SECTION 0 – GENERAL REQUIREMENTS

PART 1 – GENERAL OVERVIEW

1.01 Definitions

For the purposes of these Gravity Sanitary Sewer Specifications ("Specifications"), the following definitions shall apply:

A. "HSE" shall mean Hamilton Southeastern Utilities, Inc., the public utility that 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 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 Contractor's company.

E. "Design Engineer" shall mean the engineer sealing the Construction Plans, as opposed to Engineer for HSE 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 HSE approved Construction Plans and the standards, specifications, and details of HSE.

G. "Sanitary Sewer Facilities" shall mean any pipes, manholes, flow monitoring/metering 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 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 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, Specifications and Details

A. HSE's Gravity Sanitary Sewer Details sheet, 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, and Design Specifications for Sanitary Sewer Facilities 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, HSE's Gravity Sanitary Sewer Details sheet and HSE's Design Specifications for Sanitary Sewer Facilities are complementary in nature and should not be interpreted individually.

C. These Specifications and HSE's Gravity Sanitary Sewer Details sheets, 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 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 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 the 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 "French 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 Sanitary Sewer Facilities, access drives and other appurtenances to convey sewage to the receiving sewer in an acceptable and operable manner.

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

C. All pipe, fittings, 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 and fittings 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. 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.

C. Certified copies of test reports on factory tests.
1. Where required by the applicable manufacturing standards provide a copy of the manufacturer's inspection or test report and a certified statement by the manufacturer that the material has been sampled, tested, and inspected in accordance with the applicable manufacturing standards.
2. All factory inspections, tests and record keeping identified as mandatory or required under the applicable standards for each product are required under these Specifications. Factory inspections and tests which are identified as optional under the applicable manufacturing standards, are not required unless otherwise specifically indicated in the Construction Plans or these Specifications.
3. An authorized agent of the manufacturer or distributor must sign each certification and report.

D. Catalog cuts with product data, including details of manufacture, for all manufactured items.

E. Manufacturer's recommendations on all materials and methods of installation.

F. Form of warranty.

G. Operation and maintenance instructions for all mechanical and electrical equipment.

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 PDF and AutoCAD file of complete set of Construction Plans.

D. Contractor will not be permitted to initiate construction until the 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 the initiation of construction.

I. A pre-construction meeting is required between 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 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, flow monitoring/metering manholes, grease traps, grit traps, oil/water separators, neutralization tanks, etc. (Manholes) can be left open and incomplete.

2.05 Stop Work Order

A. Engineer has the authority to direct the issuance of an order requiring suspension of the pertinent construction activity (Stop Work Order) when it is determined that construction activity:
1. Is proceeding in an unsafe manner.
2. Is proceeding in violation of a requirement or specification of HSE.
3. Is proceeding in a manner which is materially different from the application, plans, or supporting documents; or
4. For which a permit is required, and work is proceeding without such permit being in force. In such an instance, Stop Work Order shall indicate the effect of the order is terminated when required permit is issued.
5. Stop Work Order shall be in writing by HSE and shall state to what construction it is applicable and the reason for its issuance.
6. One (1) copy of Stop Work Order shall be conspicuously posted on the property, and one (1) copy shall be delivered via mail to the Owner of the property or their agent.
7. Stop Work Order shall state the conditions under which construction may be resumed.
8. If a Stop Work Order is issued, Contractor shall restore site to a safe condition prior to stopping work pursuant to the order.
9. The sanctions provided in this section shall in no way limit the imposition of penalties provided elsewhere in these Specifications.

2.06 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.

2.07 Cleanliness

The Project site must at all-time be kept free of trash, rubbish, unsightly materials, and other nuisances associated with sanitary infrastructure installation.

2.08 Product Delivery, Handling, and Storage

A. Contractor is responsible for the 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 not to 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 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. 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.

2.09 Quality Assurance

A. Contractor must test and perform quality assurance requirements on all Sanitary Sewer Facilities 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), and American Association of State Highway and Transportation Officials (AASHTO) standards or as indicated in these Specifications and/or the Construction Plans, whichever is more stringent.

C. All sanitary sewer facilities must be new and unused.

D. Line and grade requirements
1. Contractor must provide assurance to Engineer that the sewer is laid accurately to the required line and grade as shown on the Construction Plans. Contractor must constantly check horizontal and vertical alignment of the gravity sewer. Contractor may install either main line pipe between three (3) manhole structures or to a manhole structure which is one thousand (1,000) lineal feet of main line pipe from an as-built manhole structure associated with an adjoining project Section or sanitary sewer interceptor which has been verified and reflected as complete on the HSE GIS infrastructure map, whichever is of the greater distance.
2. Contractor must coordinate verification of Sanitary Sewer Facilities installation with Engineer to provide an as-built record, as described later in these Specifications, with the completion of every three manholes. Verification is defined as certification by Contractor's representative as to actual invert elevation, length of pipe, and slope. Construction is not permitted to continue until the above stated verification conditions are satisfied. Variations from uniform line and grade, as shown on the Construction Plans and as described below, are cause for the pipe to be rejected and re-laid in compliance with the Construction Plans.
3. The variance from design line and grade between manhole structures cannot be greater than one-half (1/2) inch total, provided that such variation does not result in a level or reverse sloping of the pipe between joints.
4. Contractor's survey equipment (level, transit, GPS, etc) shall bear calibration certification documentation by the manufacturer's approved service facility within six (6) months of it being in use.
5. Engineer will not accept gravity sanitary sewers below minimum slope. Reconstruction of sanitary sewers may be required at the utility's discretion.

2.10 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 Gravity Sanitary Sewer Details 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.

D. Pre-cast reinforced concrete structures, adjustment rings, and tops are subject to rejection for failure to conform with, but not limited to, any of the following requirements:
1. Fractures or cracks passing through the shell with a depth greater than or equal to one (1) inch.
2. Cracks having a width of four-tenths (.40) mm (.016 in) or greater.
3. Defects that indicate imperfect proportioning, mixing, or molding.
4. Surface defects indicating honeycombing or open texture.
5. Damaged ends where such damage would prevent making a satisfactory joint.
6. Infiltration into the structure.
7. The internal diameter of the structure must not vary by more than one (1) percent from the nominal diameter.
8. Not clearly marked with date of manufacture, trade name, size designation, ASTM number, etc.
9. Having any visible steel bars or wire mesh along inside or outside surfaces of the structure.
10. Evidence of patching.

2.11 Relation to Wells and Water Supplies

A. Sewers 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 sewer crosses a water main, the sewer should be laid at least eighteen (18) inches below the water main.

C. When the above conditions cannot be obtained, the sewer must be constructed of ANSI/AWWA C905 waterworks grade PVC pipe, SDR 21 PVC (ASTM D2241) pressure sewer pipe, or ANSI/AWWA C900 with compression fittings. The joints must be located equidistant in both directions from the water main. The sewer must be the type of pipe described above for a minimum of ten (10) feet beyond the cross point. Special structural support for the water main and sewer may be required.

D. 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).

2.12 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 HSE, 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.

2.13 Installation Service

A. The service of an experienced installation representative of the manufacturer must be provided when Engineer deems it necessary. The representative must be available when installation problems arise, when requested by Engineer to resolve installation problems, and during testing of the Sanitary Sewer Facilities having equipment installed.

B. The manufacturer of any Sanitary Sewer Facilities may be required to provide installation advice to Contractor's workforce. Engineer will determine the need for these services based on job site conditions encountered during construction.

2.14 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.

2.15 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 (horizontal location and vertical elevation), materials of construction, and other relevant information necessary to develop a set of as-built record drawings.

B. As-built horizontal locations are required on all manholes, wyes, lateral markers, and end of stubs (if greater than 20 feet). As-built vertical elevations are required on all manhole top of casting and inverts, clean-out top of castings, and upstream inverts of stubs greater than 20 feet. Engineer will schedule the as-built survey of completed new infrastructure construction and bill Subscriber for the as-built costs.

2.16 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. On a daily basis, Utility inspector and Contractor shall submit a HSE Lateral Location form to Engineer detailing all wye connections, pipe type, stationing, and pipe grade. Prior to being submitted, Utility Inspector and Contractor must digitally sign the Lateral Location Form. The as-built location of the wye station can be supplied by measuring along the pipe section and assigning a station to each connection from the nearest downstream manhole structure. An accuracy of two (2) +/- feet is required.

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, Lateral Location forms, television logs, etc. are the responsibility of Inspector who shall provide them to Engineer.

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 the 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.

2.17 Inspection and Reimbursement

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

B. If, for any reason, construction work is delayed or canceled, Contractor shall notify Engineer's inspector assigned to the Project and Engineer's chief inspector at least one hour (1) prior to the normal scheduled start time on the day the work is delayed or canceled. Contractor will be charged the prevailing rate for failure to notify Engineer's inspector and/or inspector's supervisor per occurrence.

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

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

E. 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 – TESTING, PUNCH LISTS, AND CLEANING

3.01 General Testing Requirements (Except Pump Factory Test)

A. Notification must be provided at least three (3) days prior to any testing. All lines must be clean and free of any debris.

B. At HSE's option, all testing within the HSE service area may be performed by HSE or their agent. Contractor shall reimburse HSE or its agent at HSE's current rate for all testing related services.

C. All testing (except manhole vacuum testing) must be conducted after the backfill has been in place for at least thirty (30) days and after all other in ground utilities have been installed.

D. At Engineer's discretion, testing may be delayed, or additional testing may be required, based upon weather conditions (inadequate precipitation to allow for adequate settlement, temperature variance between mandrel and pipe, etc.). Testing may also be delayed, or additional testing may be required due to the installation of site improvements (including but not limited to fencing, signage, landscaping, site lighting, and other sub-surface improvements).

E. If Subscriber requires sanitary sewer service prior to final testing, a preliminary test may be performed, however, Subscriber must provide, in writing, a guarantee that all cleaning and testing will be performed per the Construction Plans and HSE's then current standards, specifications, and details.

3.02 Deflection Testing

A. If testing is delayed per Section 3.01-E above, due to the lack of precipitation and, in the opinion of Engineer, the densification of the backfill is inadequate, Contractor may perform a mandrel test utilizing a mandrel sized to measure a deflection limit of three (3) percent. This may only be done with permission of Engineer, in writing, after all requirements of Section 3.01-D have been met.

B. All PVC (non-lateral) pipe must be tested for deflection with an acceptable go-no-go mandrel. No pipe can exceed a deflection of five (5) percent. The deflection test must be conducted using a mandrel having a diameter equal to ninety-five (95) percent of the inside diameter of the pipe. The test must be performed without a mechanical pulling device and the rope used to pull the mandrel must be no stronger than one hundred-fifty (150) pound test. Tag/trail rope may be of any size to allow removal of mandrel. A single individual of average size, weight, and strength, without the use of tools to gain leverage, must pull the mandrel. All pipe exceeding the allowable deflection must be replaced or repaired and re-tested.

C. Engineer reserves the right to require an additional mandrel test on sections of flexible pipe which are crossed by storm sewers any time prior to conveyance to HSE.

D. Engineer will not accept sewers with "sags" greater than one thirty-second (1/32) of an inch per inch of pipe diameter, not to exceed one-half (1/2) inch total.

3.03 Sewer Water Tightness Testing

A. Acceptability Limits
1. Maximum infiltration/exfiltration limits for all new sanitary sewers will be fifty (50) gallons per inch of diameter per mile of pipe per twenty-four (24) hours. This standard is applicable to each discrete section of the Project and includes all manholes and lateral service connections. All sections of the sewer must be tested and any sections not meeting these limits must be repaired and re-tested.
2. In the presence of groundwater or poor soil conditions, and if required by Engineer, the sewer may be required to successfully complete a water tightness test before proceeding with any additional construction.

B. Test for water tightness must be conducted on all sewers in the Project.

C. Where test results exceed allowable limits, Contractor must correct the construction of the sewer and retest so that the section tested is within allowable limits. All methods and materials used in the repair must be accepted by Engineer in writing. Grouting of joints is not an acceptable repair method.

D. If groundwater is present during installation of the sanitary sewer mainline, Contractor shall maintain a dewatering management operation to keep water out of the pipe and not incur any floatation issues. As with all aspects of construction, it is Contractor's responsibility to ensure all materials and modes of operation are properly secured and safe.

E. At Engineer's discretion, the following tests may be required:
1. Air Test for Leakage per ASTM F1417
   a. The ends of the pipe being tested must be sealed and properly braced for developed end thrust to prevent displacement while the line is under pressure and potential safety concerns. The air supply line will have an on/off valve and a pressure gauge (calibrated within the past 6-months) having a range from zero (0) to fifteen (15) psi. The gauge must have minimum divisions and an accuracy of five-hundredths (0.05) psi.
   b. The pipe to be tested must be clean.
   c. The groundwater level surrounding the section of pipe under testing must be determined from static dewatering well or prior observation. If the groundwater table is above the pipe, test pressures must be increased forty-three hundredths (0.43) psi for each foot of water over the lowest invert.
   d. The air must be introduced slowly to the section of pipe under evaluation to enable equalization in the pipe section. Air pressure should be increased in small steps until the internal air pressure is five (5) psi greater than the hydrostatic pressure head created by the groundwater over the pipe section.
   e. A minimum of two (2) minutes must be provided for the air pressure to stabilize to conditions within the pipe. Engineer shall determine the stabilization time based on field conditions and weather. The stabilization period is necessary for variations in temperature to adjust to the interior pipe conditions. Air can be added slowly during the stabilization period to maintain a minimum pressure of five (5) psi greater than the hydrostatic pressure created by groundwater.
   f. After the stabilization period, when the pressure reaches exactly five (5) psi greater than the hydrostatic pressure created by groundwater, the stopwatch must be started; and when the pressure reaches three and half (3 ½) psi greater than the hydrostatic pressure created by groundwater, the watch must be stopped. The portion of the line being tested will be acceptable if the time for the air pressure to decrease within the stated range is greater than the time shown below. If the pipe length is between the specified lengths below, the time must be based on the next greater length.
   g. Safety precautions during Air Test
      i. The air test may be dangerous if, because of ignorance or carelessness, a line is improperly prepared. It is extremely important that the various plugs be installed and braced in such a way to prevent blowouts. Contractor should realize the sudden expulsion of a poorly installed plug could be dangerous. Likewise, a plug that is partially deflated before the pipe pressure is released can be equally dangerous.
      ii. As a safety precaution, pressurizing equipment should include a regulator set at ten (10) psi to avoid over pressurizing and damaging an otherwise acceptable line.
      iii. No one is allowed in the manholes during testing.

3.04 Manhole Testing

A. All sanitary sewer manholes and flow monitoring/metering manholes must be vacuum tested per ASTM C1244 after installation, repair, or modification. Test to be performed by Contractor or HSE appointed agent and witnessed by Field Inspector prior to adjustment ring(s) and casting placement.

B. Installation and operation of vacuum equipment and indicating devices must be in accordance with ASTM C1244.

C. With the vacuum tester in place, draw a vacuum of ten (10) inches of mercury and close the valve.

D. Acceptance standards for leakage will be established from the elapsed time for a negative pressure change from ten (10) inches to nine (9) inches of mercury. The maximum allowable leakage rate for a four (4) foot diameter manhole must be in accordance with the following:

Manhole Depth	Minimum Elapsed time for a Pressure Change of 1-inch Mercury
10ft or less	60 sec
>10ft but <15ft	75 sec
>15ft but <25ft	90 sec
>25ft but <30ft	105 sec
>30ft but <35ft	120 sec

For manholes five (5) feet in diameter, add an additional fifteen (15) seconds and for manholes six (6) feet in diameter, add an additional thirty (30) seconds to the time requirements for four (4) foot diameter manholes.

E. Manholes will be subject to visual inspection with all visible leaks being repaired.

3.05 Punch Lists

A. After all tests have been successfully completed, Engineer will perform inspection of Sanitary Sewer Facilities and provide Contractor a written summary of items, or punch list, which require corrective action.

B. Contractor must complete all punch list items within twenty-one (21) days of issuance. If, in opinion of Engineer, punch list has not been completed, Contractor must pay HSE additional inspection fees per re-inspection (inclusive of associated management costs) until Engineer deems punch list complete.

3.06 Video Inspection

A. Sections of sewer will be inspected at Engineer's discretion and in coordination with Contractor. This work shall be at the expense of HSE prior to approving sanitary sewer availability for service.

B. Prior to conveyance of the infrastructure to the Utility, HSE will furnish all equipment and personnel to perform all work required in the inspection and video recording operation at Contractor's expense.

C. All new sewers must be cleaned by Contractor prior to any testing or video inspection of mainline sewers. Failure to adequately perform this task will delay work completion. The inspection staff shall exercise reasonable effort to not introduce debris into otherwise clean manhole structures.

PART 4 – OPERATION, CLEANING, AND FINAL INSPECTION PRIOR TO CONVEYANCE

4.01 Operation

No person, including but not limited to, Subscribers, maintenance workers, Contractors, sub-contractors, and engineers shall, directly or indirectly, allow flow to occur from any Project which is not Complete to a Completed Project status.

4.02 Cleaning

The Project must be cleaned, as directed by Engineer at Subscriber's expense at least once prior to conveyance.

4.03 Final Inspection

A. Within six (6) months prior to conveyance, Engineer will conduct an inspection (Final Inspection) at Subscriber's expense. The Final Inspection will consist of a walk-through and video inspection of the Project to identify any defects. The Final Inspection may also consist of flow monitoring, smoke, infiltration, deflection tests as determined by Engineer.

B. After Final Inspection has been performed, Engineer will provide a written summary, or punch list, of items which require corrective action. Subscriber must complete all punch list items within sixty (60) days from the date of issuance of the punch list. If, after the sixty (60) day period, and in sole opinion of Engineer, the punch list items have not been corrected in entirety, Contractor and/or Subscriber may be required to pay HSE additional inspection fees until the items are corrected.

C. Subscriber must rectify all defects identified during the Final Inspection in a manner acceptable to Engineer prior to Sanitary Sewer Facilities being conveyed to HSE.

SECTION 1 – MANHOLES, PIPES AND FITTINGS

PART 1 – PRODUCTS

1.01 General Requirements

A. Under general laying conditions, sewer pipe can be any one of the pipe materials specified in these Specifications provided, the material is that pipe type and standard indicated on the Construction Plans.

B. Markings
1. All pipe and fittings must be clearly marked in accordance with the various standards under which they are manufactured. All pipe must be marked with durable printing according to ASTM/AWWA standards.
2. A marking must be provided on the spigot of each pipe utilizing bell joints to indicate when the pipe is driven home.

1.02 Polyvinyl Chloride ("PVC") Pipe

A. PVC pipe and fittings must be smooth wall inside and out and must conform to ASTM D3034 and ASTM F1336 (SDR 26 or SDR 21), Type PSM or CAN/CSA-B182.2.M90, the more stringent must apply for sizes up to 15 inches; ASTM F679 (T-1; T-2 as approved by Engineer) or AASHTO M278 or CAN/CSA-B182.2.M90, the more stringent must apply for sizes greater than 15 inches; ASTM D2241 (SDR 21) for sizes up to 24 inches; ANSI/AWWA C900 (DR 18) for sizes 4 – 12 inches; ANSI/AWWA C905 (DR25 or DR 18) for sizes 14 – 24 inches.

B. Joints, on PVC sewer pipe, must be the integral bell type gasketed joint designed so when assembled, the elastomeric gasket inside the bell is compressed radially on the pipe spigot to form a positive seal. The joint must be designed to avoid displacement of the gasket when installed in accordance with manufacturer's recommendations. The joint must comply with ASTM F477 and ASTM F913 and the physical requirements of ASTM D3212 and Uni-Bell PVC Pipe Association's UNI-B-1 "Recommended Specifications for Thermoplastic Pipe Joints, Pressure and Non-Pressure Applications", the more stringent must apply. The gasket must be the only element depended upon to make the joint flexible and watertight.

C. PVC pipe type ASTM D3034 (SDR 26) can be used to thirty (30) feet.

1.03 Fittings

A. Fittings such as wyes, tees, and bends must be made in a manner that will provide strength and water tightness at least equal to the class of the adjacent mainline pipe to which they are joined. Fittings must conform to all other requirements specified for pipe of the corresponding class and diameter. Joints must be of the same type as used on the adjoining pipe. All fittings must be bell by bell. Bell by spigot fittings will not be permitted except at Engineer's discretion. Fabricated fittings (not molded as a single integral unit) and saddles will not be allowed. Plastic Trends, Inc. fittings are recognized as an acceptable alternative to this standard.

B. If necessary, due to material shortage, water grade fittings may be substituted provided the application is clearly marked as sanitary sewer.

1.04 Manholes and Other Structures

A. Manholes must be constructed of monolithic concrete or pre-cast manhole sections. Pre-cast manhole sections must conform to the requirements of ASTM C478 and manhole joints to the requirements of ASTM C443.

B. Materials for Manholes and miscellaneous concrete structures must comply with the following:

1. Concrete for pre-cast manhole sections and monolithic manholes must use four thousand (4000) psi concrete. Ready-mix concrete must conform to ASTM C94, alternate 2. Maximum size aggregate must be one and a half (1.5) inches. Water/cement ratio must be no more than 0.53 by weight. Mix design to include Xypex C-1000 Red by Xypex Chemical Corporation, or ConBlock CDA Red by ConSeal Concrete Sealants, Inc.
2. Reinforcing steel must conform to ASTM A615, Grade 40 deformed bars or ASTM A616, Grade 40 deformed bars.
3. Mortar materials:
   a. Sand – ASTM C144, passing a #8 sieve.
   b. Cement – ASTM C150, Type 1.
   c. Water – must be potable.
4. Joints on pre-cast manhole sections must utilize rubber gaskets meeting the requirements of ASTM C443 and these Specifications, the more stringent will apply. The joint must be further sealed as noted on HSE's Gravity Sanitary Sewer Details sheet.
5. Manufacturer of pre-cast manholes must provide factory cut openings to produce a smooth, uniform, cylindrical hole of the proper size to accommodate the resilient connector. Resilient connectors can alternately be embedded by the manufacturer. All pipes entering and leaving manholes must have a resilient connector meeting the requirements of ASTM C923 firmly clamped around the pipe. The resilient connectors must be PSX gasket or Press Wedge II as manufactured by Press-Seal Gasket Corp. or similar flexible manhole sleeves as manufactured by Kor-N-Seal or equal.
6. Without prior written consent of Engineer, pre-cast manhole sections must be steam cured and cannot be shipped from point of manufacture for at least five (5) days after having been cast. Upon written consent of Engineer, pre-cast manhole sections can be shipped prior to five (5) days if they were manufactured of high-early strength concrete and are verified through testing to have achieved a strength acceptable to Engineer.
7. Manhole castings must be of good quality cast iron conforming to ASTM A48 or DI conforming to ASTM A536, Grade 65-45-12 with concealed rectangular pick-hole. Refer to HSE's Gravity Sanitary Sewer Details sheet for detailed information. Unless specifically designated otherwise, manhole castings must be the non-locking type. East Jordan Durostreet frame and composite cover are to be installed where there is a potential of flooding or corrosive gases (i.e. forcemain outfall).
8. Manhole steps must be made from steel reinforcing encapsulated in a copolymer polypropylene resin. The manhole steps must equal or exceed IOSHA and ASTM C478 requirements. Manhole steps manufactured by M.A. Industries, Inc., American Step Company, Inc., or equal are acceptable.
9. Any special manhole or miscellaneous concrete structures must be constructed as detailed on the Construction Plans.
10. Manhole bases must be combination pre-cast concrete base and first section as a single unit. Detailed drawings must be submitted to Engineer prior to casting or manufacture.
11. No interior surface applied materials can be used.
12. Exterior concrete manhole joints including adjustment rings are to be sealed by butyl and shrink-wrap.
13. Fiber mesh reinforcement for Type 2 cleanouts: Application per cubic yard must equal a minimum of one and a half (1 ½) pounds. Fibers are for the control of cracking due to dry shrinkage and thermal expansion/contraction, to lower concrete permeability and to increase impact capacity, shatter resistance and abrasion resistance. Fiber mesh reinforcement must be manufactured by Fibermesh, 4019 Industry Drive, Chattanooga, TN 37416, or equal as approved by Engineer on a case-by-case basis.

PART 2 – EXECUTION

2.01 Handling and Cutting Pipe

A. Each product to be incorporated into the Project must be handled into its position, placed, and supported only in such manner and by such means as Engineer accepts as satisfactory.

B. Pipe and fittings must be handled carefully to avoid cracking or abrasion of the coating. Handle in a manner to ensure installation in sound and undamaged condition. Do not drop or bump. Use slings, lifting lugs, hooks, and other devices designed to protect pipe, joint elements, and coatings. Ship, move, and store with provisions to prevent movement or shock contact with adjacent units. Handle with equipment capable of performing the work with an adequate factor of safety against overturning or other unsafe procedures.

C. Any fitting or pipe showing a distinct crack, or which received a severe blow which could have caused an incipient fracture, even though no such fracture can be seen, must be marked as rejected and removed at once from the site.

D. All field cutting of pipe must be done in a neat, trim manner. Field cut pipe will only be allowed at manholes, tees, wyes, and at the connection of a new sanitary sewer to an existing sanitary sewer. The cut end must be beveled using a file or a wheel to produce a smooth bevel of approximately fifteen (15) degrees and a minimum depth of 1/3 of the pipe wall thickness.

1. PVC Pipe
   a. PVC pipe must be cut with either a hand saw or power saw.
   b. Smooth cut by power grinding to remove burrs, and sharp edges and smoothly tapered to not damage socket gasket.

2.02 Construction Staking

Contractor shall contract with a Land Surveyor, registered in the State of Indiana, to furnish and set all line and grade stakes (HUB). Land Surveyor will be required to set, or oversee the setting, all benchmark stakes necessary for the installation of any sanitary sewer facility being constructed. Temporary construction benchmarks shall be set in strategic locations, but no more than one thousand (1,000) feet from the Project, to facilitate the installation of grade stakes and elevation control in the area of active sanitary sewer pipe installation. A permanent Benchmark shall be installed by Contactor at the entrance of a new development.

2.03 Laying Pipe

A. Unless approved by Engineer, Contractor must not install different sizes, types, classifications, and grades of pipe between Manholes.

B. No construction work will be permitted after 8:00 PM or dusk, whichever is earlier. Manhole installation must be planned to be stacked out through cone prior to the end of the day and not subject to potential flooding by stormwater.

C. All rough grading of development projects (on-site and off-site) must be finished to within one (1) foot of final grade prior to the start of construction of the Sanitary Sewer Facilities. Contractor must provide and protect survey grade stakes that enable Engineer to verify compliance with the rough grading requirement at least 5-days prior to a scheduled preconstruction meeting for sanitary sewer related work.

D. Contractor must install all off-site laterals with a minimum cover of six (6) feet from top of pipe to grade. Laterals will be considered off-site if they are constructed in an area that will not be platted immediately upon completion.

E. The point of commencement for laying pipe is to be the lowest point in the proposed line. Provisions for beginning construction at other than the lowest point in the proposed line shall require approval by Engineer. All bell and spigot pipe shall be laid with bell end pointing up grade.

F. The existing sewer segment downstream from any connection must be inspected for potential debris prior to plug removal and connection to the existing sanitary sewer. Engineer may require the downstream pipe to be cleaned by a vactor truck, pending inspection findings.

G. If, for any reason, live or in-service Sanitary Sewer Facilities must be plugged, the accumulated wastewater must be pumped out at the location of the plug and either conveyed to an available manhole with sufficient capacity or transported to a proper disposal site. Additionally, the upstream lines and manholes must be cleaned and flushed to the location of the plug on completion of the work.

H. All pipe must be bedded as described in these Specifications under Pipe Bedding and Haunching and on HSE's Gravity Sanitary Sewer Details sheet. Bell recesses must be excavated in advance of pipe laying so the entire pipe barrel will bear uniformly on the prepared sub-grade.

I. The supporting of pipe on block will be permitted only where the pipe is to receive total concrete encasement. Encased pipe must be accurately and effectively supported and secured on crossing "X" rebar.

J. All pipe must be laid accurately to the required line and grade in the manner prescribed by the pipe manufacturer and appropriate ASTM/AWWA standards. Each section of pipe must be laid to form a close, concentric joint with the adjoining pipe at an elevation conforming to the required grade. PVC gravity sewer pipe and fittings must, at a minimum, be installed in accordance with the directions contained in ASTM D2321.

K. Obtain approval from Engineer of method proposed for transfer of line and grade from control of work.

L. At a minimum, Contractor must use laser beam equipment to maintain accurate line and grade. Before proceeding to the next joint, the last joint must be checked for proper line and grade. Survey instruments bearing proof of calibration within prior six (6) months and capable of third order accuracy must be used for checking alignment and grade throughout the Project. It is the Contractor's responsibility to regularly test all equipment to ensure compliance with manufacturer's specifications.

M. Clean interior of all pipe and fittings prior to installation.

N. When bell and spigot pipe is laid, the bell of the pipe must be cleaned of mud, sand, and other obstructions before the clean spigot of the next pipe is inserted. The joint must be made in a satisfactory manner in accordance with the recommendations of the manufacturer and the direction of Engineer. The new pipe must be shoved "home" firmly against the back of the bell. Experienced personnel must perform all joint work.

O. Locate pipe joint to provide for differential movement at changes in type of pipe embedment or at changes in trench bottom material. Do not locate joint within eight (8) feet of Manhole walls, use full length pipe from up-stream connection. Clean and lubricate all joint and gasket surfaces with lubricant recommended by manufacturer. Check joint deflection for specified limits.

P. No water in an excavation shall be permitted to enter the pipe. Contractor to have water under control prior to installing pipe and protect pipe interior from groundwater.

Q. Perform pipe installation only when weather and trench conditions are suitable. Allow pipe to reach trench air temperature prior to installation. Contractor must discontinue pipe installation when there is a danger of the quality of work being impaired because of cold weather. Contractor is responsible for heating the pipe and jointing material to prevent freezing of joints. Pipe must not be laid on frozen ground. Pipe must not be installed unless the outside temperature is greater than thirty-two (32) degrees Fahrenheit.

R. Install a temporary watertight plug at the end of the sewer when installed pipe is left unattended. Contractor must prevent all water, earth, or other material from entering Sanitary Sewer Facilities. An airtight, watertight plug must always be maintained in the Project at the point of connection with the existing sewer from the initiation of construction to the Completion of the Project. At least once a day, Contractor must inspect the plug for water tightness and pump out all accumulated water in excess of six (6) inches from the invert of the outgoing pipe. Contractor is to hold HSE harmless in the event any water, earth, or other material enters the downstream sewer. Contractor is responsible to HSE for the costs of sewage treatment, electrical power, equipment repairs, incidental damages, cleaning, and any other costs or expenses related to such entry, including legal fees, IDEM action response and fines imposed. Contractor shall pay HSE damages per occurrence and all imposed fines and remediation costs.

S. Pipe must be installed to cross storm sewers and other utilities at approximately ninety (90) degrees and must maintain a minimum horizontal separation (measured from outer spring line of each pipe) of ten (10) feet from all storm and utility structures.

2.04 Bores

A. Casing wall thickness as per Section 716 – Trenchless Pipe Installation of the "Indiana Department of Transportation Standard Specifications" latest edition.

B. All work within rights-of-way must be in accordance with the requirements of the governmental agency having jurisdiction. Where no procedures for a particular portion of the work are given, the recommendations of the "Indiana Department of Transportation Standard Specifications," latest edition, must be followed.

C. The gravity-flow carrier pipe shall be shimmed to proper line and grade with stainless steel casing spacers. Verify line and grade upon completion.

D. Contractor shall perform low-pressure air and mandrel testing of the carrier pipe prior to grouting or attachment of end seals.

E. After successful testing, use cellular grout to fill void between the two pipes or attach end seals per manufacture's recommendations.

F. Upon completion of the bore, Contractor must coordinate with Engineer to verify that the carrier pipe is on line and grade. Contractor must submit invert elevations to Engineer.

G. For further information refer to HSE's Gravity Sanitary Sewer Detail sheet.

H. Contractor may request alternate methods or materials such as the use of directional boring and/or PE pipe. In this case, Engineer must approve in writing, the use of alternate methods or materials and Contractor performing the bore.

2.05 Pipe Bedding and Haunching

A. Each pipe section must be laid on a firm foundation of bedding material, haunched, and backfilled with care. These materials must be placed and compacted in accordance with ASTM D2321-Underground Installation of Thermoplastic Pipe for Gravity Sewers.

B. INDOT washed #8 crushed stone, as indicated on HSE's Gravity Sanitary Sewer Details sheet, must be shovel sliced or otherwise carefully placed and "walked" or hand tamped in to ensure compaction of the haunch area and complete filling of all voids. Material must be added in six (6) inch lifts.

C. Prior to pipe installation, carefully bring bedding material to grade along the entire length of pipe. If, in opinion of Engineer, soil conditions are unstable, the trench must be undercut until stable soil is encountered and #2 stone must be placed below the bedding zone sufficiently deep enough to demonstrate compacted base support.

D. When the bedding material is placed in a "fill" area, "fill" must be compacted to 95% standard proctor density prior to installing the sewer.

E. For flexible pipe, such as PVC, the placement of embedment material or haunching around pipe must be done with care. The ability of the pipe to withstand loading in a trench depends upon the method employed in its installation.
   1. Objects that may cause point loading on the pipe must be removed.
   2. Care should be taken to not compact directly over the top of the pipe or displace alignment.

F. Where excavation occurs in rock or hard shale, the trench bottom must be undercut and a minimum of six (6) inches of #8 crushed stone must be placed below the bedding zone prior to pipe installation.

G. All stone bedding above and below Sanitary Sewer Facilities must be free of dirt, organic matter, and frozen material.

2.06 Concrete, Concrete Caps, and Concrete Cradles.

A. The strength of concrete indicated on all drawings, details, and specifications is twenty-eight (28) day compressive strength.

B. Concrete caps, cradles, and encasement must be provided at all locations indicated on the Construction Plans. Where ordered by Engineer, concrete caps, cradles, and encasement not shown on the Construction Plans must be installed. When storm sewers cross Sanitary Sewer Facilities with less than eighteen (18) inches of vertical separation (from the outer edge of each pipe), the Sanitary Sewer Facilities must be supported with a concrete cradle.

C. At Engineer's discretion, Contractor must take four (4) cylinders per five (5) cubic yards of concrete and provide certified test results to Engineer.

D. If the outside temperature is between twenty (20) and thirty-two (32) degrees Fahrenheit and rising, Contractor must use a fifty (50) percent ethylene-glycol/water mixture. If the outside temperature is forecasted to be below thirty-two (32) degrees Fahrenheit during the curing of any concrete or grout application, the concrete must be protected from freezing with insulation blankets acceptable to Engineer. All concrete work must be performed at an outside temperature of over twenty (20) degrees Fahrenheit and rising.

2.07 Manholes and Other Structures

A. All manhole structures to be coated on exterior with asphaltic coating.

B. All manholes, flow monitoring/metering manholes and cleanouts must be constructed in accordance with HSE's Gravity Sanitary Sewer Details sheet.

C. In manholes with multiple influent pipes, Contractor must install all pipe from lowest to highest elevation. The lower elevation pipe must be extended to the next upstream manhole before commencing installation on the next higher sewer.

D. Unless otherwise approved by Engineer in writing, all flow monitoring/metering manholes must be at least five (5) feet in diameter.

E. Manhole channels must be formed and poured with concrete to the crown of the connecting pipe. The finished invert must be a semi-circular shaped, smooth channel directing flow to the downstream sewer. Changes in direction in base channels must be accomplished by smooth, constant radius turns in the channel joining the downstream channel tangentially.

F. Where approved by Engineer, manholes can be added to an existing sanitary sewer. No "doghouse" or "saddle" structures will be permitted. The upstream and downstream sanitary sewers between the new manhole and the existing manholes must be low-pressure air tested and deflection tested. The new manhole must also be vacuum tested while maintaining continuous service.

G. Manholes must be placed and aligned to provide vertical sides within a tolerance not exceeding one (1) inch up to ten (10) feet in depth and two (2) inches up to twenty (20) feet in depth, plus one-eighth (1/8) inch per foot over twenty (20) feet in depth. Tolerance to be checked with a plumb line.

H. All cored holes, penetrations, and/or other openings into a manhole or other sanitary structure must have a minimum separation of eight (8) inches from any joint.
   1. Any holes cut in the field must be smoothly and cleanly drilled with a core-drill or in a manner acceptable to Engineer. All pipes entering and exiting manholes must utilize a resilient connector as previously described in these Specifications.
   2. For cored holes, penetrations, and/or other openings through manholes, an internal separation of greater than eighteen (18) inches between the outer edges of the openings is recommended. If a separation of less than eighteen (18) inches exists, a larger diameter manhole may be required.
   3. All cored holes, penetrations, and/or other openings through manholes must have a minimum internal separation of eight (8) inches from the outer edge of the openings.

I. Contractor must install steps with a minimum horizontal separation of twelve (12) inches from all pipes entering and exiting manholes.

J. Finished grade around manholes and castings must be set at an elevation to prevent surface water runoff from running over or ponding on top of the manhole.

K. Manhole frames must be securely anchored to the cone with bolts and concrete anchors adequate in length to penetrate the structure.

L. Flat top structures are generally not permitted. If a flat top structure is permitted, Contractor must receive written approval from Engineer. No more than eight (8) inches of adjustment rings can be installed on flat top structures.

M. Engineer may, for inspection or testing purposes, take samples of concrete after it has been mixed or as it is being placed in the forms or molds.

N. All grout used to seal or join structures must be non-shrink grout.

2.08 Laterals, Stubs, Connections, Bulkheads, and Miscellaneous Items

A. Where existing sewers carrying sanitary sewage are encountered, Contractor must provide and maintain temporary or redundant pumping systems.

B. Where called for on the Construction Plans, lateral connections and stubs for future sewer connections must be provided. Lateral locations must be recorded on a HSE digital Lateral Locate Form. The upstream end of lateral connections and mainline stubs must be field marked with a two by four (2" X 4"), wrapped with #10 tracer wire. The depth of the lateral must be indicated on the marker.

C. Without written permission from Engineer, Contractor cannot connect any existing sewers or house service into the Project prior to the Project being deemed Complete by HSE.

D. Laterals must be installed to cross storm sewers and other utilities at approximately ninety (90) degrees and must maintain a minimum horizontal separation of ten (10) feet from exterior surface of all water lines, storm structures and utilities.

E. Contractor must notify Engineer at least seventy-two (72) hours prior to any construction of storm sewers that may affect previously constructed Sanitary Sewer Facilities.

F. All laterals must be installed with an insulated #10 tracer wire along the top of pipe from the wye to the terminus. The mainline Contractor shall install the wire from the wye to the cap and wrap wire around the cap. The lateral Contractor shall extend the wire from the terminus to the cleanout adjacent to the building.

G. All lateral tracer wire connections shall use a DryConn Direct Bury Lug electrical insulating, corrosion resistant, wire splice kit.

2.09 Existing Utilities, Structures, Property, Etc.

A. Prior to proceeding, all improvements, including but not limited to, poles, trees, fences, sewer, gas, water or other pipes, wires, conduits, manholes, railroad tracks, buildings, structures, property, etc. along the route of Sanitary Sewer Facilities must not be disturbed without the approval of the responsible representative. Following authorization by the associated owner's representative, the contractor is to support and protect from damage all potentially affected property.

B. Moveable item such as mailboxes can be temporarily relocated during construction, provided their function is maintained. Place movable items back in their original location immediately after backfilling is finished, unless otherwise shown on the Construction Plans. Any movable items damaged during construction must be replaced by an item of equal or better quality.

C. Contractor must proceed with caution in the excavation and preparation of trenches so the exact location of underground utilities and structures can be determined. Contractor is responsible for repair of utilities and structures when broken or otherwise damaged due to construction activity.

D. Contractor must make explorations and excavations when, in the opinion of Engineer, it is necessary to determine the location of underground structures pursuant to locate services having previously marked the area.

E. Where pipes or conduits cross the trench, Contractor must support said pipes and conduits without damage to them and without interrupting their service. The manner of supporting such pipes, etc. is subject to approval by owner of the pipe or conduit.

F. When utility lines must be removed or relocated for the Project, Contractor must notify Engineer and utility line owner in ample time for necessary measures to be taken to prevent interruption of the utility's service.

G. Contractor must conduct the work so that no equipment, material, or debris will be placed or allowed to fall upon private property in the vicinity of the Project, unless Contractor has first obtained the property owner's written consent and provided a copy to Engineer.

H. All excavated material must be piled in a manner that will avoid obstructing sidewalks, driveways, and thoroughfares. Hydrants under pressure, valve pit covers, valve boxes, curb stop boxes, fire and police call boxes, or other utility controls must be left unobstructed and accessible during the Project. Contractor must prevent runoff from stored piles of excavated material from entering ditches, waterways, gutters, or storm sewers.

2.10 Right-of-Way Guidelines/Restrictions

All sanitary sewer related activity planned to transgress or potentially be located within the rights-of-way of any public governing body or utility located in same shall be reviewed by any and all utilities for potential concerns or conflicts in addition to an Asset Protection specialist to obtain prior written approval.

2.11 Excavating

A. De-watering
   1. Contractor must provide, install, and operate sufficient trenches, sumps, pumps, hoses, piping, well points, etc. to depress and maintain the groundwater level below the base of the excavation until all Sanitary Sewer Facilities are Completed. Provide sufficient dikes and de-watering equipment and make satisfactory arrangements for the disposal of the water without undue interference with other work, damage to property, or damage to the environment. Water disposal must comply with the regulations of the Environmental Protection Agency (EPA), Indiana Department of Environmental Management (IDEM), Soil Conservation Service (SCS), and all other applicable agencies.
   2. Contractor must prevent all water from entering Sanitary Sewer Facilities. In the event any water enters Completed Sanitary Sewer Facilities, Contractor is responsible to HSE for the costs of sewage treatment, electrical power, equipment repairs, incidental damages, cleaning, and any other costs or expenses related to such entry. In addition, Contractor shall pay HSE damages per occurrence. Failure to comply with HSE within 60 days may (at the discretion of HSE) result in the suspension or termination from performing work in the utility's service area.
   3. Operate de-watering equipment ahead of pipe laying to keep the water level below the excavation until structures are secured by backfill.
   4. Contractor must provide de-watering equipment, shoring, or other construction practices to maintain dewatered excavations and safe construction conditions.
   5. To measure the static water level; wells must be accessible until successful completion of the low-pressure air test. All wells (potable, non-potable, and de-watering) must be drilled, capped, and abandoned in accordance with the requirements of Engineer, the Indiana Administrative Code, Indiana Department of Natural Resources – Groundwater Section, Hamilton County Health Department, and all other governmental agencies and public entities having jurisdiction. When possible, removal is recommended.
   6. Contractor may maintain the well casing in-place for all Sanitary Sewer Facilities which will be extended in the future.

B. Trenching
   1. All excavation work must incorporate safety measures that comply with all applicable IOSHA regulations and these Specifications. In the event of a conflict, the more stringent requirement will apply.
   2. Trees, boulders, and other surface encumbrances, located to create a hazard to employees involved in excavation work or in the vicinity thereof at any time during operations, must be removed or made safe before excavation begins.
   3. Do not open more trench than necessary for the installation of each pipe section while complying with the manufacturer's requirements for optimum installation and performance.
   4. Contractor must provide sloped side walls (provided that the bottom four (4) feet of trench will not be sloped), sheeting, shoring, or trench boxes as safety measures for all excavations in accordance with all applicable IOSHA regulations. Contractor is responsible for the determination of the angle of repose of the soil in which the trenching is to be done. Except for areas where solid rock allows for line drilling or pre-slitting or where sheeting, shoring, or trench boxes are to be used, excavate all slopes to beyond the angle of repose, but not steeper than a one (1) foot rise to each half (1/2) foot horizontally.
   5. Sides, slopes, and faces of all excavations must meet accepted engineering requirements by scaling, benching, barricading, rock bolting, wire meshing, or other equally effective means. Give special attention to slopes that could be adversely affected by weather or moisture content.
   6. Flatten the excavation sides when an excavation has water conditions, silty materials, loose boulders, and areas where erosion, deep frost action, and slide planes appear.
   7. A competent Contractor's representative, as defined under IOSHA regulations, must inspect excavations, and approve trench safety measures for the excavation after every rain event or other hazard increasing occurrence.
   8. Do not store excavated or other material nearer than four (4) feet from the edge of any excavation. Store and retain materials to prevent materials from falling or sliding back into excavation. Install substantial stop logs or barricades when mobile equipment is utilized or allowed adjacent to excavations.
   9. Minimize the amount of excavation around Manholes.
   10. The width of the trench is predicated upon the diameter of the pipe and depth the pipe is to be installed. If, when performing work for HSE, the specified trench width is exceeded, Contractor is responsible for the provision and installation, at his own expense, of all remedial measures required to return site to clean near original conditions. Any requested remediation beyond the preconstruction conditions is the responsibility of HSE.
   11. Test air in excavations where oxygen deficiency or gaseous conditions are possible. Establish controls to assure acceptable atmospheric conditions. Provide adequate ventilation and eliminate sources of ignition when flammable gases may be present. Emergency rescue equipment, such as a breathing apparatus, a safety harness, and line and basket stretcher must be readily available where adverse atmospheric conditions may exist or develop in an excavation.
   12. Provide walkways or bridges with guardrails where employees or equipment are required or permitted to cross over excavations.
   13. Provide ladders where employees are required to be in excavations four (4) feet deep or more. Ladders must extend from floor of excavation to at least three (3) feet above the top of the excavation. Locate ladders to provide means of exit without more than twenty-five (25) feet of lateral travel.
   14. Provide adequate barriers and physical protect all excavations. Barricade or cover all wells, pits, shafts, and similar excavations. Backfill temporary wells, pits, shafts, and similar excavations upon termination of exploration and similar operations.

C. Backfilling
   1. Backfilling must meet the requirements of ANSI/AWWA C605 unless otherwise specified in these Specifications.
   2. Engineer retains the right to delay an excavation backfill to inspect workmanship if he deems necessary.
   3. Place and tamp bedding and backfill in a manner that will not damage the pipe.
   4. Excess dry replacement material without visible fines will not be acceptable.
   5. When used in these Specifications and performing work for HSE, the term "clean backfill" shall mean backfill material of any type which is free of roots, brush, sticks, debris, junk, rocks, cinders, broken concrete or brick, large lumps of clay, frozen material, stones, etc. greater than three (3) inches in their largest dimension. Not more than fifteen (15) percent of the rocks or lumps can be larger than two and a half (2 1/2) inches in their largest diameter.
   6. All job excavated materials which are used for trench backfill above pipe embedment and which are to be compacted by any method except settlement by water, must be "clean backfill".
   7. When performing excavation work for HSE in areas which will require topsoil restoration, Material excavated from an open trench can be used for backfilling, from the pipe to six (6) inches below finished grade, providing it meets the requirements of "clean backfill" and providing a different type of backfill material has not been specified or shown on the Construction Plans. Where excavated material is used for backfilling and there is a deficiency due to the rejection of a part thereof, Contractor, upon direction of Engineer, must remove the rejected material from the site and furnish an additional quantity of "clean backfill" at his own expense. Should the native spoil be deemed unsuitable by either Engineer or Contractor and conditions could not be anticipated, HSE shall be responsible for the cost.
   8. Excavated material must be placed immediately after the hand backfill in such a manner to prevent the formation of voids and potential damage to pipe. The earth backfill must be mounded six (6) inches for settlement.
   9. In no case must backfill be dropped from such height or in such volume that its impact damages Sanitary Sewer Facilities. Engineer reserves the right to regulate and control the manner of depositing such backfill. Contractor will be held liable for damage to the Sanitary Sewer Facilities.
   10. Settling of backfill by flooding or puddling will not be permitted.
   11. Excess trench material must be roughly graded over the trench in a timely manner soon after the pipe is installed. This material must be mounded over the trench with a crown height of no more than six (6) inches, feathered to existing grade, until final settlement has occurred, and the trench is ready for rough grading and cleanup. An exception to this would be trenches in traveled pathways and established lawn areas. Any excess must be hauled off and disposed of or stored by Contractor.
   12. In established vegetated areas associated with excavation work performed for HSE, after settlement of backfill, and immediately before restoration of vegetated areas, grade and remove excess earth in unpaved areas. Remove to a depth of six (6) inches below finished grade. Place six (6) inches of topsoil over entire area to be restored.

2.12 Restoration Related to Work Performed For HSE

A. This section pertains to the restoration of the Project site upon Completion of the work.

B. Restoration of improvements on public and private property must be in-kind and acceptable to the owner.

C. Restoration of road surfaces, drainage ways and other similar improvements within the public right-of-way or acquired easements must be in accordance with the directions of the government agency or public entity having jurisdiction.

D. All vegetated areas disturbed or damaged during construction must be re-vegetated with a stand of grass. Agricultural areas and areas purchased for planned development or under construction do not require re-vegetation.
   1. Backfills, fills, and embankments must be brought to a sub-grade level six (6) inches below finished grade. When sub-grades have settled, deposit and spread fine raked topsoil, ready for seeding, to a finished depth of at least six (6) inches.
   2. Commercial fertilizer, 6-12-12 or equal, must be uniformly spread at the rate of thirty-five (35) pounds per one thousand (1,000) square feet over the topsoil by a mechanical spreader at least forty-eight (48) hours before seeding and mixed into the soil for a depth of two (2) inches.
   3. A grass seed mixture comprised of thirty-five (35) parts Kentucky Blue Grass, thirty (30) parts Perennial Rye, thirty (30) parts Kentucky 31 Fescue and no more than five (5) parts inert matter must be sown on the disturbed areas at a rate of three (3) pounds per one thousand (1,000) square feet. Seeding must be done only between April 1 and June 1 or August 15 and October 15.
   4. Seeded areas must be mulched with straw, hay, wood cellulose fiber, or cane fiber. Straw or hay must be applied at a rate of two and a half (2 ½) tons per acre. Wood cellulose or cane fiber mulch must be applied at a rate of one thousand (1,000) pounds per acre. On special areas of high-water concentration, unstable soils, or sloped surfaces, manufactured mulch materials such as soil retention blankets, erosion control netting or others may be required by Engineer. Manufactured mulch materials must be installed according to the manufacturer's recommendations.
   5. The seeded areas must be thoroughly watered with a fine spray to prevent wash out of the seed. Areas shall be maintained and patched as directed by Engineer. A satisfactory stand of grass at least one (1) inch in height, without bare spots, will be required.

E. Within three (3) months after Project Completion, Contractor must correct defective work, such as settled areas, uneven road surfaces, bare spots in grass coverage, erosion, and gullies.