Joints for Plastic Pipes Using Flexible Elastomeric Seals
5. ASTM D3261: Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene Plastic Pipe and Tubing
6. ASTM D3350: Standard Specification for Polyethylene Plastic Pipe and Fitting Materials
7. ASTM F477: Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
8. American Water Work Association (AWWA)
9. AWWA C900: Standard for PVC Pressure Pipe and Fabricated Fittings 4" through 12" for Water Distribution
10. AWWA C901: Polyethylene (PE) Pressure Pipe and Tubing ½" through 3" for Water Service.
11. AWWA C905: Standard for PVC Pressure Pipe and Fabricated Fittings 14" through 48" for Water Transmission and Distribution
12. AWWA C906: Polyethylene (PE) Pressure Pipe and Fittings 4" through 63" for Water Distribution.

3.04 Submittals

A. Data supporting the Directional Drilling Contractor's qualifications and experience.

B. Work Plan: Prior to beginning work, Contractor must submit to Engineer a Work Plan detailing the procedure and schedule to be used to execute the Project. Work Plan should include a description of all equipment to be used, down-hole tools, a list of personnel and their qualifications and experience (including backup personnel if an individual is unavailable), list of subcontractors, a schedule of work activity, a safety plan (including SDS sheets of any potentially hazardous substances to be used), an environmental protection plan, and contingency plans for possible problems. Work Plan should be comprehensive, realistic, and based on actual working conditions for this Project. Plan should document thoughtful planning required to successfully complete the Project.

C. Bore Plan: Prior to beginning work, Contractor must submit to Engineer a signed and sealed, scale drawing of the pilot bore plan for review and approval. (Max vertical scale 1" = 2', max horizontal scale 1" = 20'). The plan shall show finished grade, deflection and radii of the pilot bore, all existing utilities with minimum vertical and horizontal clearances. The plan shall also address the location of the drilling rig setups for multiple bores, the lengths of each bore based on soil condition, equipment used, topography, etc. Proposed vertical and horizontal clearances between bored pipe and any existing/proposed conflicting pipes, conduits, or obstructions shall exceed the guidance system accuracy tolerance by a minimum of 100%.

D. Material: Specifications on material to be used shall be submitted to Engineer. Material shall include the pipe, fittings, and any other item that is to be an installed component of the Project.

E. Equipment: Submit specifications on directional drilling equipment to be used to ensure that equipment will be adequate to complete the Project. Equipment list shall include but not be limited to drilling rig, mud system, mud motors (if applicable), down-hole tools, guidance system, and rig safety

systems. Calibration records for guidance equipment shall be included. Specifications for any drilling fluid additives Contractor intends to use or may use shall also be submitted.

3.05 Quality Assurance

A. All directional drilling operations shall be performed by a qualified Directional Drilling Contractor with at least three (3) years' experience involving work of a similar nature to work required for the Project. Contractor must have installed a minimum of 50,000 linear feet of pipe (4" diameter or greater) using directional drilling operations. A list of project references is required prior to job commencement.

B. All work shall be scheduled through Engineer. Notify Engineer a minimum of three (3) days in advance of the start of work.

C. All work shall be performed in the presence of Engineer.

D. All applicable permits and applications must be in place prior to start of work.

PART 4 - PRODUCTS

4.01 Polyvinyl Chloride (PVC) Pipe

A. Pipe material to be used for 4" through 12" diameters shall meet AWWA C900 standards for Polyvinyl Chloride pressure pipe and fittings and shall have a dimension ratio of DR 14 (Class 200). Pipe material to be used for 14" through 18" diameter shall meet AWWA C905 standards for Polyvinyl Chloride pressure pipe and fittings and shall have a dimension ratio of DR 18 (Class 235). PVC pipe that is intended for use as a casing for a finished product pipe may have a dimension ration of DR 18. Pipe shall be designated as Certa-Lok C900/RJ or Certa-Lok C905/RJ as manufactured by CertainTeed Corporation. All other pipes shall have the written approval of Engineer and meet all submittal review as an approved optional product.

B. PVC AWWA C900 and C905 shall only be white in color.

C. Pipe shall be joined using a separate PVC coupling with built-in sealing gaskets and restraining grooves. The restraining splines shall be square and made from Nylon 101.

D. Exposed splines shall be cut ¾" from coupling to reduce soil drag.

E. Couplings shall be beveled on leading edges to minimize soil friction.

F. Using Certa-Lok C900/RJ pipe, Contractor shall adhere to pipe manufacturer's most current data regarding tensile load limitations for trenchless application. Generally, the maximum pull-in force shall not exceed the following values:

Size	SDR	Class	Pipe O.D.	Coupling O.D.	Max Bending	Max No Bending
(in.)		(psi)	(in.)	(in.)	(lbs.)	(lbs.)
4	18	235	4.800	5.964	8,000	10,300
6	18	235	6.900	8.366	9,300	14,700
8	18	235	9.050	10.947	18,900	28,800
10	18	235	11.100	13.361	24,900	38,300
12	18	235	13.200	15.836	28,300	48,300

G. Using Certa-Lok C905/RJ pipe, Contractor shall adhere to pipe manufacturer's most current data regarding tensile load limitations for trenchless application.

H. Contractor shall adhere to the following data regarding radius of curvature for Certa-Lok C900/RJ pipe used for trenchless application. Confirmation of proposed radius of each bore shall be part of the required submittal prior to work.

Size (inch)	Min Radius Of Curvature (feet)	Offset per 20' Length (inch)	Deflection per 20' Length (%)
4	125	19	10.0
6	188	13	6.7
8	250	9	5.0
10	313	7	4.0
12	375	6	3.3

In any case, deflection radius shall not exceed 75% of the maximum allowable curvature allowed for standard C900 PVC pipe.

I. Pipe shall be joined using non-metallic couplings, which have been designed as an integral system for maximum reliability and interchangeability. High-strength flexible thermoplastic splines shall be inserted into mated, precision-machined grooves in the pipe and coupling to provide joint restraint with evenly distributed loading. Couplings shall be designed for use at the rated pressure of the pipe with which they are utilized and shall incorporate twin elastomeric sealing gaskets meeting the requirements of ASTM F477. Joints shall be designed to meet the leakage test requirements of ASTM D3139 or Engineer's requirements, whichever is more stringent.

4.02 High-Density Polyethylene (HDPE) Pipe

A. HDPE pipe shall be manufactured by Phillips Driscopipe, Inc., Chevron Chemical Company, or Engineer approved equal. Contractor shall refer to pipe manufacturer for appropriate handling, unloading, and storage of pipe.

B. HDPE pipe shall only be black in color.

C. HDPE pipe (PE 3408) shall meet the requirements of ASTM D3350/F714. Cell classification shall be 345444C. Pressure Class and Standard Dimension Ratios (SDR) shall be Class 160 – DR11.

D. Fittings shall be manufactured in accordance with the reference standards listed in these specifications, material types, design pressure, and temperature ranges specified.

E. Fittings shall be manufactured by the same manufacturer as the pipe to which fusion bonding is intended, using identical materials, and meeting the same pressure requirements.

F. Fittings shall not be field fabricated.

G. Tapping sleeves shall not be accepted.

H. Flange backup rings shall be of the type and pressure rating as the pipe. Harvey couplings will be required for all transitions from HDPE to any other pipe material.

I. Ductile iron backup rings shall be the convolutant type, fabricated from ductile iron per ASTM A 536, grade range 60/40/18 to 65/45/12. Ductile iron flange backup ring bolting dimension shall conform with ANSI B16.5 Class 150.

J. Backup rings shall be cast and finished with flash removed from all edges and bolt holes to the specified dimensions. Additional finish requirements, if any, shall be as noted on the plans and in accordance with the following:
   1. Epoxy coated, with bitumastic 300M high build coal tar epoxy or equal per manufacture's recommendations.
   2. Gasket materials shall be compatible with the service piping system. Asbestos gaskets are not allowed.

K. Fusion Bonding Procedure
   Piping joints, other than those shown as flanged or otherwise mechanically connected, shall be butt fusion bonded in accordance with a written bonding procedure specification (BPS) as required by ANSI (ASME B31.3, Chapter VII, paragraph A-328). BPS shall include cutting and facing requirements.
   1. Materials to be fusion bonded shall be from same manufacturer.
   2. Bonders and bonding operators shall be qualified in the use of the BPS as required by ANSI/ASME B31.3, Chapter VII, paragraph A-328. Qualification records certifying that bonders and bonding operators employed to complete fusion bonding are qualified in the BPS shall be submitted prior to commencement of fusion bonding work.
   3. Bonding equipment specified in the BPS shall be in proper operating condition. Equipment heater performance shall be tested and certified prior to use for fusion bonding. Bonders and bonding operators shall be qualified for the specific bonding equipment utilized in fusion bonding work.

L. Quality Assurance
   Pipe and fittings manufacturer shall have an established quality control program responsible for inspecting incoming materials and outgoing pipe, fittings, and components. Incoming polyethylene materials shall be inspected for density per ASTM D1505 and melt flow rate per ASTM D1238 and contamination. All incoming materials shall be certified by the supplier. Certificates shall be verified by the pipe manufacturer and submitted to Engineer.

4.03 Directional Drilling Equipment Requirements

A. General: Directional drilling equipment shall consist of a directional drilling rig of sufficient capacity to perform the bore and pull back of the pipe, a drilling fluid mixer, delivery and recovery system of sufficient capacity to successfully complete the installation, a drilling fluid recycling system to remove solids from the drilling fluid so that the fluid can be reused (if required), a Magnetic Guidance System (MGS) or "walkover" system to accurately guide boring operations, a vacuum truck of sufficient capacity to handle the drilling fluid, trained and competent personnel to operate the system. All equipment shall be in good, safe condition with sufficient supplies, materials, and spare parts on hand to maintain the system in good working order for the duration of the Project.

B. Drilling Rig: Directional drilling rig shall consist of a hydraulically powered system to rotate and push hollow drilling 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 installation. The hydraulic power system shall be self-contained with sufficient pressure and volume to power drilling operations. Hydraulic system

shall be free of leaks. Rig shall have a system to detect electrical current from the drill string and an audible alarm that automatically sounds when an electrical current is detected.

C. Drill Head: The drill head shall be steerable by changing its rotation and shall provide necessary cutting surfaces and drilling fluid jets.

D. Mud Motors (if required): Mud motors shall be of adequate power to turn the required drilling tools.

E. Drill Pipe: Shall be constructed of high quality 4130 seamless tubing, grade D or better, with threaded box and pins. Tool joints should be hardened to 32 – 36 RC.

4.04 Guidance System

A. General: An electronic "walkover" tracking system or a Magnetic Guidance System (MGS) probe or proven (non-experimental) gyroscopic probe and interface shall be used to provide a continuous and accurate determination of the location of the drill head during the drilling operation. The guidance system shall be capable of tracking at all depths up to fifty (50) feet and in any soil condition, including hard rock. It shall enable the driller to guide the drill head by providing immediate information on the tool face, azimuth (horizontal direction), and inclination (vertical direction). The guidance system shall be accurate and calibrated to manufacturer's specifications of the vertical depth of the borehole at sensing position at depths up to fifty (50) feet and accurate to two (2) feet horizontally.

B. Components: Contractor shall supply all components and materials to install, operate, and maintain the guidance system.

C. The MGS shall be setup and operated by trained and experienced personnel. Contractor shall be aware of any geo-magnetic anomalies and shall consider such influences in the operation of the guidance system.

4.05 Drilling Fluid (MUD) System

A. Mixing System: A self-contained, closed, drilling fluid mixing system shall be of sufficient size to mix and deliver drilling fluid. The mixing system shall be able to molecularly shear individual bentonite particles from the dry powder to avoid clumping and ensure thorough mixing. The drilling fluid reservoir tank shall be 1,000 gallons minimum. Mixing system shall continually agitate the drilling fluid during drilling operations.

B. Drilling Fluids: Composed of bentonite clay, potable water, and appropriate additives. Water shall be from an authorize source with a pH of 8.5 – 10. Water with a lower pH or with excessive calcium shall be treated with the appropriate amount of sodium carbonate or equal. No additional material may be used in drilling fluid without prior approval from Engineer. The bentonite mixture used shall have the following minimum viscosity as measured by a March funnel:

Rock Clay ..... 60 seconds
Hard Clay ..... 40 seconds
Soft Clay..... 45 seconds
Sandy Clay ..... 90 seconds
Stable Sand..... 80 seconds
Loose or Wet Sand..... 110 seconds

These viscosities may be varied to best fit the soil conditions encountered, or as determined by the operator.

C. Delivery System: The drilling fluid pumping system shall have a capacity of 35 – 500 GPM and be capable of delivering the drilling fluid at a constant minimum pressure of 1200 psi. The delivery system shall have filters in-line to prevent solids from being pumped into the drill pipe. Used drilling fluid and drilling fluid spilled during operation shall be contained and conveyed to the drilling fluid recycling system or shall be removed by vacuum trucks or other methods acceptable to Engineer. A berm, minimum 12 inches high, shall be maintained around drill rigs drilling fluid mixing system, entry and exit pits, and drilling fluid recycling system to prevent spills into the surrounding environment. Pumping equipment and/or vacuum truck(s) of sufficient size shall be in place to convey drilling fluid from containment areas to storage and recycling facilities or disposal.

4.06 Other Equipment

A. Pipe Rollers: Pipe rollers shall be used for pipe assembly during final product pull back.

B. Restrictions: Other devices or utility placement systems for providing horizontal thrust, other than those previously defined, shall not be used unless approved by Engineer prior to commencement of work. Consideration for approval will be made on an individual basis for each specified location. The proposed device or system will be evaluated by Engineer without undue delay and shall maintain line and grade within the tolerances prescribed by the conditions of the Project.

4.07 Personnel Requirements

A. All personnel shall be fully trained in safety and their respective duties as part of the directional drilling crew. Each person must have at least two years directional drilling experience.

B. A competent and experienced supervisor representing Contractor and Drilling Subcontractor shall always be present during the actual drilling operations. A responsible representative who is thoroughly familiar with the equipment and type of work to be performed must be in direct charge and control of the operation at all times. In all cases, the supervisor must be continually present at the job site during the actual Directional Bore operation. Contractor and Subcontractor shall always have enough competent workers on the job to ensure the Directional Bore is made in a timely and satisfactory manner.

C. Personnel who are unqualified, incompetent, or otherwise not suitable for the performance of this Project shall be removed from the job site and replaced with suitable personnel.

PART 5 – EXECUTION

5.01 General Requirements

A. Engineer must be notified a minimum of 3 days in advance of starting work. All necessary permits and approvals must be in place prior to commencement of work. The Directional Bore shall not begin until Engineer is present at the job site and agrees that proper preparations for the operation have been made. Engineer's 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. It shall be the responsibility of Engineer to provide inspection personnel when appropriate without causing undue hardship by reason of delay to Contractor. A copy of the Construction Drawing must be on the job site during construction and used for field marking "as-built" information daily. If field "as-built" data is not maintained by Contractor, Engineer shall recommend that Subscriber withhold payment(s) until field data is updated.

B. All work under this specification affecting Indiana Department of Transportation (INDOT) property, right-of-way, or facilities shall be carried out to the full satisfaction of INDOT authorized representative. Contractor shall fully inform himself of all requirements of INDOT as they pertain to Project and shall conduct all work accordingly.

C. All equipment used by Contractor on Subscriber's property and rights-of-way may be inspected by Subscriber and shall not be used if considered unsatisfactory by Subscriber.

D. Contractor shall be fully responsible for all damages arising from his failure to comply with all applicable regulations and the requirements of these specifications.

E. Where the pressure sewer is shown to be constructed parallel and close to any existing utility line, the exact location of which is not shown, Engineer will shift the location of the new pressure sewer where possible, to avoid interference with existing utility lines. Should such interference develop during construction, no additional compensation will be allowed for shifting of the pressure sewer main to avoid such interference other than unit prices provided in Contract for quantity of items installed.

F. Force Mains shall be laid 10 feet horizontally from any existing or proposed water line, measured edge to edge. Force Mains shall be laid to provide a minimum vertical distance of 18 inches between the outside of water main and outside of sanitary sewer.

G. Contractor shall be responsible for contacting all property owners regarding the location of all existing service lines, water wells, septic tanks, etc. and for contacting all utilities for determination of the location of all existing underground lines, cables, pipes, valves, vaults, etc. Contractor shall be responsible for restoring existing service connections damaged during installation of the new pressure sewer main.

5.02 HDPE Connections & Thrust Blocking

A. Connections from plain end HDPE pipe to other pipe materials or mechanical joint fittings shall be properly restrained by the following method:
   1. If HDPE pipe transitions to a gasket pipe joint product, Contractor shall restrain the gasket pipe joint with the recommended joint restrainer a minimum of three joints immediately after the transition.
   2. Approved polyethylene joint adapters such as Harvey couplings shall be used by fusing the joint adapter to the HDPE carrier pipe and restraining it to transitions by methods specified above.

B. A polyethylene thrust anchor fitting such as a branch saddle or thrust anchor manufactured by Central Plastics Inc. shall also be attached to the outside diameter of the HDPE carrier by butt fusion or electrofusion. The area shall be encased in concrete not more than five (5) feet before the transition and as indicated in the Contract drawings.

5.03 Directional Drilling Operation

A. Contractor shall provide all material, equipment, and facilities required for directional drilling. Proper alignment and elevation of the borehole shall be consistently maintained throughout the directional drilling operation. The method used to complete the directional drill shall conform to the requirements of all applicable permits. Contractor is responsible for acquiring all permits.

B. The entire drill path shall be accurately surveyed by Contractor with entry and exit stakes placed in the appropriate locations within the areas indicated on drawings. If Contractor is using a magnetic guidance system, drill path shall be surveyed for any surface geo-magnetic variations or anomalies.

C. Contractor shall place silt fence between all drilling operations and any drainage, well-fields, wetlands, waterways, or other area designated for such protection if required by documents, 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. Contractor shall adhere to all applicable environmental regulations. Fuel may not be stored in bulk containers within 200 feet of any water body or wetland.

D. Readings shall be recorded after advancement of each successive drill pipe (no more than 10') and the readings plotted on a scaled drawing of 1" = 2' vertical and 1" = 20' horizontal. Access to all recorded readings and plan and profile information shall be made available to Engineer and Subscriber at all times. At no time shall the deflection radius of the drill pipe exceed the deflection limits of the carrier pipe as specified herein.

E. A complete list of all drilling fluid additives and mixtures to be used in the directional operation will be submitted to Engineer, along with their respective Safety Data Sheets. All drilling fluids and loose cuttings shall be contained in pits or holding tanks for recycling or disposal, no fluids shall be allowed to enter any unapproved areas or natural waterways. Upon completion of the directional drill project, the drilling mud and cuttings shall be disposed of by Contractor at an approved dumpsite.

F. The pilot hole shall be drilled on bore path with no deviations greater than 80% the pipe diameter for force mains and 25% for gravity sewers, over the length of the bore unless previously agreed to by Engineer. If pilot does deviate from the bore path more than above tolerances, Contractor will notify Engineer. Engineer may require Contractor to pull-back and re-drill from the location along bore path before the deviation. In the event of a drilling fluid fracture, inadvertent returns, or returns loss during pilot hole drilling operations, Contractor shall cease drilling, wait 30 minutes, inject a quantity of drilling fluid with a viscosity exceeding 120 seconds as measured by a March funnel and wait another 30 minutes. If mud fracture or returns loss continues, Contractor will discuss additional options with Engineer and work will then proceed as agreed.

G. Upon completion of pilot hole phase of the operation, a complete set of "as-built" records shall be submitted in duplicate to Engineer. These records shall include copies of the pilot bore path plan and profile record drawing, as well as directional survey reports as recorded during the drilling operation.

H. Upon approval of the pilot hole location by Engineer, the hole opening or enlarging phase of the installation shall begin. The bore hole diameter shall be increased to accommodate the pullback operation of the required size of carrier pipe. The type of hole opener or back reamer to be utilized in this phase shall be determined by the types of subsurface soil conditions that have been encountered during the pilot hole drilling operation. Contractor shall select the proper reamer type with the final hole opening being a maximum of 1.5 times the largest outside diameter pipe system component to be installed in the bore hole.

I. The open bore hole shall be stabilized by means of bentonite drilling slurry pumped through the inside diameter of the drill rod and through openings in the reamer. The drillings slurry must be in a homogenous/flowable state serving as an agent to carry the loose cuttings to the surface through the annulus of the borehole. The volume of bentonite mud required for each pullback shall be calculated based on soil conditions, largest diameter of the pipe system component, capacity of the bentonite mud pump, and the speed of pullback as recommended by the bentonite drilling fluid manufacturer. The bentonite slurry is to be contained at the exit or entry side of the directional bore in pits or holding

tanks. The slurry may be recycled at this time for reuse in the hole opening operation or shall be hauled by Contractor to an approved dumpsite for proper disposal.

J. The pipe sections shall be joined together according to manufacturer's specifications. The gaskets and the ends of pipe must be inspected and cleaned with a wet cloth prior to each joint assembly so they are free of any dirt or sand. The pipe must be free of any chips, scratches, or scrapes. A pulling eye will be attached to the pulling head on the lead stick of pipe which in turn will be attached to a swivel on the end of the drill pipe. This will allow for a straight, smooth pull of the product pipe as it enters and passes through the borehole toward the drill rig and original entrance hole of the directional bore. The product pipe shall be elevated to the approximate angle of entry and supported by means of a side boom with roller arm, or similar equipment, to allow for the "free stress" situation as the pipe is pulled into the exit hole toward the drill rig. The product pullback phase of the directional operation shall be carried out in a continuous manner until the pipe reaches the original entry side of the bore.

5.04 Pipe Handling

A. Care shall be taken during transportation of the pipe so it will not be cut, kinked, or otherwise damaged.

B. Ropes, fabrics, or rubber protected slings and straps shall be used when handling pipes. 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. Pipe and fittings shall not be dropped into rocky or unprepared ground.

C. Pipes shall be stored on level ground, preferably turf or sand, free of sharp objects that could damage the pipe. Stacking the pipe shall be limited to a height that will not cause excessive deformation of the bottom layers of pipe under anticipated temperature conditions. Where necessary, due to ground conditions, pipe shall be stored on wooden sleepers, spaced suitably and of such width to prevent deformation of the pipe at the point of contact with the sleeper or between supports.

D. Handling of the assembled pipeline shall be in a manner that pipe is not damaged by dragging it over sharp and cutting objects. Slings for handling the pipeline shall not be positioned at pipe joints. Sections of the pipes with cuts and gouges or excessive deformation shall be removed and replaced.

5.05 Testing Pipe

A. Cleaning and flushing are to be done by Contractor to obtain a clear and debris free product. Only potable water shall be used for flushing and pressure testing.

B. Directional drilling pipe shall be tested by Contractor after pullback. Average pressure shall be maintained at 100 psi for eight (8) hours. Test pump and water supply shall be arranged to allow accurate measurements of the water required to maintain the test pressure. Any material showing seepage, or the slightest leakage shall be replaced as directed by Engineer at no additional expense to Engineer.

C. Pipe manufacturer's recommendations on pipe stretch allowances, bending radius, tensile strength, allowable test leakage, and magnitude and duration of test pressure shall be observed.

D. Pipeline shall be tested end to end.

E. All new service lines connected to the new main, and installed with new pipe, shall be pressure tested along with the newly installed main.

F. Pressure testing shall not be required for the drilled pipe if the pipe is intended to be used as a casing for a finished product pipe.

5.06 Tracer Wire

A. All mainline and service line pressure sewers shall be provided with two (2) continuous type TW insulated #10 solid tracer wires. The wire shall be installed along the pipe, fastened to the pipe at 20 ft. intervals and terminating above ground with the lead taped around each structure.

B. The wire shall be brought to ground level every 400 feet through a vinyl coated aluminum riser pipe with cap and/or at all line valve boxes. All lateral tracer wire connections shall be soldered and a 3M Scotchcast Electrical Insulating Resin 4 Size A epoxy sealer packet to be used at ALL spliced locations. The riser pipe and cap shall not be placed in areas which are subject to vehicular traffic. The tracer wire shall be capable of, and demonstrated to be, continuous transmission of tracing signal along the full length of pressure sewer and laterals.

C. A minimum of two (2) wires shall be installed with pressure sewer mains and laterals to ensure a continuous line is available.

5.07 Site Restoration

A. Following drilling operations, Contractor will de-mobilize equipment and restore work site to original conditions or better. All excavations will be backfilled and compacted according to the specifications.

B. Surface restoration shall be completed in accordance with the requirements of the Workmanship & Materials in the Detailed specifications or permits to a condition as good as or better than existing prior to construction.

5.08 Record Keeping and As-Builts

A. Contractor shall maintain a daily project log of drilling operation and a guidance system log with a copy given to Engineer at completion of project.

B. Guidance system data shall be recorded during the actual crossing operation. Contractor shall furnish to Engineer, “as-built” plan and profile drawings based on these recordings showing the actual location horizontally and vertically of the installation, and all utility facilities found during the installation. Guidance data shall be certified accurate by Contractor to the capability of the guidance system.

C. “As-built” drawings shall be completed and mapped at Contractor’s expense in a form as required by Engineer, including signed plans, and electronic data files if available.