HORIZONTAL BORE SPECIFICATIONS

SECTION 0 – GENERAL REQUIREMENTS

PART 1 – GENERAL OVERVIEW

1.01 Definitions – For the purposes of these Horizontal Directional Drill Specifications ("Specifications"), the following definitions shall apply:

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

B. "Engineer" shall mean the engineer for HSE, which is Sanitary Management & Engineering Company, Inc. ("SAMCO") or SAMCO's engineers. SAMCO's inspector shall be the 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 HSE 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 HSE to construct, install, maintain, repair and remove public or Private sanitary sewer facilities within the HSE service area. This definition is intended to include all employees, sub–contractors and/or agents acting for or on behalf of the Contractor's company.

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

F. "Record Drawing Engineer" shall mean the engineer who will certify the record drawings, as opposed to the Engineer for HSE and the Design Engineer, both of whom are also defined under these Specifications. The 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 the Record Drawing Engineer's company.

G. "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 HSE approved Construction Plans and the standards, specifications and details of HSE.

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

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

J. "Completed" with regards to Projects shall mean any Projects which are acceptably constructed, tested and through which customer service has been authorized by HSE, but for which HSE has not received title. All applicable fees must be paid to HSE 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 HSE'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 HSE's "Sanitary Sewer Completion Specifications". Completion Documentation must meet the applicable standards in effect at the time the documents are submitted.

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, Specification and Details

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

B. These Specifications, including those identified in section 1.05A above and HSE's Design Specifications for Sanitary Sewer Facilities 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 when provided to the 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 the sanitary sewer flow, different or unusual conditions may occur which cannot be action 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, the 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 the 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 a part of this contract.

C. In the event construction practices are not described, but in the Engineer's opinion, will affect the quality of construction or long term maintainability of the sanitary sewer facilities, the Engineer must approve any construction practices proposed by the 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 HSE 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 the horizontal directional bore and other miscellaneous items ("Infrastructure") to convey sewage in an acceptable and operable manner.

B. Contractor must provide all necessary work to install the 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 and 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. 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 the 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 one (1) complete set of Construction Plans for distribution to the Engineer's inspectors and Contractor.

D. Contractor will not be permitted to initiate construction until the Construction Plans are formally approved and the 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 obtained from and approved by all affected government 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. The 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 the initiation of construction.

I. A pre–construction meeting is required between the Engineer and Contractor prior to the initiation of construction. The 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 the Sanitary Sewer Facilities.

2.04 Continuity of Construction

A. Once construction has commenced, the Project must be Completed promptly and in a timely manner as directed by the Engineer.

B. Contractor can not discontinue work on the Project, except for weather delays, without written approval from the Engineer and in this case no sanitary sewer structures including gravity manholes, wet wells, valve vaults, air/vacuum release manhole, clean–out manholes, flow monitoring/metering manholes, 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, Record Drawing Engineers and surveyors must abide by HSE's "General Procedures for Manhole Opening and Entry" or the most recent IOSHA confined space entry standards, which ever is more stringent.

2.06 Cleanliness

A. The 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 the 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. The Contractor is responsible for the delivery, storage and handling 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 so as 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 the interior of products free from dirt or foreign matter. Drain and store products in a manner that will protect them from damage by freezing. Store electronic 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. The Contractor is responsible for verifying that the 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. The 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 of the type approved by the National Electric Code ("NEC"), Uniform Building Code and Underwriters Laboratories Inc. ("UL").

D. All Infrastructure must be new and unused.

E. The Contractor must provide assurance to the Engineer that the pressure/gravity sewer is laid accurately to the required line and grade as shown on the Construction Plans. The Contractor must constantly check horizontal alignment of the force main. The Contractor must coordinate verification of the force main with the Record Drawing Engineer so as to provide an as–built record set as described later in these Specifications. 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 force main 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 force main of each size and type of material has satisfactorily passed the initial performance tests or a waiver is received. No initial performance test is done with gravity sewers.

2. Subsequent Performance Testing – As work progresses, the Engineer may designate additional sections for subsequent performance testing as conditions in his opinion warrant. The Engineer will notify the Contractor of the location where subsequent performance test(s) are to be required not later than fifteen (15) days after the force main is installed. Unless otherwise authorized, the Contractor must arrange to commence the subsequent performance test(s) within fifteen (15) days after the force main has been installed or fifteen (15) days after receiving notification by the 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, the process of manufacture and the finished product are subject to inspection and acceptance by the Engineer. Such inspection may be made at the place of manufacture and/or on the work site after delivery. The 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 rejected, immediately removed from the site and replaced at Contractors sole expense.

C. Contractor must repair, or permit manufacturer to repair, any pre–cast concrete structures with exposed steel or welded wire fabric reinforcement.

2.10 Relation to Walls 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, the Contractor must notify the Engineer for specific instructions.

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

C. Sewer/water supply separations and pipe classifications must conform with the latest edition of the Indiana State Board of Health's ("ISBH") "On–Site Water Supply and Wastewater Disposal for Public and Commercial Establishments – Bulletin S.E. 13."

2.11 Utilities

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

B. Permanent Relocation of Utilities

1. Except as otherwise noted on the Construction Plans, it is the responsibility of the Contractor to move or pay for moving all utility appurtenances, including but not limited to, water mains, storm sewer inlets, gas lines, wire 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 the Contractor has considered in his bid all of the permanent and temporary utility appurtenances shown or otherwise indicated on the Construction Plans. It is also understood and agreed that no additional compensation will be allowed for any delays, inconvenience or damage sustained by the Contractor due to any interference from said utility appurtenances or the operation of moving them either by the respective utility company or the Contractor.

3. The 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 Completed.

2.12 Installation Service

A. Provide services of factory–trained representative for up to a period of 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 during the course of the Project an up–to–date plan set which accurately reflects the actual, as–built dimensions, materials of construction, horizontal location, vertical elevation and other relevant information necessary to develop a set of as–built record drawings in accordance with HSE's "Sanitary Sewer Completion Specifications".

B. As–built horizontal locations and vertical elevations are required on all fittings (including ells, tees, valves and adapters), the force main (at a maximum separation of 500 feet), the top and bottom of the wet well and valve vault and inverts into the wet well, clean–outs and air/vacuum release manholes.

C. Failure to provide as–built information as specified in HSE's "Sanitary Sewer Completion Specifications" may require excavation by the Contractor to obtain this information.

2.15 Completion Documentation

A. HSE's "Sanitary Sewer Completion Specifications" specify the requirements which must be met prior to the time the Project is placed into service.

B. Contractor and Record Drawing Engineer must provide to HSE and Engineer in Subscriber's name the necessary Completion Documentation for the Project, including record drawings and a digital file. At the end of construction, Engineer will provide a Record Drawing Notification to the Subscriber and Record Drawing Engineer. Completion Documentation, including record drawings in a digital file format, must be delivered by Contractor and Record Drawing Engineer in the name of Subscriber to Engineer within thirty (30) days of the date of this notification. If the Completion Documents have not been provided within sixty (60) days of the date of this notification, HSE will procure the services necessary to generate or otherwise acquire the record drawings and other Completion Documentation at Subscriber's expense.

C. Record Drawing Engineer must also submit Sanitary Sewer Record Drawing Information sheets for all Lift Station/Force Main Manholes that have not been previously as–built. These sheets must be submitted to Engineer within fourteen (14) days of the Record Drawing Notification.

D. 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. Contractor must also provide timely responses to Record Drawing Engineer for questions associated with constructed conditions including, pipe sizes, pipe types, horizontal location of concrete encasement/capping and bores, water tight castings, fittings, etc.

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

2.16 Inspection and Reimbursement

A. Full time inspection by Engineer is required for all repairs, maintenance or construction to Infrastructure. Engineer must approve, in writing, all methods of repair to Infrastructure as recommended by the Contractor and manufacturer. Failure to comply will be grounds for removal from the HSE approved contractor list.

B. Contractor must pay Engineer for all inspector's overtime cost. Contractors will be charged overtime costs at the rate of $28.00 per hour prior to 7:00 a.m. and after 3:30 p.m. on weekdays and all day on Saturdays. The hourly rate for Sundays and holidays will be $56.00 per hour. The above rates are subject to change without notice. Contact Engineer prior to starting construction for current rates.

C. If, at the sole discretion of Engineer, construction volume is less than what is deemed acceptable, then the Contractor may be required to pay $200 per day for additional inspection services.

D. The 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

3.0 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. The 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, and then enlarging the pilot hole 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 the Directional Drilling Contractor within the scope of this project.

D. The 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, cleaning up, and all other operations necessary to complete the work as shown on the plans and specified.

3.01 SCOPE

This specification covers the use of HDPE and thrust–restrained Poly–Vinyl Chloride (PVC) pipe.

3.02 REFERENCE DOCUMENTS

American Society for Testing and Materials (ASTM)

ASTM F1962: Use of Maxi–Horizontal Directional Drilling for Placement of Polyethylene Pipe or Conduit Under Obstacles, Including River Crossings,

ASTM D1784: Standard for Rigid PVC Compounds and Chlorinated PVC Compounds.

ASTM D2837: Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials

ASTM D3139: Standard Specification for Joints for Plastic Pipes Using Flexible Elastomeric Seals

ASTM D3261: Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene Plastic Pipe and Tubing

ASTM D3350: Standard Specifications for Polyethylene Plastic Pipe and Fitting Materials

ASTM F477: Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe

American Water Works Association (AWWA)

AWWA C900: Standard for PVC Pressure Pipe and Fabricated Fittings, 4" Through 12", for Water Distribution

AWWA C901: Polyethylene (PE) Pressure Pipe and Tubing ½ in. through 3 in. for Water Service

AWWA C905: Standard for PVC Pressure Pipe and Fabricated Fittings, 14" through 48", for Water Transmission and Distribution.

AWWA C906: Polyethylene (PE) Pressure Pipe and Fittings 4 in. through 63 in. for Water Distribution.

3.03 SUBMITTALS

A. Data supporting the directional drilling contractor's qualifications and experience.

B. Work plan: Prior to beginning work, the CONTRACTOR must submit to the ENGINEER a work plan detailing the procedure and schedule to be used to execute the project. The work plan should include a description of all equipment to be used, crew size and models, a list of all personnel and their qualification and experience (including backup personnel in the event that an individual is unavailable), list of subcontractors, a schedule of work activity, a safety plan (including MSDS 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 particular project. Plan should document the thoughtful planning required to successfully complete the project.

C. Bore plan: Prior to beginning work, the CONTRACTOR must submit to the ENGINEER a signed and sealed, scaled drawing of the pilot bore plan for review and approval. (Max. Vertical scale 1" = 2' and Max. Horizontal scale 1" = 20'). The plan shall show finished grade, deflection and radiuses of the pilot bore, all existing utilities with minimum vertical and horizontal clearances. The plan shall also address the location of the drill rig setups and for multiple bores, the lengths of each bore based on soil condition, equipment used, topography, etc. The proposed bore path and horizontal clearances between the 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 the 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), downhole tools, guidance system, and rig safety systems. Calibration records for guidance equipment shall be included. Specifications for any drilling fluid additives that CONTRACTOR intends to use or might use shall also be submitted.

3.04 QUALITY ASSURANCE

A. All directional drilling operations shall be performed by a qualified directional drilling CONTRACTOR with a least (3) years experience involving work of a similar nature to the work required of this project. The CONTRACTOR must have installed a minimum of 50,000 linear feet of pipe (4–inch 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 the 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. The 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 DR 14 (Class 200). The pipe material to be used for 14" through 18" diameters shall meet AWWA C905 standards for Polyvinyl Chloride pressure pipe and fittings and shall have a dimension ratio DR18 (Class 235). PVC pipe that is intended for use as a casting for a finished product pipe may have the dimension ratio DR 18. The pipe shall be designated as Certa–Lok C900/RJ or Certa–Lok C905/RJ as manufactured by CertainTeed Corporation. All other pipe shall have the written approval of the Engineer and meet all submittal review as an optional approved product.

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

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

D. Exposed splines shall be cut 3/4" 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, the Contractor shall adhere to the pipe manufacture's most current data regarding tensile load limitations for trenchless application. Generally, the maximum pull–in force shall not exceed the following values:

Size (inch)	SDR	Class (psi)	Pipe O.D. (inch)	Coupling O.D. (inch)	Maximum Pull–in Force Tightest Bending (lbs.)	Maximum Pull–in Force Straight Pull (No Bending) (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, the Contractor shall adhere to the pipe manufacture'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 installation. The combination of proposed radius of each bore shall be part of the required submittal prior to work.

Pipe Diameter (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, the deflection radius shall not exceed 75% of the maximum allowable curvature allowed for standard C900 PVC pipe.

I. The 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 the Engineer's requirements, whichever is more stringent.

4.02 HIGH DENSITY POLYETHYLENE (HDPE) PIPE

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

HDPE pipe shall only be black in color.

B. HDPE pipe (PE 3408) shall meet the requirements of ASTM D3350/F714. Cell classifications shall be 345444C. Pressure Class and Standard Dimension Ratios (SDR) shall be as follows:

Class 160 – DR 11

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

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.

Topping sleeves shall not be acceptable.

Fittings shall not be field fabricated.

D. 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.

Ductile iron backup rings shall be of the convolutant type, fabricated from ductile iron per ASTM A 536, grade 60–40–18 (Class 150). Ductile iron flange backup ring bolting dimension shall conform with ANSI B16.5 Class 150.

Backup rings shall be finished and coat 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 manufacturer's recommendations.

2. Gasket materials shall be compatible with the service of piping system. Asbestos gaskets are not allowed.

E. 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.

Materials to be fusion bonded shall be from the same manufacturer.

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.

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 the fusion bonding work.

F. Quality Assurance

The 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 D–1505 and melt flow rate per ASTM D–1238 and contamination. All incoming materials shall be certified by the supplier. Certificates shall be verified by the pipe manufacturer and submitted to the Engineer.

4.03 DIRECTIONAL DRILLING EQUIPMENT REQUIREMENTS

A. General: The directional drilling equipment shall consist of a directional drilling rig of sufficient capacity to perform the bore and pull back the pipe, a drilling fluid mixing, 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 volume, 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 this project.

B. Drilling Rig: The directional drilling machine 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 monitor and record maximum pull–back pressure during pull–back operations. There shall be 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. Tools 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 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 feet and accurate to 2–feet horizontally.

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

C. The Magnetic Guidance System (MGS) shall be set up and operated by personnel trained and experienced with the system. The 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 composed of bentonite clay, potable water, and appropriate additives. 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 minimum of 1,000 gallons. Mixing system shall continually agitate the drilling fluid during drilling operations.

B. Drilling Fluids: Drilling fluids shall be composed of potable water and bentonite clay. Water shall be from an authorized source with a pH of 8.5 – 10. Water of 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 minimum viscosity's as measured by a March funnel:

Rocky Clay	– 60 seconds
Hard Clay	– 40 seconds
Soft Clay	– 45 seconds
Sandy Clay	– 90 seconds
Stable Sand	– 80 seconds
Loose Sand	– 110 seconds
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 minimum 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 drill pipe. Used drilling fluid and drilling fluid spilled during operations 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 of 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 in the preceding sections shall not be used unless approved by the ENGINEER prior to commencement of the work. Consideration for approval will be made on an individual basis for each specified location. The proposed device or system will be evaluated by ENGINEER without undue delay and shall maintain line and grade within the tolerances prescribed by the particular conditions of the project.

4.07 PERSONNEL REQUIREMENTS

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

B. A competent and experienced supervisor representing the CONTRACTOR and Drilling Subcontractor shall be present at all times 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. The CONTRACTOR and Subcontractor shall have a sufficient number of competent workers on the job at all times to insure 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. The 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 the ENGINEER is present at the job site and agrees that proper preparations for the operation have been made. The 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 at such time as appropriate without causing undue hardship by reason of delay to the CONTRACTOR. A copy of the construction drawing must be on the job site during construction and used for field marking "as built" information on a daily basis. If the field "as built" data is not maintained by the CONTRACTOR the ENGINEER shall recommend that that OWNER withhold payment(s) until the field data is up dated.

B. All work under this specification affecting Indiana Department of Transportation property, right–of–way or facilities shall be carried out to the full satisfaction of the INDOT auth