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WATER FACILITIES
PERMITTING DIVISION

York County Government Sewer Specifications & Standard Details

SC DEPT. OF HEALTH & ENVIRONMENTAL CONTROL
BUREAU OF WATER

STANDARD SPECIFICATIONS APPROVAL
 WATER SYSTEMS SEWER SYSTEMS

DATE APPROVED: 9-25-2008

APPROVED BY: [Signature]

APPROVED FOR: SEWER SEWERS (PVC, DIF)
 For: MWIS (PVC, DIF); DETAILS (MH's, FM-TIE-INS)



Mark Kettle
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September 2008

EMGR



York County Government
Sewer Specifications &
Standard Details

September 2008

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STANDARD SEWER SPECIFICATIONS AND DETAILS

DESCRIPTION: All materials, equipment, and labor for sewer construction shall be provided in accordance with the following specifications and standard details. The Plans shall be prepared under the direction of a Professional Engineer licensed to practice in the state of South Carolina.

I. MATERIAL SPECIFICATIONS

Unless superseded or modified by the construction documents, all materials, apparatus, supplies, methods of manufacture, and construction shall conform to the following specifications: Current National material standards and addenda (ASTM, ANSI, etc.) shall be used.

A. Pipe

1. PVC (Poly Vinyl Chloride) Pressure Sewer Pipe: Unless amended on the construction drawings or elsewhere in these specifications, the following shall apply:
 - a. 2" and 3" : Must be PVC 1120 in accordance with ASTM D-2241: PC315 with a SDR of 13.5 or less for C-900.
 - b. 4" through 12": Must be PVC 1120 in accordance with ASTM D-1785 or ASTM D-2241, AWWA C900, DR-14.
 - c. 14" through 48": Must be Polyvinyl Chloride Pipe (PVC) large diameter sewer pipe with a minimum pipe stiffness of 46 PSI in accordance with ASTM Specification F-679.
 - d. Pipe joining shall be push-on elastomeric joints only and joints shall be manufactured in accordance with ASTM Specification D-3212. The pipe shall be furnished with integral bells and with gaskets that are permanently installed at the factory. The pipe shall be furnished in nominal lengths of 20 feet. PVC sewer pipe shall be green or white in color.
 - e. PVC pipe shall contain the markings required by ASTM D-3034 or F-679 as applicable. The manufacturer shall submit certification that the pipe has been tested in accordance with ASTM D-3034 or F-679 as applicable and has been found to meet all requirements. Test samples shall be as selected by the manufacturer or testing laboratory unless stipulated elsewhere in the construction documents.
 - f. Fittings shall be in accordance with ASTM D-3034, F-679, and/or D-3212 as applicable, with stiffness and wall thickness equal to or greater than the pipe. Adapters shall be provided to join different materials.

2. PVC Profile Gravity Sewer Pipe: Unless amended on the construction drawings or elsewhere in the specifications, the following shall apply:
- a. 8" through 24": Must be SDR 35 manufactured in accordance with the requirements of ASTM D 3034 for diameters from 4"-15", and ASTM F for diameters from 18"-24".
 - b. The pipe shall be produced with integral bell and spigot end construction with elastomeric seals and shall conform to all requirements of ASTM D-3212. Joining shall be by rubber gaskets that conform in all respects to the physical requirements specified by ASTM F 477 for low head applications. The lubricant used for assembly shall be as recommended by the manufacturer and shall have no detrimental effect on either the pipe or the rubber gasket.
 - c. The average nominal inside diameter and manufacturing tolerance shall be as listed for stiffness Series 46 in Table 1A for open profile pipe and Table 1B for closed profile pipe of ASTM F-794. The pipe shall be furnished in nominal lengths of 20 feet and shall contain all markings required by ASTM F-794.
 - d. One sample of each size pipe specified, from the production runs for this project, shall be tested in accordance with the requirements of ASTM F-794. The manufacturer shall furnish certification that the pipe was manufactured, sampled, tested and inspection in accordance with and has been found to meet the requirements of ASTM F-794 in all aspects.
 - e. Fittings shall be in accordance with ASTM F-794, D-3212, and/or D-3034 as applicable, with stiffness and was thickness equal to or greater than the pipe. Adapters shall be provided to joint different materials.
3. Ductile Iron Gravity Sewer Pipe: Unless amended on the construction drawings or elsewhere in these specifications, the following shall apply:
- a. Ductile iron pipe shall conform to the requirements of AWWA Standard C-151 and shall have a cement-mortar lining of standard thickness in accordance with AWWA C-104. Ductile iron pipe used in force main applications shall have an interior coating of Protecto 401 Ceramic Epoxy, Sewper Coat as manufactured by LaFarge Calcium Aluminates, American Polybond lining or approved equal.
 - b. All ductile iron pipe shall be furnished with push-on joints in accordance with AWWA C-111.

- c. 12-inch and smaller diameter (push-on joint) pipe shall be minimum pressure class 350 (PC350). 16-inch and larger diameter pipe shall be minimum pressure class 250 (PC250). Also, the pipe class selection for 12-inch and larger diameter pipe shall be based on the installation conditions. This pipe class shall be as shown on the plans and/or elsewhere in the specifications.
 - d. Fittings shall be in accordance with AWWA C-110 or AWWA C-153 and shall have a cement mortar lining in accordance with AWWA C-104.
 - e. Ductile iron pipe exterior is to be Bituminous Coated a minimum of 1mm thick.
 - f. Flanged Pipe (if required) is to be thickness Class 53.
4. Steel Pipe - (Aerial Creek Crossings): Unless amended on the construction drawings or elsewhere in these specifications, the following shall apply:
- a. High Strength Steel Pipe shall be welded or seamless, manufactured in accordance with ASTM A-53 for Welded and Seamless Steel Pipe (1/8-inch to 26-inch inclusive) and/or ASTM A-139 for Welded Straight-Seam Steel Pipe (4-inch to 92-inch inclusive).
 - b. All steel shall be Grade "B" only, with minimum yield strength of 35,000 PSI. Thickness shall be 0.250" unless otherwise specified or shown on the plans.
 - c. The pipe shall be produced in a single continuous length. Welding of two or more individual pieces together end to end shall not be permitted. Spiral-seam pipe shall not be permitted.
 - d. All steel pipe shall receive one (1) of the following shop applied linings on the inside of pipe barrel:
 - (i) Coal tar lining 3/32-inch minimum thickness in accordance with AWWA 203.
 - (ii) Coal tar epoxy lining 24 mils (dry) minimum dry film thickness and shall be Koppers' No. 300M, Americoat No. 78, Carboline-Carbomastic No. 14 or approved equal.
 - e. The outside of steel pipe and complete couplings shall receive one coat of Koppers 300M coal tar epoxy - 16 mils minimum dry film thickness - or approved equal. The coal tar epoxy coat shall be shop applied to the pipe,

and field applied to the couplings. Damage to exterior shop applied coatings shall be repaired with the same coating used by the manufacturer and applied as recommended by the manufacturer.

f. Pipe ends shall have tolerances within the limits required for approved couplings. Pipe shall also be furnished with plain right-angle ends with all burrs removed from the ends. Steel mechanical transition couplings shall be as follows:

1. Steel Pipe to Steel Pipe:

(i) 30-inch and smaller pipe sizes shall have a center ring length of seven (7) inches.

(ii) 36-inch and larger pipe sizes shall have a center ring length of ten (10) inches.

(iii) Couplings shall be as manufactured by Dresser Industries - Style 38 Straight Coupling, or approved equal. Center ring, glands, bolts, and nuts shall receive one shop coat of primer.

2. Steel Pipe to Ductile Iron Pipe:

(i) 8-inch and smaller pipe sizes shall have a center ring length of five (5) inches.

(ii) 10-inch through 20-inch pipe sizes shall have a center ring length of seven (7) inches.

(iii) 24-inch and larger pipe sizes shall have a center ring length of ten (10) inches.

(iv) Couplings shall be as manufactured by Dresser Industries - Style 62 Transition Coupling, or approved equal. Center ring, glands, bolts, and nuts shall receive one shop coat of primer.

(v) Couplings shall receive field applied protective coatings as specified for steel pipe.

5. 4-Inch Sanitary Sewer Laterals: Unless amended on the construction drawings or elsewhere in these specifications, the following shall apply:

- a. All 4-inch laterals shall be SDR 35 PVC, Schedule 40 PVC or Ductile Iron (PC350) Pipe. SDR 35 PVC and ductile iron laterals shall be as hereinbefore specified.
 - b. 4-inch laterals must connect perpendicular to the mainline when possible.
 - c. Schedule 40 PVC: Schedule 40 PVC laterals shall be in accordance with ASTM D-2665, NSF 14, and D-1785. Fittings shall be socket type in accordance with ASTM D-2466. Joining shall be through solvent cement in accordance with ASTM D-2564.
 - d. Cleanouts constructed of SCH 40 PVC shall be provided at the roadway right-of-way or easement line (as applicable).
6. 6-inch Sanitary Sewer Laterals: Unless amended on the construction drawings or elsewhere in these specifications, the following shall apply:
- a. All 6-inch laterals shall be Ductile Iron Pipe, SDR 35 Polyvinyl Chloride Pipe, or Schedule 40 PVC Pipe as hereinbefore specified.
 - b. 6-inch laterals must connect perpendicular to the mainline when possible.
7. Couplings/Saddles: Unless amended on the construction drawings or elsewhere in these specifications, the following shall apply:
- a. Couplings used to join various types of 12-inch and smaller pipe shall be elastomeric PVC sleeve couplings with stainless steel compression bands and stainless steel shear rings as manufactured by Mission Clay Products, Fernco, Logan Clay Products, or approved equal.
 - b. Couplings for 12-inch and smaller pipe may also be elastomeric PVC with internally molded rigid fiberglass insert and stainless steel bands as manufactured by DFW Plastics or approved equal. The coupling shall provide a water and/or gas tight connection.
 - c. Couplings for 15-inch and larger pipe shall be submitted to the Engineer for approval.
 - d. Saddles for lateral connections shall be ABS Plastic, PVC, Elastomeric PVC, or approved equivalent. Saddles shall be connected to VCP using epoxy sealant. Saddles shall be connected to PVC pipe using a flat or

profile gasket, as applicable to the type of pipe, and at least two stainless steel bands around the pipe and saddle. The lateral shall be connected to the saddle with a compression gasket, solvent weld adapter, and/or stainless steel band, as applicable.

B. Manholes

All sewer manholes shall be constructed or precast concrete sections in conformance with the following specifications and York County Government Water & Sewer Department Standard Detail Drawings. Special cast in place manhole structures shall be as shown on the plans and shall comply with the various other applicable sections in the specifications.

Manholes will be furnished with the following clear inside diameters according to the sewer main diameter unless amended by the Plans or other project documents:

8" to 18" pipe	4' Manhole
21" to 36" pipe	5' Manhole
42" to 54" pipe	6' Manhole
54" and larger	8' Manhole

The manhole diameter for a given pipe size may be increased from that shown above for applications where the angle between the influent and effluent pipe precludes proper installation of the pipe connections in the standard size manhole.

Manholes shall be furnished with pre-cast bottom slabs and flexible watertight boots for 15-inch and smaller pipe. The boots shall be cast in as integral parts of the base or installed in cored openings with stainless steel compression bands, and shall conform to ASTM C-923. Manholes for 18-inch and larger pipe may be furnished with precast bottom slabs and flexible boots, flexible seals, or concrete collars. The flexible seals shall be A-Lok or Contour Seal. Flexible connectors shall conform to ASTM C-923. The concrete collars shall be according to the applicable Standard Detail. Manholes to be placed over existing pipelines shall be furnished with "doghouse" openings cast in the bottom section allowing it to be set over the existing pipe. A concrete base and invert shall be poured around the bottom section and the pipe according to the applicable Standard Detail.

Shop drawings, which show dimensions, openings for pipe, reinforcing steel dimensions and layout and other essential details shall be submitted for approval.

1. Precast Reinforced Concrete Manhole Sections: All precast reinforced concrete manholes shall conform to York County Government Water & Sewer Department Standard Detail drawings and to ASTM C-478. The following minimum standards shall also apply:

- A. Wall thickness shall be a minimum of 1/12th of the inside diameter of the manhole with a minimum thickness of five (5") inches.
- B. Base sections shall be cast monolithically or have a waterstop cast in the cold joint between the walls and the base slab.
- C. Cone sections shall normally be eccentric with the inside face of one side vertical and flush with the inside face of the barrel section. Eccentric cones with bolt down frame and cover shall have a minimum vertical height, as measured from the top of the cone to the bottom of the bell, of 32 inches. Eccentric cones without bolt down frame and cover to be installed flush to finish grade may have a minimum vertical height of 24-inches. Concentric cones with a vertical height of 20-inches may be used on manholes less than five (5') feet deep (4' diameter manhole only). Transition cone sections may be provided for an eccentric transition from a 60-inch riser to a 48-inch cone section to be placed directly beneath the 48-inch cone.
- D. Transition slabs may be placed a minimum of five (5) feet above the invert shelf for six (6) feet and larger diameter manholes where the slab will be buried. Flat top slabs may be used in six (6) feet and larger diameter manholes, unless the manhole is located within pavement or maintained lawns.
- E. Joints between sections shall be manufactured in accordance with ASTM C-443. Joints may be sealed with rubber gaskets in accordance with ASTM C-443 or with butyl rubber sealants conforming to Federal Specifications SS-S-210A and AASHTO —198, Type B.
- F. All markings required by ASTM C-478 shall be clearly stamped on the inside of each section.
- G. Aggregate shall be sound, crushed, angular granitic stone only, substantially in accordance with ASTM C-33, except that the requirement for gradation in that standard shall not apply. Smooth or rounded stone (river rock) shall not be acceptable.
- H. The cement shall be Type II with a maximum Tricalcium Aluminate ($3CaOAl_2O_3$) content 8%.

In lieu of Type II cement and granitic aggregate, precast manhole sections may be furnished of Type III cement with calcareous (limestone) aggregate. The manufacturer will submit lab tests certifying the amount of Alkalinity (minimum 78%) present in the complete mix.

- I. Manhole riser sections, transition slabs, flat top slabs, and cone sections shall be designed for H-20 loadings.
 - J. The manufacturer shall furnish the Engineer with test results on compression and absorption for one section in every twenty-five sections poured, and certification from cement manufacturer and aggregate supplier certifying chemical content. The Engineer reserves the right to pick random sections for the required testing.
2. Steps: Manhole steps will be furnished in accordance with Standard Details, ASTM C-478 and current OSHA regulations. In addition to the testing requirements of ASTM C-478 each step installed in precast manholes will be tested to resist a 1000 lb. pullout. The manhole manufacturer will furnish certification of each test with each shipment showing manhole location, date of test, and results.
 3. Watertight Manhole Covers: Watertight manhole covers required where the top elevations are lower than the 100 year flood elevation.
 4. Manhole Diameter: Manholes shall have a minimum inside diameter of 4 feet for invert depths of 19 feet or less. Manholes with invert depths of 20 feet or greater shall be a minimum of 5 feet in diameter. The minimum access diameter shall be 22 inches.

C. MISCELLANEOUS STEEL

1. Steel Pier Material: Steel piles, cross braces, cradles, etc., shall consist of structural steel shapes of the section required on the Plans and Details. The steel shall conform to specifications for Steel for Bridges and Buildings, ASTM A-36.

All bolts and nuts will conform to ASTM A-325 for 7/8 inch and to ASTM A-490 for 1-inch and larger.

The Contractor shall handle and store steel members above ground on platforms, skids, or other supports. Members shall be free of dirt, grease, and other foreign material and protected against corrosion.

Coal tar epoxy coating Koppers' No. 300M, Amercoat No. 78, Carboline-Carbomastic No. 14 or approved equal shall be applied to all specified surfaces of the steel pier.

Welding Electrodes shall conform to the following:

Shielded Metal-Arc:	AWS A5.1 or AWS 5.5, E70XX
Submerged-Arc:	AWS A5.17, F70X-EXXX
Gas Metal-Arc:	AWS A5.18, E70S-X or E70U-1
Flux Cored-Arc:	AWS A5.20, E70T-X (except 2 and 3)

2. Steel Encasement Pipe: Steel pipe shall be welded or seamless, smooth wall or spiral weld, consisting of Grade "B" steel as specified in ASTM A-139.

Minimum yield strength shall be 35,000 PSI; and pipe thickness shall be as specified for each individual job.

All pipe shall be furnished with beveled ends prepared for field welding of circumferential joints. All burrs at pipe ends shall be removed.

Encasement pipe must be approved by the appropriate controlling agency (SCDOT, Railway Corporation, etc.) and the County's Engineering department prior to ordering.

3. Structural Steel Tunnel Liner Plates: The tunnel liner plates shall be either the four (4) flange type (as approved for use within SCDOT right-of-way) or the lap seam type (as approved for use within railroad rights-of-way) fabricated to permit assembly of a continuous steel support system as the tunnel is excavated. Tunnel liner plates shall be fabricated from hot rolled, carbon steel sheets or plates conforming to the specifications of ASTM A-569.

The tunnel liner shall be designed in accordance with the requirements of Section 16-Division I and constructed to conform to Section 25-Division II of the current or interim AASHTO Standard Specifications for Highway Bridges.

Liner plates shall be galvanized in accordance with AASTO M167 and fully bituminously coated in accordance with AASHTO M190. All hardware necessary to the tunneling operation shall be hot-dip galvanized in accordance with ASTM A-153 prior to bituminous coating application. Hardware shall conform to ASTM Specification A-307, Grade A.

The minimum mechanical properties of the flat steel plate before cold forming used for the design of the tunnel liner shall be:

- A. Minimum Tensile Strength of Liner Plates: 42,000 PSI
- B. Minimum Yield Strength of Liner Plates: 28,000 PSI
- C. Steel Liner Plates must be approved by the appropriate controlling agency (SCDOT, Railway Corporation, etc.) and the County's Engineering

department prior to ordering. Gauge or thickness of liner plates will be as noted on the plans and elsewhere in the specifications.

- D. Elongation, 2-inches = 30 percent
- E. The moment of inertia shall be 0.042 inches to the 4th power per inch of width for four flange 12 guage liner plate.

- 4. Steel Vent Pipe: Unless otherwise specified, steel vents shall be Schedule 40 five-inch (5") diameter steel pipe, consisting of Grade "B" steel as specified in ASTM A-139.

All steel shall be Grade "B", with a minimum yield strength of 35,000 PSI.

The steel pipe shall have an inside coal tar lining 3/32 inch minimum thickness in accordance with AWWA C-203 or a coal tar epoxy lining conforming to that required for steel (aerial creek crossing) pipe.

Outside surface of pipe shall be sand or grit blasted to commercial standard and have one (1) coat of zinc chromate primer applied in accordance with Federal Specification TT-86a.

Pipe shall be furnished with two (2) evenly applied coats of rust inhibiting enamel paint, either Koppers Glamortex No. 501 Enamel (Olive Green), Southern Coatings Rustaloy No. 0537 Enamel (Garden Green), or equal.

- 5. Steel Straps and Anchors: All pipe and/or pier straps shall conform to the requirements of ASTM A-36 with a minimum yield strength of 36,000 PSI.

Finished straps and anchors shall be galvanized in accordance with ASTM A-153. The entire strap and all exposed surfaces of anchors and/or bolts (and nuts) shall be fully bituminously coated in accordance with AASHTO —190. Anchor bolts (non-head) shall conform to ASTM A-36 with tension test to be made (as required) on the bolt body or on the bar stock used for making the anchor bolts. Unless otherwise specified all other fasteners shall conform to ASTM A-307 for carbon steel externally and internally threaded standard fasteners Grade A or B.

D. CONCRETE

- 1. Portland Cement: All concrete shall conform to the Standard Specifications for READY MIXED CONCRETE, ASTM C-94. An air-entraining admixture, conforming to ASTM C-260, shall be added either Type I, Type II, or Type III Portland Cement. Fly Ash conforming to ASTM C-618 for Class C Fly Ash may be added to the concrete mix but shall not be considered as replacement for more

than 10 % of the cement therein (strengths shall not be less than hereinafter required).

Types I, IA, III and IIIA Portland Cement shall only be used for manhole inverts, concrete encasement, concrete blocking, and/or as directed by the Engineer, and shall conform to ASTM C-150.

Types II and IIA Portland Cement shall be used in precast manholes, cast in place manhole structures, reinforced concrete pipe, reinforced concrete piers and concrete or reinforced concrete rip-rap as directed by the Engineer, and shall conform to ASTM C-150 except that Tricalcium Aluminate ($3CaOAl_2O_3$) content shall not exceed 8%.

- 2. Aggregates: All aggregates used for concreting shall conform to ASTM C-33 and shall be checked daily for any variances in moisture content. Said variances shall be corrected and/or taken into consideration for each batch.
 - A. Coarse Aggregates: Shall be uniformly and evenly graded for each application in accordance with A.C.I. Standard 318. Unless otherwise approved, aggregate shall be sound, crushed, angular granitic stone. Smooth or rounded stone (river rock) shall not be acceptable.
 - B. Fine Aggregates: Shall consist of natural sand, manufactured sand or a combination thereof. Fine aggregates shall conform to the sieve analysis as specified in paragraph 4.1 of the standard except that the percent passing a No. 50 sieve shall not exceed 6% and the percent passing a No. 100 sieve shall be 0% as provided for in paragraph 4.2 of the standard.
- 3. Mix Design: Concrete shall be watertight, resistant to freeze-thaw cycles and moderate sulfate attack, abrasion resistant, workable, and/or finishable. These qualities may be met through the use of admixtures (if and only if approved in the mix design as hereinafter specified) conforming to the appropriate ASTM with the exception of the use of calcium chloride, which shall be limited to no more than 1% by cement weight - thoroughly mixed to insure uniform distribution within the mix. If the concrete is used with reinforcing steel, no calcium chloride will be allowed.

The Contractor shall assume responsibility for concrete mixture. The concrete shall be proportioned to meet the following requirements: (Note: This mix does not apply "in total" to precast manhole or reinforced concrete pipe).

A.	Compressive Strength	Minimum 3600 PSI
B.	Water-Cement Ration By Weight	Maximum 0.50
C.	Slump	Min. 3" Max. 5"

- D. Air Content (Entrained & Entrapped) Min. 4% Max. 6%
- E. Coarse Aggregate 3/4"- 1 1/2 (as required by the application)

When required by the Engineer, and prior to beginning construction, the Contractor, at his expense, shall obtain from an approved commercial testing laboratory a design for a suitable concrete mix and submit same with his list of materials and material suppliers for approval.

- 4. Curing Compound: All concrete curing shall conform to the standard specifications for LIQUID MEMBRANE - FORMING COMPOUNDS FOR CURING CONCRETE, ASTM C-309, TYPE 2.

Curing compounds shall be applied as forms are stripped.

- 5. Grouts: All grouts shall be of a non-shrink nature (as may be achieved through additives or proportioning) and depending upon application range from plastic to flowable cement water paste. Testing as specified above for concrete may be required for acceptance of grouts to include frequent checks for consistency by a time-of-flow measurement.

Expansion grouts shall be either Gilco pre-mixed or Supreme non-metallic grout as manufactured by Gifford-Hill and Company, Incorporated, or Embeco 636 grout as manufactured by Master Builders or equal.

Acceptable range of testing requirements:

Compressive Strength	10,500 to 12,500 PSI
Bond Strength	1,350 to 1,700 PSI
% Expansion	+0.025% to +0.75%
Expansion grouts shall be used only as directed by the Engineer.	

Grouts shall be mixed (if applicable) and placed in accordance with the manufacturer's recommendations, for each specific application.

- 6. Mortar: Mortar used in sanitary sewer manholes shall be hydraulic cement mortar in accordance with ASTM C-398. Mortar used in water meter vaults and water valve vaults shall be Type M mortar in accordance with ASTM C-270.

E. STONE AND BRICK

- 1. Granular Bedding Material: All bedding material shall be angular, clean washed crushed stone graded in accordance with Size #57 or #67 in ASTM D-448 for "Standard Sizes of Coarse Aggregate", (SC DOT Standard size #57 or #67).

Bedding material will be used only as instructed in the Specifications and/or as specifically directed by the Engineer.

2. Stone Stabilization Material: All stone stabilization material shall be angular, clean washed crushed stone graded in accordance with standard sizes #467 in ASTM D-448, (SC DOT Standard size #467M).

Stabilization material will be used only as instructed in the specifications and/or as specifically directed by the Engineer.

3. Silt Check Dam Material: Shall be coarse angular, clean washed crushed stone, gravel, or rock, well graded, and ranging in size from 2-inches to 6-inches, (SC DOT stone for erosion control-Class A).
4. Rip-Rap: All rip rap shall consist of clean field stone or rough unhewn quarry stone, resistant to the action of air and water, varying in weight from 25 to 250 pounds with 60% weighing a minimum of 100 pounds each and no more than 5% weighing less than 50 pounds each, (SC DOT Class 2 Rip Rap). Rip-rap will be placed from a minimum of 4.0 feet below the toe of the bank to top of the bank in areas determined by field conditions. Rip-rap thickness shall be 1 1/2 times the diameter of the largest stones used, or as directed by the plans.
5. Brick: All brick used to construct manhole inverts or adjust frames shall be made from clay or shale, shall be solid only and shall be of standard building size. All brick shall meet or exceed the compressive strength and water absorption properties specified in ASTM C-32 for Grade MS brick or in ASTM C-216 and ASTM C-62 for Grade SW brick. All manholes placed within the limits of roadway pavement and sidewalk are to use a minimum of one course of adjusting brick and a maximum as previously called for.

F. FERROUS CASTINGS

1. Special Castings: All cast iron pipe fittings and special castings shall be furnished in weight, classes, and/or special thickness as specified elsewhere. The castings shall conform to ASTM A-126 and shall be manufactured in domestic foundries. Coatings and linings (if applicable) shall be the same as specified for Ductile Iron Pipe.
2. Frames, Covers and Grates: All manhole frames and covers shall conform to ASTM A-48, Class 30 and shall be manufactured in domestic foundries. Dimensions shall conform to the Standard Details.

Manhole frames and covers shall be furnished with the common contact surfaces between frame and cover machines. Frames and covers shall be Dewey Brothers RCR 2010, Vulcan VM-83, U.S. Foundry or approved equal.

Where watertight frames and covers are specified, the watertight seal between frame and cover shall be accomplished by means of a rubber gasket. Watertight frames and covers shall be Dewey Brothers RCR 2010W, Vulcan VM 1383, U.S. Foundry or approved equal.

G. TRAFFIC CONTROL DEVICES

All traffic control signs, barrels, barricades, pavement markings, etc., shall conform to the "Manual on Uniform Traffic Control Devices" (MUTCD) published by the U.S.D.O.T. and any supplements to the MUTCD as adopted by S.C.D.O.T.

H. EROSION CONTROL

1. Seed: All seed shall be labeled to show that it meets the current requirements of the South Carolina Seed Law. Seed shall have been tested within the six (6) months immediately preceding its use. Further specifications for each seed item are given below:
 - a. Kentucky Fescue #31: Minimum 98% pure live seed; maximum 1% weed seed; minimum 90% germination.
 - b. Sericea Lespedeza (Sacrificed and Unsacrificed): Minimum 98% pure live seed; maximum .50% weed seed; minimum 85% germination. Scarified may include 20% hard seed.
 - c. Rye Grass (Annual): Minimum 98% pure live seed; maximum .10% weed seed; minimum 85% germination.
 - d. Sudangrass: Minimum 98% pure live seed; maximum .25% weed seed; minimum 85% germination.
2. Fertilize: All fertilizer for undeveloped areas shall have minimums 5-10-10 analysis or a comparable 1-2-2 ratio. All fertilizer for established lawn areas shall have a minimum 10-10-10 analysis or a comparable 1-1-1 ratio. All fertilizer shall be uniform in composition, dry and free flowing and shall be delivered to the job site in the original unopened containers, each bearing the manufacturer's guaranteed analysis. Any fertilizer, which becomes caked or otherwise damaged,

will not be accepted. The quality of all fertilizer and all operations in connection with furnishing same, shall comply with the current requirements.

3. Lime: All lime shall be finely ground limestone (Dolomite) containing not less than 85% total carbonates.
4. Superphosphate: All superphosphates shall be composed of finely ground phosphate rock, as commonly used for agricultural purposes, containing not less than 20% available phosphoric acid.
5. Mulch: All mulch shall be small grain or tame hay. Small grain or tame hay shall be furnished undamaged, air dried, threshed and free of undesirable weed seed.
6. Erosion Control Fabric: Material shall be as specified in the Environmental Protection Section of these specifications per Erosion Control Standard Detail 6.62.
7. Jute Netting or Thatching: All jute shall be of a uniform open plain weave of single jute yarn, 18-inches in width (± 1 "). The yarn shall be loosely twisted construction and shall not vary in thickness by more than one-half ($\frac{1}{2}$) its normal diameter.

There shall be 78 warp ends (± 2), per width of netting; 41 weft ends (± 1 "), per linear yard; and the weight shall average 1.22 pounds ($\pm 5\%$) per linear yard of netting. Jute shall be anchored into place in accordance with the manufacturer's requirements. Installation shall only be at the direction of the Engineer.

8. Erosion Control Blanket: Erosion control blankets shall be manufactured from wood fiber, straw, coconut fiber or other degradable material woven into a mat and secured with photo degradable plastic mesh or biodegradable thread. Blankets shall be installed according to manufacturers recommendations where directed by the Engineer. The following manufacturers area approved. AMXCO-Curlex Blanket, North American Green-SC 150, and HV Excelsior.
9. Gabions: Gabions shall be manufactured from zinc coated steel wire mesh (minimum H-gauge) to form rectangular units. The front, base, back and lid shall be woven into a single unit and the ends and diaphragms shall be factory connected to the base. The individual units shall be installed per the manufacturers instructions and filled with hard durable, clean stone from 4-8 inches inside or as approved by the Engineer.

II. DETAILED SPECIFICATIONS FOR SANITARY SEWER CONSTRUCTION

Unless superseded or modified by a Special Provision, all materials, apparatus, supplies, methods of manufacture, or construction shall conform to the specification for same contained in this Section. The Contractor shall furnish all materials, equipment and labor required to construct the project as outlined in these specifications and accompanying plans.

A. HANDLING AND STORAGE OF MATERIALS

The Contractor shall be responsible for the safe storage of materials furnished by or to him, and accepted by him and intended for the work, until they have been incorporated in the completed project. The interior of all pipe, manholes and other accessories shall be kept free from dirt and foreign materials at all times.

1. Transportation of Materials and Equipment: The Contractor and his Suppliers are directed to contact the South Carolina Department of Transportation to verify axle load limits on State maintained roads (and bridges) which would be used for hauling of equipment and materials for this project. The Contractor and his Suppliers shall do all that is necessary to satisfy the Department of Transportation requirements and will be responsible for any damage to said roads which may be attributed to this project.

All materials furnished by the contractor shall be delivered and distributed at the site by the Contractor or his material supplier.

2. Loading and Unloading Materials: Ductile iron pipe and cast iron accessories shall be loaded and unloaded by lifting with hoists or skidding so as to avoid shock or damage. Concrete pipe, clay pipe, and precast manholes will be unloaded with hoists and/or as recommended by the respective manufacturers. Under no circumstances shall such materials be dropped. Pipe handled on skidways shall not be skidded or rolled against pipe already on the ground.
3. Responsibility for Materials on Site: In distributing the material at the site of the work, each piece shall be unloaded opposite or near the place where it is to be laid in the trench. Pedestrian or vehicular traffic shall not be unduly inconvenienced in placing of material along the streets or right-of-way, as applicable.

The Contractor will string in advance no more than the amount of pipe and material that can be installed within four (4) weeks or less as approved by the Engineer. All the materials shall be placed in such a manner as not to hinder access, endanger or impede traffic, or create a public nuisance. Materials strung

through residential areas (or any area with maintained lawns) shall be placed in such a manner as not to restrict normal maintenance of established lawns, and must either be installed within two (2) weeks or removed to an approved storage yard, as required by the Engineer.

4. Material and Equipment Storage: The Contractor will be responsible for locating and providing storage areas for construction materials and equipment. Unless prior written consent from the owner of the proposed storage area is received by this Department, the Contractor will be required to store all equipment and materials within the limits of the sanitary sewer right-of-way and temporary construction easement provided. The materials and equipment storage shall comply with all local and state ordinances throughout the construction period. Material and equipment may only be stored within road right-of-way if approved by the controlling agency.

The Contractor shall be responsible for the safeguarding of materials and equipment against fire, theft, and vandalism and shall not hold the County responsible in any way for the occurrence of same.

5. Care of Coatings and Linings: Pre-cast manholes, pipe and fittings, including rings and covers, steps, straps, etc., shall be so handled that the coating or lining will not be damaged. If, however, any part of the coating or lining is damaged, the repair shall be made by the Contractor at his expense in a manner satisfactory to the Engineer.

B. CONNECTION TO EXISTING SEWERS

Tie-ins to existing activated sewer lines will be allowed when proper precautions are taken to protect the existing main. Tie-ins to existing unactivated sewer lines not installed under the same contract will not be allowed without written approval from all parties involved (York County, contractors, contract holders, etc.). The Contractor will be required to install watertight masonry plugs in the proposed pipeline at the existing manhole and at the first proposed manhole until all construction is completed and testing begun. If the proposed sewer does not begin at an existing manhole, a straddle type manhole as shown on the Standard Details will be constructed over (and around) the undisturbed existing pipeline and the proposed pipeline plugged as specified. The existing pipeline will not be broken-out and the new invert formed until all testing has been successfully completed. Any connection with 18-inch and small pipe at an existing precast-in-place manhole will require the Contractor to core the necessary opening through the manhole wall. Connections to existing manholes with 21-inch and larger pipe may be cored or sawed as approved by the Engineer.

1. Temporary Watertight Plugs: The Contractor shall install temporary watertight plugs in the proposed sewer line at any manhole that is incomplete, at the open end of the pipeline prior to leaving the job site daily and elsewhere as dictated by good engineering and construction practices. All installed pipe shall be backfilled or otherwise securely tied down to prevent flotation in the event water enters or rises in the trench.

The plugs are installed shall prevent infiltration or the introduction of any foreign material into either the existing or proposed systems.

The County will not accept any pipeline or manhole, which contains any silt, sedimentation or other foreign material, within. The Contractor shall at his own expense flush, or otherwise cause the line (and manholes) to be cleaned out without any discharge into the existing system.

Upon completion of all construction, the Contractor will be responsible for the complete removal of all watertight plugs, in the sequence necessary to allow testing and subsequent activation, all under the direction of the Engineer.

2. Scheduling: When the flow of an existing sewer must be interrupted and/or bypassed, the Contractor shall, before beginning any construction, submit a work schedule which will minimize the interruption and/or bypassing of wastewater flow during construction. The schedule must be approved by the appropriate controlling agencies and Engineer and may require night, holiday, and/or weekend work.
3. Bypass Pumping: If pumping is required, and identical standby pump shall be on site in the event of failure of the primary pump. If, at any time during construction, effluent from the existing sewer is not fully contained by the bypass system, gravity service will be restored by a temporary tie to the new construction and work shall be suspended until the problem is resolved to the satisfaction of the Engineer. The Contractor shall be responsible for any fines levied as a result of effluent reaching the creek. The Contractor will be required to verify his method of handling sewer flows during construction by pumping at peak flows for 1 hour as approved by the Engineer.

C. EXISTING UTILITIES

The Contractor will be required to excavate to determine the precise location of utilities, or other underground obstructions, which are shown on the Construction Plans. Such location and excavation shall be at least 500 feet ahead of construction or as noted in the Special Provision Section of this document.

All utility owners will be notified prior to excavation as required by the 1985 Underground Damage Prevention Act. Owners who are members of PUPS may be notified in accordance with current PUPS procedures. The York County Water/Sewer Department is a PUPS member. The Contractor will be fully responsible for damage to any utilities if the owners have not been properly notified as required by the Underground Damage Prevention Act.

Utility owners may, at their option, have representatives present to supervise excavation in the vicinity of their utilities. The cost of such supervision, if any, shall be borne by the Contractor.

Conflicts with underground utilities may necessitate changes in alignment and/or grade of this construction. All such changes will be approved by the Engineer before construction proceeds.

When underground obstructions not shown on the Construction Plans are encountered, the Contractor shall promptly report the conflict to the Engineer and shall not proceed with construction until the conflict is resolved by the Engineer.

Whenever a sewer main crosses under other utility lines (gas, telephone conduit, storm drain, etc.) there shall be 2 feet clearance between the top of the sewer and the bottom of the affected utility. Stone bedding shall be used from 6-inches below the sewer to 12-inches above the sewer from one foot outside the utility trench. If this clearance is not possible, the sewer line shall be Ductile Iron Pipe one foot outside the utility trench with a minimum length of 10 feet.

Whenever a sewer main crosses over other utility lines (storm drains, gas, encased or capped telephone conduit, etc.) the following will apply:

1. For PVC sewer lines - There shall be one foot clearance from the top of the utility to the bottom of the sewer. If this clearance is not possible the sewer line shall be ductile iron pipe from one foot outside the utility trench with a minimum length of 10 feet.

D. SEWER LINE/WATER LINE CLEARANCE

When a sewer main or lateral crosses or is parallel to an existing water main, the Contractor shall ductile iron pipe (including laterals) for the sewer main as described below.

1. Vertical Separation of Sewer Lines & Water Lines: Whenever it is necessary for a sewer main to cross under a water main with less than 18-inches of vertical

separation, the sewer main and water main shall be constructed of ductile iron pipe, with joints meeting water main standards, for a distance of 10 feet on each side of the point of crossing.

Whenever it is necessary for a sewer main to cross over a water main, the sewer main and water main shall be constructed of ductile iron pipe, with joints meeting water main standards, for a distance of 10 feet on each side of the point of crossing.

2. Horizontal Separation of Sewer Lines and Water Lines: Sewer mains shall be laid at least 10 feet horizontally from existing or proposed water mains unless local conditions or barriers prevent a 10-foot horizontal separation. In that case, the sewer main will be laid in a separate trench, with the elevation of the bottom of the water main at least 18-inches above the top of the sewer. When these conditions are not met, the sewer main and water shall be constructed of Ductile Iron Pipe with joints meeting water main standards.
3. Horizontal Separation of Sewer Lines, Manholes, Pump Stations and Force Mains from Water Wells: Sewer lines, manholes, pump stations and force mains shall be installed at least 100 feet from a public water supply well and at least 20 feet from any other potable water well, as defined in SC DHEC Regulation 61-71; (67.300.A.13).

E. CLEARING

Unless otherwise specified, the entire permanent right-of-way shall be cleared and all stumps, limbs and trash removed and disposed of at an approved location. When the sewer line is installed in undeveloped/non-maintained areas (woods), stumps can be left flush with the ground if they are outside the trench excavation. Stumps must be removed from all maintained areas (yards, lawns, etc.).

Temporary construction easements will be selectively cleared with specimen trees left standing as stipulated in Special Provisions and/or right-of-way agreements. No clearing or grubbing may be performed of rights-of-way except under supervision of the Project Inspector.

Useable timber and/or firewood may be left on adjoining property, off the permanent right-of-way at the request or with the consent of the property owner. Such requests must be in writing and must release the County from any claims for improper disposal of timber.

The Contractor shall abide by all special conditions contained in the right-of-way agreements for this project. When the right-of-way agreement specifies stacking timber or firewood adjacent to the right-of-way, a written release is not required. The Contractor

shall verify cut lengths of timber/firewood for such placement and location with property owner.

Fences removed during construction shall be replaced of the same material and to the same condition existing prior to the construction. The Contractor may refer to the “Environmental Protection Section” contained herein for further instructions pursuant to right-of-way treatment.

F. **EXCAVATION**

All excavations for pipe laying, manholes, piers, drainage ditches, grading and any other excavation required for the proper completion of this contract shall be included herein.

Excavation within street right-of-way shall be backfilled when left unattended for more than 1 hour unless otherwise approved by the controlling agency. Excavations within sewer/water rights-of-way shall be backfilled, fenced or otherwise protected when left unattended for more than 1 hour. Fencing or other protection methods shall be designed to reasonably prevent people and large animals from entering the excavation.

1. **Trench Excavation:** No more trench (100 ± LF) shall be opened in advance of the pipe laying than is necessary to expedite the work unless prior approval is given by the Engineer. Ground conditions and/or location requirements shall govern the amount of trench open at any one time as determined by the Engineer.

a. **Trench Width:** The maximum trench width shall be as indicated for each type of pipe specified. If the actual trench width exceeds the specified width, due to shoring methods, the contractor must obtain approval from the Engineer.

Trench width shall be measured between faces of cut at the top of the pipe bell. If the Contractor varies from the requirement without prior approval of the Engineer, or if specified trench widths cannot be maintained, improved bedding and/or improved pipe material shall be installed as directed by the Engineer.

b. **Trench Bottom Conformation:** The excavation shall be made to the elevations, grades, and lines shown on the Construction Plans unless otherwise approved by the Engineer. The trench bottom shall be excavated slightly above grade and cut down to the pipe grade by hand in the fine grading operation. The trench bottom shall be true and even with bell holes at each joint to provide the barrel of the pipe with soil and/or granular (as applicable) support for its full length. This should prevent joint loading at the bells. If the trench bottom is inadvertently cut below

grade, the Contractor shall fill it to grade with approved material thoroughly tamped.

Pipe depth and/or soil conditions may dictate a granular embedment as specified below. Such bedding shall also be shaped to allow adequate support of the pipe along the full length of the barrel.

If the trench passes either under or over another pipeline or previous excavation, the trench bottom in this area shall be tamped, if necessary, so the disturbed soil has approximately the same supportive strength as the native soil.

2. Excavation for Structures: The excavation shall be made to the lines, grades and elevations shown on the Plans and Standard Details. The area excavated shall be limited to no more than is necessary to allow the proper installation of the structure as determined by the Engineer. The excavation shall remain open no longer than is necessary to allow the proper and complete installation of the structure.
 - a. Structure Pit Bottom Conformation: The pit bottom shall be true and even, and capable of supporting the structure as determined by the Engineer. If the pit bottom is inadvertently cut below grade, the Contractor shall fill it to the proper elevation with approved material capable of continually maintaining adequate supportive strength.

3. Excavation for Bore Pits: The excavation shall be controlled by the limits of the existing rights-of-way and shall not exceed these without prior written approval of the current property owner. The excavation shall be made to the proper elevation, line and grade as required to install the casing pipe as shown on the construction plans.
 - a. Bore Pit Conformation: The pit bottom shall be true and even with adequate stabilization to maintain proper elevation and grade on the boring rig for the duration of the bore.

4. Rock Excavation: Rock excavation shall be defined as solid ledge rock that requires drilling and blasting, sledging, or barring for its removal. Soft, disintegrated rock that can be removed with a pick shall not be classified as solid rock.

Boulders greater than one cubic yard in volume will also be considered rock excavation. Smaller boulders and soft rock, which in the opinion of the Engineer can be excavated by the use of a power shovel, without undue delay, shall not be classified as rock.

Rock shall be removed to a depth of six (6) inches below the pipe bell and to the trench widths specified for each size and type of pipe installed. Rock around structures shall be removed to the same twelve (12) inch minimum as measured between vertical planes around the structure, but only to a depth necessary to allow proper installation. Over excavation of rock due to removal methods, or for safety considerations, shall be the Contractor's responsibility.

When rock removal is necessary for pipeline installation either Type II or Type III bedding shall be installed as specified and directed by the Engineer.

All blasting shall be conducted in a manner specified elsewhere in these Specifications.

5. Piling Excavated Material: All excavated material shall be piled in a manner that will not endanger the work. Excavated material will be piled a safe distance away from the edge of the excavation allowing room for an adequate angle of repose and if shoring, sheeting, and bracing is used to protect the excavation, no material will be piled within three (3) feet of the nearest edge. Sidewalks, driveways, hydrants, valve pit covers, valve boxes, curb stop boxes, existing manholes, fire and police call boxes, or other utility controls shall be unobstructed and accessible until the work is completed. Gutters, catch basins, and natural watercourses shall not be obstructed or silted.

When working in close proximity with a creek channel or natural watercourse the Contractor shall pile all excavated material on the side of his excavation away from the watercourse.

6. De-watering: The Contractor shall at all times provide and maintain ample means and equipment with which to remove and properly dispose of any and all water entering the excavation or other parts of the work and keep all excavations dry until such time as pipe laying and grading is completed and structures to be built therein are completed.

No water shall be allowed to rise around the pipe in unbackfilled trenches nor shall it be allowed to rise over masonry until the concrete or mortar has set (minimum 24 hours). All water pumped or drained from the work shall be disposed of in such a manner as to prevent siltation and erosion to adjacent property or other construction.

7. Shoring And Shielding: The Contractor shall comply with OSHA trenching and excavation regulations as revised in Subpart P of Part 1926 in the Federal Register. Shoring and/or shielding systems shall be used as specified in Subpart P to prevent caving of trench banks and to provide a safe excavation.

The Contractor will be responsible for excavation safety and shall designate his “competent person” (as defined in Subpart P) for the determination of proper shielding/shoring systems.

If, in the opinion of the Engineer, the trench/excavation is not in compliance with OSHA regulations, the Contractor may be directed to stop work. Continued unsafe conditions will be reported to the appropriate regulatory agency. The Contractor will be responsible for paying all fines resulting from safety violations.

G. PIPE LAYING

The various pipes referred to herein shall be handled, belled up and laid in accordance with the manufacturer’s requirements and good engineering practices as defined in the various publications referenced in this document. The following requirements and/or standards of the York County Water/Sewer Department shall govern this construction unless exceeded by other regulatory bodies.

1. Construction:

- a. In all instances pipe shall be laid in a workmanlike manner, true to line and grade, with bell ends facing up-grade in the direction of laying.
- b. Sewer pipe is to be laid with a uniform slope between manholes.
- c. Sewers 24 inches or less in diameter shall be laid with straight alignment between manholes.
- d. The internal angle of deflection at manholes must be equal to or greater than 90 degrees.
- e. PVC gravity sewer mains must be installed in accordance with ASTM D-2321, or latest revision.
- f. PVC sewer force mains must be installed in accordance with ASTM D-2321, or latest revision.
- g. Ductile iron force main pipe must be installed in accordance with AWWA C-600.
- h. Sewer force mains tying into manholes shall enter the manhole a vertical distance of not more than two (2) feet above the flow line of the receiving manhole.

2. Pipe Bedding: Unless otherwise specified or noted on the Plans the following bedding classes are commonly required by this Department.

When granular material embedment is required, the Contractor will follow the layered procedure specified in Type I for soil placement, above the granular bedding, to an elevation one (1) foot above the pipe bell.

- a. Type I - Shaped Bottom Bedding: The trench bottom shall be shaped so the pipe bears uniformly upon undisturbed native earth. Soil shall then be placed by hand around the pipe and completely under the pipe haunches in uniform layers not to exceeding six (6) inches in depth up to an elevation one (1) foot above the top of the pipe bell.

Each layer shall be placed and then carefully and uniformly tamped, so that the pipe is not damaged nor the alignment disturbed.

- b. Type II - Granular Material Embedment: The trench bottom shall be undercut a minimum of six (6) inches below the pipe barrel grade and filled with a approved stone to an elevation such that the pipe will be completely and uniformly bedded to a vertical height of one-third the outside diameter of the pipe bell for the pipe's entire length and for the entire width of the ditch. Depending upon soil and ground water conditions, greater depths (undercut) may be required to create a stable condition. Type III granular material embedment shall be used as directed by the Engineer.
- c. Type III - Granular Material Embedment: The trench bottom shall be undercut a minimum of six (6) inches below the pipe barrel grade and filled with an approved stone to an elevation such that the pipe will be completely and uniformly bedded to vertical height of one-half the outside diameter of the pipe bell for the pipe's entire length and for the entire width of the ditch. Depending upon soil and ground water conditions, greater depths (undercut) may be required to create a stable condition. Type III granular material embedment shall be used as directed by the Engineer.
- d. Stone Stabilization: When the bottom of the trench is not sufficiently stable to prevent vertical or lateral displacement of the pipe after installation with Type II or Type III bedding, stone stabilization will be required to develop a nonyielding foundation for the bedding and pipe. When such conditions are encountered, the trench will be excavated to a depth determined by the Engineer, and #467 crushed stone will be placed

to an elevation six-inches below the bottom of the pipe. The pipe will then be laid with Type II or Type III bedding as directed by the Engineer.

- e. Concrete Encasement and Cradles: Shall be as designed for each individual case and will be noted on the Plans and in the Special Provisions when applicable.

3. Installation Depth Limitations: The following are limitations and bedding requirements for supportive strength and shall be adhered to at all times. Granular material embedment may still be required for lesser depths of cover should groundwater and/or soil conditions warrant its use, as determined by the Engineer.

- * The standard trench width for 8"-15" pipe shall be limited to the nominal pipe size plus 30-inches.
- * The standard trench width for 18"-30" pipe shall be limited to the nominal pipe size plus 36-inches.
- * The standard trench width for 36" and larger pipe shall be limited to the nominal pipe size plus 42-inches.

Deviations from the standard trench width shall be as approved by the Engineer.

Trench widths must be maintained constant as measured at the top of the pipe. Deviation from the standard trench width will necessitate an increase in the stone bedding around the pipe and/or a change in the type or class of pipe being installed at the Contractor's expense.

All pipes regardless of bedding or pipe type shall require adequate tamping of backfill as specified for Type I, Shaped Bottom Bedding.

- a. PVC Pipe shall be installed with a minimum of 3.0 feet of cover over the top of the pipe subject to the bedding limitations specified below. When the cover is less than 3.0 feet or greater than the depths shown for Type III Bedding, Ductile Iron Pipe must be used.

<i>MAXIMUM DEPTH OF COVER</i>			
Size	Type I Bedding	Type II Bedding	Type III Bedding
8"-15"	10'	15'	18'

- b. Ductile Iron Pipe: Installation of Ductile Iron Pipe shall be installed subject to the bedding limitations specified below, based on a deflection limit of three (3) percent for cement lining. Greater depths of cover may be achieved by using a higher pressure classification and/or using pipe with a flexible lining.

MAXIMUM DEPTH OF COVER - DIP				
Pipe Size	Pressure Class	BEDDING		
		Type I	Type II	Type III
8"	350	20'	34'	50'
10"	350	15'	28'	45'
12"	350	15'	28'	44'
14"	250	15'	23'	36'
16"	250	15'	24'	34'
18"	250	14'	22'	31'
20"	250	14'	22'	30'
24"	250	15'	20'	29'
30"	250	15'	19'	27'
36"	250	14'	18'	25'
42"	250	14'	17'	25'
48"	250	13'	17'	24'

- c. Poly Vinyl Chloride (PVC) Pipe: PVC pipe shall be installed with a minimum of 3.0 feet of cover and a maximum of 16 feet of cover. When the cover is less than 3.0 feet or more than 16 feet, Ductile Iron Pipe must be used subject to the specified bedding limits. PVC pipe shall be installed in accordance with ASTM D-2321 with the following modifications:
1. All PVC pipe shall be installed using Type III Granular Embedment. The bedding shall extend from the pipe to the trench wall or to two and one half pipe diameters (OD) on each side of the pipe, whichever is less.
4. Grade and Line For Pipe: As a minimum, centerline hubs will be set at each manhole and offset stakes set at each manhole, and if required at 100 foot

intervals between manholes. Cut sheets will show the vertical distance from the offset stakes to the inlet and outlet pipe invert at each manhole and to the pipe invert at each offset stake. Grade and line may be transferred to "batter boards" set at intervals not to exceed fifty (50) feet. Unless otherwise approved by the Engineer, three (3) batter boards will be in place at all times while pipe laying is in progress. Each joint shall be checked with a grade rod and plumb line with care being taken to keep the string line taut at all times.

Laser beams may be used to set line and grade when the Contractor provides adequate and accurate equipment for the Engineer to check his line and grade at each cut stake (lock levels shall not be considered adequate). If laser equipment is used, the grade shall be checked at each manhole and at benchmarks every 500 feet. The Contractor shall keep close check of his laser for variations in line and grade. No variations between manholes shall be corrected without relaying that portion of line, which has deviated from line or grade unless otherwise approved by the Engineer.

H. LATERAL INSTALLATION

1. 4-Inch and 6-Inch Laterals: Four inch and six inch laterals shall be connected to the main with tees as previously specified if the lateral is installed during the construction of the main. Four inch and six inch laterals shall be connected to existing mains with saddles placed in holes cored by an approved coring machine. Saddles and tees shall be as previously specified and as shown on the Standard Details

Laterals shall be completed to the property line using 22½° bends at the tee or saddle and pipe as previously specified and as shown in these Standard Details. The lateral shall be laid with a minimum slope of 1/8-inch per foot (1%). The end of the lateral will be plugged water/air tight. All tees, saddles and bends shall be completely encased in #67 washed stone. An "S" shall be cut in the curb at the location where lateral crosses under curb.

In subdivisions constructed without curb, the Contractor will paint an "S" on the edge of pavement at the location where the lateral crosses under the edge of pavement. Markings will be made using green paint.

All laterals except those serving lots adjacent to in line manholes or upstream from dead-end manholes in cul-de-sacs shall be connected to the sewer main. Laterals connected to manholes shall be laid on a line from the center of the lot to the center of the manhole and shall extend not more than six inches inside the

manhole wall. Manholes in cul-de-sacs shall have a maximum of three (3) laterals. Any in line manhole shall have a maximum of two (2) laterals. The lateral elevation entering the manhole shall match crown to crown with the main entering the manhole and a trough shall be formed for the lateral invert. Laterals that are connected to outfall lines shall enter the manhole at the shelf and an invert shall be formed to carry the lateral flow to the main invert.

The laterals shall be installed with a minimum of four (4) feet of cover at the property line, unless otherwise approved by York County Water/Sewer Department. The depth of the lateral at the property line shall not be greater than five (5) feet unless greater depth of the lateral unit the installation is approved by a York County Water/Sewer Department Inspector.

2. 8-Inch And Larger Laterals: 8-inch and larger diameter laterals shall connect to manholes with the lateral crown level with the crown of the main line pipe, or with outside drops, in accordance with the specifications and standard details for mainline construction. When the lateral is the same diameter as the main line pipe, a drop of 0.2 feet will be provided in the manhole between the invert of the lateral and the invert of the main line pipe. The lateral shall be laid with a minimum slope of 1/8-inch per foot (1%).

I. BACKFILL

All backfill shall be of non-plastic nature free from roots, vegetative matter, waste, construction material, rock larger than $\frac{3}{4}$ cubic foot, or other objectionable material. Small rock (less than $\frac{3}{4}$ cubic foot) shall not exceed 10% of the fill material. Rock shall not be placed within 3-feet of the pipeline or within three feet of the finished grade. Rock larger than $\frac{3}{4}$ cubic foot will not be permitted within the trench. No objectionable or unsuitable material will be allowed in the backfill. Backfill material shall be capable of being tamped by mechanical tamps using relatively low velocity and heavy blows. The material shall have no tendency to flow or behave in a plastic manner under the tamping blows. Material deemed by the Engineer as unsuitable for backfill purposes shall be removed from the job site before backfilling operations begin.

When the Engineer determines that the material excavated from the trench is unsuitable for backfill because of the material type or because it contains excessive debris, rock or organics, it shall be removed from the project and replaced with a backfill material approved by the Engineer. When the moisture content of an otherwise suitable material is too high to achieve specified compaction, as determined by a moisture content and density test, the Contractor shall replace the material as necessary to meet backfill

requirements. The wet material may be dried to optimum moisture content and used for backfill in subsequent phases of the project. Should an otherwise suitable material be found too dry to achieve compaction requirements, water may be added to the material to raise the moisture content to optimum.

Borrow material placed at the direction of the Engineer shall be clean earth at optimum moisture content, concord (pit) gravel or ABC stone.

Backfill shall be accomplished immediately after the pipe is laid. Backfill around pipe and to an elevation of one (1) foot above the pipe bell shall be done only by hand and in layers not exceeding six (6) inches with each and every layer thoroughly tamped. The first three (3) feet of fill shall be completely free of rocks. Successive layers of backfill shall be compacted in place as specified below.

Under no circumstances shall water be permitted to rise in unbackfilled trenches after the pipe has been placed. Should water rise in an unbackfilled ditch after the pipe has been placed, the Engineer may require the Contractor to remove the pipe, muck the trench and follow the procedure for either Type I or Type II Granular Embedment when relaying the pipe.

1. Backfill of trenches within sewer main rights-of-way: Trenches excavated outside existing roadway and railway right-of-way may be backfilled, above the initial one (1) foot, by mechanical means in layers up to twelve (12) inches thick unless otherwise directed by the Engineer.
2. Backfill of trenches within road and railway rights-of-way: Trenches excavated within existing road and railway rights-of-way shall be backfilled in layers not to exceed six (6) inches and each successive layer shall be thoroughly tamped, as specified.

J COMPACTION REQUIREMENTS

Compaction shall be attained by the use of mechanical tamps only. Each layer of backfill shall be placed loose and thoroughly compacted in place. Heavy rollers, vehicles or other equipment shall not be used for compacting pipeline and structure backfill nor allowed to cross over completed work except at points adjudged capable of adequately protecting the pipeline. Pneumatic tamps, gasoline ram type tamps or vibrating tamps with sheepsfoot rollers will be required to meet the specifications of "Mechanical Tamp". Variances shall only be with the explicit approval of the Engineer.

1. Compaction Within Sewer Rights-of-way: Trenches excavated outside existing road and railway rights-of-way shall be backfilled as hereinbefore specified and tamped thoroughly:
 1. All material shall have an in-place density of at least 85% of maximum dry density or as approved by the Engineer.
 - b. Should any public or private roadways, service roads, drives, etc. be encountered during this construction, the Contractor shall at the Engineer's direction comply with those compaction requirements specified below for work within road and railway rights-of-way.

2. Compaction Within Road and Railway Rights-of-Way: Unless otherwise approved by the controlling agencies, trenches excavated within existing road and railway rights-of-way and all structure excavation regardless of location shall be backfilled as hereinbefore specified and thoroughly tamped.
 - 1 Unless otherwise directed by the Engineer, all material from the bottom of trench to within six (6) inches of the subgrade shall have an in-place density as defined by a standard proctor curve for the material.
 - b. All material within six (6) inches of the subgrade level shall an in place density of 100% of the maximum dry density.
 - c. On roadway shoulders, all material shall have an in place density of 95% of the maximum dry density. The Contractor shall remove and replace all material failing to meet these requirements with suitable material. The extent of this removal shall be determined by the Engineer.

K. MANHOLE CONSTRUCTION

All manholes outside street rights-of-way or landscaped areas shall be constructed to a height of two (2) feet above the adjacent ground unless otherwise indicated on the Plans or by the Special Provisions. Manholes within street rights-of-way or landscaped areas shall have finished rim elevations flush with the pavement or adjacent finished grade.

1. Precast Reinforced Concrete Structures: All precast manhole sections shall conform to the Material Specifications and Standard Details.

Precast manholes shall be treated similar to reinforced concrete pipe for installation. That is, if ground water and/or soil conditions require stabilization for pipe installation comparable measures will be required for precast manhole installation. Under no circumstances will a precast base section be placed on unstable soil as solely determined by the Engineer.

Jointing of precast sections will be done in accordance with the manufactures recommendation, with special attention called to the amount of force used.

All backfill around structures shall be thoroughly tamped in layers as specified for placing backfill.

Regardless of the type manhole construction used, the Contractor will do that which is necessary to stabilize the soil intended to support the structure. A stable condition shall only be adjudged by the Construction Engineer or his authorized representative. Any cost incurred by the Contractor in stabilizing the area to support a manhole shall be considered incidental to the manhole construction.

2. Outside Drops: When design considerations dictate a large elevation change across a manhole, an outside drop shall be constructed in accordance with the York County Water/Sewer Department Standard Details. Depending on the particular fittings used, elevation differences of 2.0 to 2.5 feet are required to accommodate an outside drop. When there is no sufficient elevation difference to permit construction of an outside drop, the grade of the influent pipe shall be lowered such that the vertical separation of the influent and effluent pipe is 0.2 feet, as measured at the center of the manhole when the grades of both pipes are projected to that point. Outside drops shall not enter the cone section of precast manholes. The influent pipe of an outside drop manhole must be a minimum of 18' ductile iron pipe.
3. Inside Drops: When connecting a proposed sewer main to an existing manhole at an elevation significantly higher than the existing invert elevation, and where safety considerations or working space limitations preclude building an outside drop, the connection may be made with an inside drop constructed in conformance with the Standard Details. Inside drops will be used only where shown on the plans or specifically approved by the Engineer. They may not be used in lieu of outside drops shown on the plans. Inside drops shall not enter the manhole in the cone section. Inside drops are not allowed on four (4) feet diameter manholes.

4. Installation of Frames And Covers: The frame shall be installed on the manhole with anchor bolts on all manholes that are not flush with the ground. 8-inch tall or 4-inch tall frames may be used for manholes with bolt down frames. These frames shall have four (4) holes in the support flange to permit installation on the cone with anchor bolts. Holes shall be equally spaced in the flange. Complete anchor bolt assemblies shall be zinc plated steel and shall consist of a drive in type anchor sleeve, a threaded stud and two nuts. Anchors shall be installed in field drilled holes in the cone. Minimum diameter of the threaded stud shall be ½ inch. The Contractor shall seal the frame to the to the manhole by installing a length of butyl rubber joint sealant to form a gasket between frame and manhole. The butyl rubber joint sealant shall have a one inch cross section, and shall make two full circles when placed on the cone section, and shall be compressed by the frame with the anchor bolts. Butyl rubber joint sealant shall be “Rubber Seal “ as manufactured by Ru Van, Inc., or approved equal. Cement mortar grouting of the frame shall be required. Brick may not be used to adjust rim elevations of above grad manholes.

Manholes that are installed flush with pavement or grade shall have frames attached to the manhole with a bed of cement mortar grout. 8-inch tall frames are required for all manholes that are flush with pavement or finished grade unless otherwise approved. Standard size brick or reinforced concrete grade rings may be used to adjust the finished rim elevation of such manholes. This adjustment may not exceed 21-inches in height.

5. Manhole Step Testing: The Contractor will furnish a hydraulic driven system consisting of cylinder, connecting hose and above ground pump with gauge to test manhole steps to exceed 1000 lbs. of resistance of pullout. All field installed steps will be tested. In lieu of field testing steps installed at the plant, certified shop reports by the manufacturer showing that each step passed the required 100 lb. pullout will be accepted. The certificates will be furnished to the inspector prior to field installation.

Unless the Contractor can furnish the manufacturer’s certification on step tests, the Contractor will be required to test 10% of the plant installed steps. An additional 10% will be tested for each failure.

6. False Walls: False walls shall be constructed in manholes when specified on the Plans. Holes of the appropriate size shall be cored or blocked out in the manhole wall at the elevation and alignment shown on the Plans. A four-inch thick masonry wall shall be constructed in the opening. Inverts shall be constructed to match proposed pipe elevations and alignments and permit installation of the future extension without demolition work other than removal of the false wall.
7. Steel Vent Pipes: Steel vent pipes will be installed in accordance with the Standard Details. Shop drawings of strap on vents, mounting straps, and anchor

a ram weight of one (1) to one and a half (1½) times the pile weight. In case the required penetration is not obtained by the use of a hammer complying with the above minimum requirements, the Contractor shall provide a heavier hammer, at his own expense. The piles shall be driven on a batter of 15° to the vertical or as shown on the plans, and shall not be out of position at the top of the pile by more than three inches in any direction after driving.

- d. Cross bracing: Cross bracing will be required only when the undisturbed ground level is below the intersection of the cross bracing.
- e. Painting Steel Piers: Unless otherwise directed, all steel in the piers shall have a coal tar epoxy coating consisting of two coats of coal tar epoxy as specified. All surfaces of the steel to one foot below the disturbed ground or to one foot below the cross bracing, whichever is greater, shall receive the coating system and shall be thoroughly sand blasted prior to application to remove rust, dirt, grease, and other foreign material and to provide a clean surface to receive the coating. Each coat of paint shall be approved by the Engineer prior to application of the next coat. The total dry film thickness shall be at least 16 mils. Areas with coatings less than 16 mils shall be recoated as required to provide the specified film thickness.
- f. Testing And Inspection: The Inspector will be present during all pile driving operations and the Contractor will provide him evidence that the average penetration for the last 10 blows is less than S calculated by use of the above formula.

Test piles furnished and driven by the Contractor for his use in determining the lengths of piles to be furnished may be so located that they may be cut off and become a part of the completed structure, provided that such test piles conform to the specifications and are approved by the Engineer.

Test piles shall be driven with equipment of the same type and capacity as that used for driving for the structure.

Test piles which are not to be incorporated in the completed structure shall be removed to at least 2 feet below the surface of the ground or the stream bed, and the remaining hole backfilled with earth or other suitable material.

The Contractor shall give written notice before beginning construction on the steel piles in order to coordinate this work with York County Water/Sewer Department.

2. Concrete Piers: If the required penetration for a pile is not obtained, as determined solely by the Engineer, the Contractor may be directed to construct a reinforced concrete pier. The Contractor will not attempt to drive a second pile at a pier location at which the first pile did not achieve the required penetration unless the Engineer has determined that the first pile will be used.

A pile, which will not be incorporated in the completed structure, will be removed or cut off so that the top of the pile is below the concrete footing.

M. REMOVAL AND RESTORATION OF PAVEMENT AND ROAD SURFACES

All removal and restoration of pavement and road surfaces will be in accordance with the specifications approved by the York County Public Work Department or of the South Carolina Department of Transportation and Safety whichever applies.

All restored bituminous and concrete pavements shall be placed to existing cross-section and ride quality. Restored pavement will in all instances be flush and level with existing pavement at the sawed edges, and at existing gutter lines where applicable unless otherwise approved by the Engineer. When pavement repairs do not meet the above criteria or are not performed in a workmanship manner as determined by the Engineer, York County Public Works, or South Carolina Department of Transportation, whichever applies, the contractor will remove and re-perform the restoration as specified.

When cuts are to be made in street rights-of-way under maintenance by York County Public Works, the Contractor shall contact the road Maintenance Supervisor or his designated representative before each separate pavement cut is made and secure a permit.

Pavement will be replaced as follows. In all pavement cuts either the permanent pavement or a temporary pavement consisting of 1"-1½" of black asphaltic concrete (later to be replaced permanently) will be placed immediately upon completion of the subgrade unless otherwise approved by the Engineer.

1. Specifications for Cutting Pavement: Unless otherwise approved or required, concrete pavement shall be removed to the nearest expansion or contraction joint. The Contractor will contact the Superintendent of Streets and/or D.O.T.'s District Engineer for determination of the limits of concrete replacement and location of joints. Where sawed joints are allowed, the depth of the sawed cut shall be at least one (1) inch and shall extend at least 1/5 of the depth of the concrete. More depth may be required if necessary to prevent damage to surrounding pavement.

Bituminous pavement shall be cut in a smooth and straight line. Sawing is required on asphaltic concrete. The width of pavement left between the edge of the ditch and the existing edge of the pavement or the front line of the gutter, shall be at least 2 feet. Residual strips of pavement less than 2 feet in width must be removed and replaced. Existing pavement shall be removed on each side of the trench for at least 12 inches beyond top of trench.

The Contractor shall remove and replace pavement, which, in the opinion of the Engineer, has been cracked or displaced by the operation of the Contractor.

2. Specification For Restoring Concrete Pavement: The concrete used to restore pavement shall have a minimum 28 day compressive strength of 3600 P.S.I. The concrete as placed shall conform to the shape, grade, and finish of the existing pavement and will be one (1) inch deeper than the original pavement including base, but in no instance less than six (6) inches.
3. Specification For Restoring Asphalt Pavement: All material above the sub-base level shall be hot-mix bituminous concrete conforming to South Carolina Department of Transportation standard specifications for roads and structures for both mix design and placement. The asphalt pavement as placed shall be one (1) inch deeper than the original pavement including base, but in no instance less than six (6) inches within City maintained roadways or eight (8) inches within state maintained roadways. The asphalt shall be placed in lifts not greater than 4 inches and shall be hot mix bituminous concrete binder Type H. The last two (2) inches in either instance shall be bituminous plant mix (1-2) suitable to the appropriate controlling agency. 1-2 asphalt pavement resurfacing will be placed with paving machines and/or rollers of a size and type currently approved by the South Carolina Department of Transportation for use on resurfacing contracts.

If a bituminous surfacing overlays a concrete base, the Contractor, at the option of the Engineer, shall replace the concrete to its original thickness, or to a level 2 inches below the finished surface. The Engineer may direct the Contractor to omit all concrete and to replace the pavement with bituminous materials.

Tack coats shall be employed with each lift. Tack costs shall be placed on both horizontal and vertical surfaces (pavement cuts or face of concrete gutters).

Under normal conditions, asphalt binder will be placed in pavement cuts at the end of each workday. 1-2 shall be replaced weekly or within five days following completion of pipeline construction along a continuous section of pavement. During inclement weather, the Engineer may permit the use of temporary asphalt (cold mix) to seal the trench until permanent asphalt can be placed.

N. CONCRETE CONSTRUCTION

1. Acceptance of Concrete: Concrete shall be accepted on the basis of its meeting the requirements listed under the Material Specifications and Detail Specifications Section of this contract. The Inspector will accept no ready mix concrete without the plant dispatch ticket.

The Engineer shall make or require any tests as he deems necessary to insure that the concrete meets specifications. The Engineer may require the test to be performed by an independent testing laboratory at the Contractor's expense.

2. Placement: Concrete will not be accepted if it cannot be placed within ninety (90) minutes of the dispatch time. Time requirements may fluctuate marginally due to temperature. Concrete shall be deposited in such a manner so as to prevent contamination by foreign material and segregation due to rehandling or flowing. Segregated concrete and/or concrete containing foreign material will not be accepted. Depositing will not be permitted when temperature has not exceeded 35° and rising by 10:00 A.M. Depositing shall cease when the descending air temperature in the shade falls below 40° F. It shall not resume until the ascending air temperature rises to 35° F. All concrete shall be kept from freezing by the Contractor. Frozen concrete shall be replaced at the Contractor's expense. Free fall shall not exceed 3 feet in any case.

3. Forms: Forms may be made of wood, plywood, metal, or any other material approved by the Engineer. Forms shall be mortar tight, of material strong enough to resist noticeable deflection or bulging between supports, and the interior dimensions of the forms shall be such that the finished concrete shall be of the form and dimensions shown on the Plans. The design of the forms shall take into account the effect of vibration of concrete as it is placed and also the rate of speed at which the forms will be filled. Forms shall be coated with a lubricant as approved by the Engineer.

Mechanical vibrators, of an approved type, and continuous spading and/or rodding of concrete shall be used to produce proper contact of concrete with forms and reinforcing steel in piers and with forms and pipe in monolithic inverts insuring a compact, dense and impervious artificial stone of uniform texture.

4. Curing: All concrete will be cured for a seven (7) day period after placement according to the following procedure:

- a. Forms will normally be left in place for the entire seven (7) day period. Exposed surfaces not covered by forms will be kept moist continuously for the entire seven day period or will be cured through use of an approved

curing compound which will be applied after all surface water has disappeared.

- b. At the discretion of the Engineer, forms may be removed after the initial set and before the end of the seven day period. In such cases, the areas previously covered by forms shall be cured as described above.
 - c. The Engineer may permit backfill of certain structures (e.g. concrete piers) before the end of the curing period. In such cases, the forms shall be stripped and the surfaces that remain exposed after backfill shall be cured as described in (a) above. Curing compound shall not be required for backfilled surfaces except where specified by the plans or Special Provisions.
5. Finishing: The structure shall have a uniform and textured surface. All form marks exposed to view shall be rubbed off with a stone.
 6. Testing: The following tests will be performed by York County Technicians to ensure the concrete quality:
 - a. Compressive strength in accordance with ASTM C-31 and ASTM C-39. Test cylinders which are formed in the field will be left in the field until compression testing (7 day, 14 day, 28 day) is completed thereby more closely approximately the curing conditions of the field placed concrete.
 - b. Slump Test in accordance with ASTM C-143.
 - c. Air Content Test in accordance with either ASTM C-173 or ASTM C-231.

O. DRY BORE WITH STEEL ENCASUREMENT

1. Bore Pits (or Tunnel Pits): Bore or tunnel pits shall be safed-up, shore, well marked, lighted, and not left unattended except as approved by the controlling agency. Requirements for stabilization and dewatering of bore pits shall be as hereinbefore specified. The angle of repose method (sloping pit walls) for creating a safe working area shall not be used.
2. Installation: Smooth wall or spiral weld steel pipe may be jacked through dry bores slightly larger than the pipe, bored progressively ahead of the leading edge of the advancing pipe as soil is mucked by the auger back through the pipe. As the dry boring operation progresses, each new section of encasement pipe shall be butt welded to the section previously jacked into place. Continuous checks shall

be made as to the elevation, grade and alignment of each successive section of encasement as well as the tracks (rails) upon which the boring rig travels.

If voids are encountered or occur outside the encasement pipe, grout holes shall be installed in the top section of the encasement pipe at ten (10) foot centers and the voids filled with 1:3 Portland Cement grout at sufficient pressure to prevent settlement in the roadway/railway.

Boring operations shall be continuous to their completion, and unnecessary or prolonged stoppages shall not be allowed.

In the event an obstruction is encountered during the boring and jacking operations, the auger is to be withdrawn and the excess pipe is to be cut off, capped, and filled with 1:3 Portland Cement Grout at sufficient pressure to fill all voids before reapplying to the Controlling Agency for permission to open cut, bore at an alternate location, or install a tunnel.

Installation shall be to the limits specified by the Controlling Agency and/or as delineated in their encroachment issued to the County. (Copy of the encroachment agreement must be kept at the site throughout boring operations).

The completed casing installation shall be such as to prevent the formation of a waterway under the road or railbed.

The Controlling Agency shall have full authority to require remedial measures and/or to stop all work if, in its opinion, said work will cause any damage to the roadway/railway section or endanger traffic. In all instances the Controlling Agencies reserve the right to sample, test, and approve all materials and methods used.

The Contractor shall notify the Controlling Agency through the Construction Engineer and acknowledgment shall be received a minimum of five (5) working days prior to beginning any work within roadway or railway rights-of-way. If required, 24-hours notice will be given prior to completion.

P. GUARANTEED CASING INTSALLATION

The casing shall be installed by jacking, with simultaneous removal of spoil. The spoil removal shall not proceed more than 18-inches ahead of the casing. The diameter of the ~~excavated hole shall be no larger than necessary to keep the casing moving freely and~~

lubricant may be used to reduce the jacking forces. Casing sections shall be joined by butt weld.

After the casing is jacked in place, 2-inch grout holes shall be used to pump a 1:3 Portland Cement grout to fill the void outside the casing. Sufficient pressure should be applied to force grout out of the adjacent grout hole. Grout holes shall be a maximum of ten feet apart at the top of the casing.

The casing size and thickness shall be as shown on the Plans or Special Provisions.

Q. TUNNELLING OPERATIONS USING STRUCTURAL STEEL LINER PLATES

All plates shall be formed to provide circumferential-flanged joints. Longitudinal joints may be flanged or offset lap seam type. All plates shall be punched for bolting on both longitudinal and circumferential seam or joints. Bolt spacing in circumferential flanges shall be in accordance with the manufacturer's standard spacing and shall be multiples of the plate length so that plates having the same curvature shall be interchangeable to permit staggering of the longitudinal seam. Bolt spacing at flanged longitudinal seams shall be in accordance with the manufacturer's standard spacing. For lapped longitudinal seams, bolt size and spacing shall be in accordance with the manufacturer's standard but not less than that required to meet the longitudinal seam strength requirements of the design specifications. All liner plates for the full length of a specified tunnel shall be either the flanged or the lapped seam type. The two types shall not be mixed in the same tunnel.

Liner plates shall be assembled in accordance with the manufacturer's instructions. Galvanized and coated plates shall be handled in such a manner as to prevent bruising, scaling, or breaking of the coating. Any plates that are damaged during handling or placing shall be replaced, except that small areas with minor damage may be repaired to the satisfaction of the Construction Engineer or his representative.

Galvanized surfaces shall be repaired by thoroughly wire brushing the damaged areas and removing all loose cracked coating, after which the cleaned areas shall be painted with two (2) coats of zinc rich paint as approved, and an acceptable bituminous coating restored.

When tunneling has proceeded a distance sufficient for placing one section of the tunnel liner, that section of liner will be placed before excavating further. Excavation shall be controlled so that the space outside the liner plate shall be held to a minimum. All voids between the liner plate and tunnel wall shall be filled with 1:3 Portland Cement grout, containing no more water than necessary, placed under sufficient pressure to fill all voids. Grout shall be placed through the grout holes provided in the top of the tunnel liner

plates. Grout holes 2" in diameter shall be provided at not more than 4.5 foot center or every third ring of plates to permit grouting as the erection of the tunnel liner progresses. At no time will the grouting operations be further than 10' from the front end or head of the tunnel construction.

At the end of each day's operations, the voids outside installed liner plates shall be grouted whether 10' or less. Grout will be forced into each grout hole. If the grout from one hole should flow along the liner plates so as to plug the next hole, the plug shall be opened by punching through the grout so that each hole may be used for grouting. The grouting operation will be continued at each hole until all spaces outside the liner plates are filled and no grout will flow.

The tunnel shall be constructed to the limits, grade and alignment shown on the Construction Plans. Excavation, without the use of jetting, shall be done in such a manner as to protect public and/or private property from damage. Prior to beginning any construction, the Contractor shall submit pit shoring and tunnel liner details for approval, and no tunneling may begin prior to approval of these details by the appropriate Controlling Agency. After approval of tunnel liner and pit shoring details, a five (5) day notice to the Controlling Agency, through the Construction Engineer, shall be provided as previously specified.

No blasting will be done without prior written approval of the controlling agency and then only in strict accordance with all Federal, State, and Local laws, ordinances, rules, or regulations governing the storage and use of explosives. Where blasting is required, only small controlled charges of 40% dynamite or plastic explosives shall be used. The depths of the holes for these charges shall not exceed the depth necessary to clear an area sufficient to place one section of tunnel liner.

The charges for the initial series of blasts should be placed in the triangle method. The second series should be placed in the radial method a minimum distance from the desired diameter of the tunnel. The triangular charges shall be set to go off first, with the radial charges to go off following a short interval or using the time-lag method.

Where is encountered before approaching the shoulder or pavement, the first four series of charges will be used in determining the amount of controlled blasting to be used before beginning any blasting beneath the railway or shoulders or pavement of the highway as applicable. If rock is encountered after tunneling progresses beneath the pavement or railway, the charges will initially be set at very low levels and increased in small increments until the proper amount of charge is determined.

In no case will an overshoot be permitted. If a boulder is encountered and removed by blasting or by other methods, a bulkhead will be formed immediately after removal of the boulder and the area filled with grout before proceeding with the tunneling operations.

If there is any indication of a vertical split in the rock formation, or any indication of settlement of the roadway or railway fill, all operations shall be stopped and the Controlling Agency notified immediately. If the vertical split is not determined to be of too great a magnitude or too close to the rails/pavement, the split shall be filled with grout at a pressure specified by the Controlling Agency, allowed to set and tunneling operations may be continued.

If it is determined that the vertical split is too great of a magnitude or too close to the pavement or railway, the Controlling Agency shall determine the method to be used to correct the split. If settlement of the roadway or railway occurs, the Controlling Agency will advise the Owner and his Contractor of the proper steps to be taken to correct the settlement. If deemed necessary by the Controlling Agency, adequate warning devices (signs, flasher, etc.) accompanied by responsible flagmen shall be placed at a distance allowing any and all traffic time to stop safely before reaching the questionable area. At the option of the Controlling Agency, it may provide the necessary flagmen, warning devices, etc., at the Contractor's expense. Traffic shall be allowed over the questionable area only as directed by the Controlling Agency.

The Controlling Agency shall have full authority to inspect entire tunnel operation, require disposition of remedial measures, and to stop all work if, in its opinion, the work will cause any damage to the roadway/railway section or endanger traffic. In all instances the Controlling Agencies reserve the right to sample, test, and approve all materials used.

The completed liner shall consist of a series of structural steel liner plates assembled with staggered longitudinal joints. Liner plates shall have been fabricated to fit the cross section of the tunnel. All plates shall be connected by bolts on both longitudinal and circumferential seams or joints.

After tunneling operations have been completed the Contractor will install the carrier pipe in a manner approved by the Engineer. Concrete fill (1:3 Portland Cement grout) will then be placed after completing installation of the sewer pipe within the tunnel liner as directed by the Engineer and end enclosure walls installed as shown on the Construction Plans or Standard Details. Ends of the tunnel liner will be sealed with an eight-inch (8") masonry wall on the lower end and a twelve-inch (12") masonry wall on the higher end. Weep holes will be provided on the downstream end for drainage - See

Standard Detail #16. The Contractor shall then remove the vertical shoring for pits (if ground conditions allow), surplus spoils, and material from the site.

The site shall then be returned to its original condition, seeded, mulched, or restored as specified and left in a neat and satisfactory condition. Shoring material shall be removed in such a manner so as to avoid collapse and to allow proper backfill. The backfill shall be placed in accordance with these Specifications or the requirements of the Controlling Agency.

Insurance requirements for work performed on Railroad (CSX, Norfolk-Southern, etc.) property will be as outlined in the Special Provision Section of this contract. The Contractor shall furnish for approval a certificate of Insurance to this office. All required submittals will be sent to the Utility Department for review and this office will then forward the documentation on to the railroad.

R. BLASTING

Prior to commencing any blasting operations the Contractor shall notify either the City Fire Department - Fire Prevention Section or the County Fire Administrator as applicable, and obtain blasting permits as required. The Contractor must furnish certification of Insurance specifically covering any and all obligations assumed pursuant to the use of explosives.

All blasting operations shall be conducted in strict accordance with any and all decrees, rules, regulations, ordinances, and laws as may be imposed by any regulatory body and/or agency having jurisdiction over the work relative to handling, transporting, use and storage of explosives. Blasting shall be done only by competent, sober and experienced personnel whose activities shall be conducted in a workmanlike manner. Satisfactory information must be provided to the Engineer that the blaster meets or exceeds the qualifications enumerated in OSHA Regulations Part 1926, Subpart U, Section 1926.901 - Blaster Qualifications.

All rock, dirt and debris from blasting shall be contained within the excavation by use of weighted mats or undisturbed overburden. The Contractor's blaster shall be fully responsible for determining the method of containment and the weight, size and placement of material required to contain the charge he is using. Charges shall be sized such that no damage to houses, structures, roadways, etc., outside the limits of the excavation will occur. Where there is a possibility of such damage, the charge will initially be set at a very low level and increased in small increments until the proper

charge is determined. The Contractor shall be held responsible for any and all injury to persons or damage to public or private property.

1. Permission to Blast: The Contractor shall not be allowed to blast within any rights-of-way maintained by any agency (D.O.T., R.R., Gas, etc.) other than the City without specific approval of the controlling agency and only in accordance with their respective requirements.

S. TESTING AND INTERNAL INSPECTION

The Contractor shall provide proper ventilation of sewer lines and manholes during any test or inspection procedure. The Contractor shall be responsible for providing all equipment and personnel necessary to comply with OSHA confined space regulations.

1. Gravity Sewer Pipe Leakage Testing: No sooner than 10 days following completion of backfill, the Contractor along with the project inspector will be required to determine the level of the ground water table. If the level of ground water table is above the top of the pipe, the sewer line shall be tested for infiltration. If there is no ground water above the top of the pipe the sewer line shall be low pressure air tested. Each test shall be performed as follows:
 - a. Infiltration: The infiltration shall not exceed 100 gallons per day per inch diameter per mile as measured for a reach of pipe the same diameter up to one mile long. However, when excessive infiltration can be isolated to a particular section (manhole-manhole) the limit will be applied to that section. There shall be no visible points of infiltration. Any section (manhole-manhole) must be isolated and tested separately if so directed by the Engineer. The York County Water/Sewer Department reserves the right to TV any sewer line to detect sources of infiltration.
 - b. Low Pressure Air Test: Tests shall be performed in accordance with ASTM C-828 and C-924 on sewer lines 42-inches in diameter and smaller. Test pressure will be measured by gauges furnished and installed by the Contractor above ground at the manhole opposite the air supply. The Contractor shall furnish all other test equipment required including connecting hoses at the manhole opposite the air supply. The Contractor shall furnish all other test equipment required including connecting hoses.

Sewer lines larger than 42-inches in diameter shall be tested for infiltration as specified above and each joint shall be visually inspected by a York County Water/Sewer representative.

2. Manhole Leakage Testing: Manholes shall be tested by plugging the inlet and outlet pipes with airtight plugs and using one of the following procedures:
 - a. Exfiltration: Fill the manhole to the rim with water and allow the level to equalize due to saturation. Refill the manhole and mark the level to begin the test. The test shall last at least 2 hours and allowable leakage shall be 3 gallons per hour. The Engineer will select 25% of the manholes on the project to be tested. If any manhole fails, an additional manhole will be tested. Manholes that fail the test shall be repaired and retested until they pass.
 - b. Vacuum Air: Manhole vacuum air testing shall be performed in accordance with ASTM C-1244. The Engineering will select 25% of the manholes on the project to be tested. Manholes that fail the test shall be repaired as specified and retested until they pass. Manholes that show leaks and are repaired prior to testing shall be tested as specified.
3. Deflection Testing of PVC Pipe: Not less than 30 days following completion of backfill, the pipe shall be tested for deflection with a 5% mandrel sized as defined in ASTM D-3034. Mandrels shall be furnished by the Contractor. The mandrel shall be pulled through each section of pipe from manhole to manhole. The mandrel must slide freely through the pipe with only a nominal hand force applied. No mechanical device shall be used in pulling the mandrel. Any pipe, which refuses the mandrel, shall be removed and replaced or re-rounded and the bedding shall be properly constructed as specified to prevent excessive deflection. Such sections shall be retested for deflection after completion of backfill.
4. Force Main Sewer Pipe Leakage Testing: Pressure and leakage tests must be conducted in accordance with AWWA C600 Standards for ductile iron material and AWWA C605 Standards for PVC material . On completion of the line or sections of the lines, connections and appurtenances, the line shall be filled and hydrostatically tested. The water for this purpose can be taken from existing lines under the supervision of the Engineer's Inspector and leakage will be measured by the Inspector with a meter furnished by the contractor. All leaks and any defective material shall be repaired or replaced to the satisfaction of the Engineer and the tests repeated until the requirements of this specification are met. Any special equipment, pumps, etc. required to make the test shall be furnished and operated by the contractor as directed by the Inspector.

The Contractor shall use great care to be sure that all air is expelled from each section under test. If openings are not available for the purpose of expelling air, the Contractor shall provide air releases of sufficient size (as determined by the Engineer) in accordance with County Standard Drawings, at his expense. Specific procedures for testing mains are as follows:

- a. Test pressure will be held for at least two (2) hours at at least 1.5 times the maximum working pressure at the low point of the section under test. When testing against valves, the differential pressure valve must not exceed 150 PSI for valves rated at 150 PSI.

If the test cannot be made with differential pressure of 150 PSI, 250 PSI valves will be specified. Differential pressures across valves may be up to 200 PSI (R.61-58.4.D.(11)(e)).

- b. Allowable leakage will be determined by Table 6, AWWA C-600 (see below) or by the following formulas:

Ductile Iron:

$$L = [SD(P)^{1/2}] / (133,200)$$

L = allowable leakage (gals/hr)
 S = length of the pipeline tested (ft)
 (ft)
 D = diameter of pipe (in.)
 P = average test pressure (psig)

PVC:

$$L = [ND(P)^{1/2}] / (7,400)$$

L = allowable leakage (gals/hr)
 N = # of joints in pipeline tested
 D = diameter of pipe (in.)
 P = average test pressure (psig)

Add .0043gal/hr. for each 3/4 inch service and .0057 gal/hr. for each 1-inch service.

TABLE 6
Allowable Leakage per 1000 ft. (305m) of Pipeline - gph†*

Avg. Test Pressure psi (Bar)	Nominal Pipe Diameter -in.															
	3	4	6	8	10	12	14	16	18	20	24	30	36	42	48	54
450 (31)	0.48	0.64	0.95	1.27	1.59	1.91	2.23	2.55	2.87	3.82	3.82	4.78	5.73	6.69	7.64	8.60
400 (28)	0.45	0.60	0.90	1.20	1.50	1.80	2.10	2.40	2.70	3.60	3.60	4.50	5.41	6.31	7.21	8.11
350 (24)	0.42	0.56	0.84	1.12	1.40	1.69	1.97	2.25	2.53	3.37	3.37	4.21	5.06	5.90	6.74	7.58
300 (21)	0.39	0.52	0.78	1.04	1.30	1.56	1.82	2.08	2.34	3.12	3.12	3.90	4.68	5.45	6.24	7.02
275 (19)	0.37	0.50	0.75	1.00	1.24	1.47	1.74	1.99	2.24	2.99	2.99	3.73	4.48	5.23	5.98	6.72
250 (17)	0.36	0.47	0.71	0.95	1.19	1.42	1.66	1.91	2.14	2.85	2.85	3.56	4.27	4.99	5.70	6.64
225 (16)	0.34	0.45	0.68	0.90	1.13	1.35	1.58	1.80	2.03	2.70	2.70	3.38	4.05	4.73	5.41	6.03
200 (14)	0.32	0.43	0.64	0.85	1.06	1.28	1.48	1.70	1.91	2.55	2.55	3.19	3.82	4.46	5.09	5.73
175 (12)	0.30	0.40	0.59	0.80	0.99	1.19	1.39	1.59	1.79	2.38	2.38	2.98	3.58	4.17	4.77	5.36
150 (10)	0.28	0.37	0.55	0.74	0.92	1.10	1.29	1.47	1.66	2.21	2.21	2.76	3.31	3.86	4.41	4.97
125 (9)	0.25	0.34	0.50	0.67	0.84	1.01	1.18	1.34	1.51	2.01	2.01	2.52	3.02	3.53	4.03	4.53
100 (7)	0.23	0.30	0.45	0.60	0.75	0.90	1.05	1.20	1.35	1.80	1.80	2.25	2.70	3.15	3.60	4.05

* If the pipeline under test contains sections of various diameters, the allowable leakage will be the sum of the computed leakage for each size.

† To obtain leakage in liters/hours, multiply the values in the table by 3.785.

- c. Pressure and leakage tests will be run concurrently and for a duration of four hours except as modified below.
- d. The Contractor will pressurize the line and verify that it is within allowable leakage before the official test is started.
- e. The Inspector will begin the test and remain at the job for the first hour, making sure that the test pressure is maintained within ± 5 PSI. The Contractor is to maintain the pressure within ± 5 PSI for the duration of the test period. At the end of the first hour, with the line pumped to full test pressure, he will read the meter and record the first hour leakage. If the first hour leakage is allowable, he will return at the end of the fourth hour and again read the meter. If the total leakage for the four hour period does not exceed four times the first hour leakage, the test will be terminated. If the total leakage exceeds four times the first hour leakage, but is still within allowable, the test will be held an additional hour. If the fifth hour leakage does not exceed the average hourly leakage for the first four hours, the test will be terminated at the end of the fifth hour. Otherwise, the test will be held until the leakage is non-increasing and within allowable for two consecutive hours. All visible leaks shall be repaired regardless of the amount of leakage.

- f. If leakage exceeds allowable for the four hour test, the test will be terminated and re-scheduled after the Contractor has verified that actual leakage is within the allowable leakage, but no earlier than the next work day.
- g. If the first hour leakage does not exceed 10% of the allowable, or if the allowable leakage rate does not exceed .4 gal/hr., the test may be terminated at the end of two hours provided the second hour leakage does not exceed the first hour leakage. If the second hour leakage exceeds the first hour leakage, the test will be held for an additional period as described in Paragraph (e) above.
- h. The maximum length pipe tested in one test shall be 5,000 feet or as close to 5,000 feet as possible depending on valve spacing.
- i. During the last stages of the test and without any reduction in pressure, first the hydrant guard valves will be closed and pressure released to determine if it is holding pressure (minimum 10 minutes per valve closing).
- j. Unless otherwise directed by the Engineer, each valve will be tested to 150 PSI for a minimum of 10 minutes after the pipeline has been successfully tested.

T. REPAIRS

All leaks shall be repaired by identifying and exposing the defective section of pipe and completing repairs as follows:

1. PVC or Ductile Iron Pipe: Defective or damaged pipe including leaking joints shall be removed and replaced with sound new pipe. The pipe shall be re-connected with approved couplings as specified in the MS Section of this document.
2. Manholes: Any damage to the interior wall of the manhole resulting from penetration of the lift holes shall be repaired with non-shrink cement grout.

Leaks through manhole joints or walls or around pipe collars, may be repaired from inside the manhole with non-shrink cement grout. If the size of the leak, or the external water pressure, prevents such repairs, the manhole shall be excavated and repaired from outside.

Leaks around boots or gaskets used to join pipe to manholes shall be repaired by external concrete collars or as approved by the Engineer.

U. ABANDONMENT

The following requirements shall apply for proposed abandonment of existing facilities unless otherwise shown on the plans or approved by the Engineer. All areas disturbed by abandonment will be restored.

1. Abandonment of Existing Manholes: Manholes which are to be abandoned will first have both influent and effluent lines plugged inside the manhole with watertight masonry. The manhole will then be filled with non-compressible material (#67 stone or as approved), to a point three feet (3'-0") below the finish grade. The remainder of the manhole shall be broken down and removed. Then the excavation shall be filled to finish grade with suitable soil compacted in place.
2. Abandonment of Mains At Manholes Which Remain In Service: Abandoned mains at active manholes shall be completely disconnected from the manhole by cutting the pipe outside the manhole and then plugging the abandoned main and the manhole wall with watertight masonry. The invert shall then be rebuilt to conform with the standard details.
3. Abandonment of Exposed Pipe: Exposed sections of abandoned mains shall be removed to a point not less than 5 feet into the adjacent banks. The remaining ends of the pipe shall be plugged with watertight masonry. Concrete piers or collars in the creek channel shall be removed completely. Concrete piers or collard not located in the creek channel shall be removed to a point three feet (3'-0") below the finish grade. Steel piers shall be cut off three feet (3'-0") below finish grade.

4. Abandonment of Existing Pump Stations: Pumps, motors, controls, etc., shall be salvaged and transported by the Contractor to the sewer maintenance yard in New Heritage. All influent and effluent pipes shall be plugged with watertight masonry. The pipe chamber and wetwell (if abandoned) will be filled with noncompressible material (#67 stone or as approved), to a point three feet (3'-0") below the finish grade. The remainder of the structure shall be broken down and removed. Then the excavation shall be filled to finish grade with suitable soil compacted in place. All above ground structures associated with the pump station, including fencing and the access road shall be removed and the area restored.

V. RESTORATION

All surfaces and structures (both public and private) within and adjacent to the construction operations shall be restored to a condition comparable to that existing prior to construction or as specified in the special provisions.

All surplus materials shall be disposed of in manner acceptable to the Engineer, and the construction area shall be left in a neat condition, with special attention called to proper drainage, smoothness of surface, and general clean up. No machinery or equipment shall be left or stored on the job site after the project is completed.

Unless otherwise specified, complete restoration to include fertilizing, seeding, and mulching of any and all areas disturbed during construction shall be completed within thirty (30) working days following the initial ground disturbing activity.

1. Water meters, valve boxes, drain pipes, and other structures encountered shall be reset or re-laid to match or clear surface grade and/or water main pipe grade as applicable.
2. All shoulder areas shall be restored, stabilized, and maintained to their original condition. Concrete, asphalt, gravel, and dirt walks, drives and roadways are to be replaced to their original shape and serviceability. Unless otherwise approved by the Engineer all areas (shoulders, side streets, drive, parking areas, etc.) which exhibit a gravel surface at the time of construction will be re-graveled with a minimum depth of six (6) inches of C.A.B.C stone compacted -in-place for the width and length of the disturbed area and then feathered gradually into the existing cross section. When a driveway is finished with other than C.A.B.C stone, a one-inch finish coating to match existing gravel gradation and appearance shall be placed.

The Contractor should note that all existing side streets and drives, which are either dirt or gravel, will be restored as specified for graveled areas.

3. Refuse Burial: Timber, rock and other refuse may not be buried within the permanent sewer rights-of-way with the exception of rock smaller than $\frac{3}{4}$ cubic foot which is allowed as previously specified.
4. Rip-Rap: The Contractor shall place stone rip-rap as specified in those areas subject to severe water action where directed by the Engineer.

Placement of rip-rap as shown on the Construction Plans shall be considered a guide only, with final determination made at the time of construction by the Engineer. Either the addition or deletion of quantities may be required.

Stone rip-rap will be placed as indicated on the Standard Details immediately following pipe installation and will be installed no steeper than a 2:1 slope except when specifically approved by the Engineer. Grading will be required as necessary to insure continuous even flow.

In locations where a creek bank is eroded near the sewer line the Contractor will be required to place compacted fill material along the creek bank in order to maintain 3' of cover over the sewer line in all directions. This is to be done before the rip-rap is placed.

The rip-rap installation shall include all earthwork necessary to stabilize the creek bank and to provide cover for the sewer line.

5. Jute Netting/Erosion Blanket: The Contractor shall install jute netting or Erosion Control Blanket in areas subject to high runoff velocities, areas subject to concentrated runoff and on steep slopes as shown on the plans and/or as directed by the Engineer.
6. Fertilizing, Seeding, and Mulching: Established lawns and landscaped areas damaged by construction shall be restored to their former condition by seeding, unless the type and condition of the existing sod warrants it being cut, removed, preserved, and replaced. All areas, regardless of previous condition, damaged by construction shall be fertilized, seeded, and mulched as outlined below:
 - a. Seed Bed Preparation: The seed bed shall be prepared by pulverizing the soil in an approved manner to a depth of three (3) inches for field conditions or slopes that are 3:1 or flatter and to a depth of one (1) to three (3) inches, as determined on site for slopes steeper than 3:1. The soil shall be tilled until a well pulverized, firm, reasonably uniform seed bed is prepared conforming substantially to ground elevations as shown on the Plans and/or as existed prior to construction. The disturbed area shall blend uniformly into adjacent topography. Good surface drainage must be provided, allowances for settlement made and ground elevations adjusted accordingly. Visible ponding will not be allowed. All stones, roots, sticks, rubbish, and other objectionable material shall be removed.

- b. Soil Improvements: Soil additives shall be incorporated in an approved manner into the topsoil at the following rates:
 - (1) Fertilizer - 20 pounds per 1000 square feet of 5-10-10 fertilizer generally and 30 pounds per 1000 square feet of 10-10-10 fertilizer for established lawn areas.
 - (2) Lime-100 pounds per 1000 square feet.
 - (3) Superphosphate (0-20-0) - 12 pounds per 1000 square feet.

- c. Seeding: Seeding must be done within thirty (30) calendar days after the initial ground disturbing activity.
 - (1) The seed must be in good, friable condition and not muddy or hard at the time seeding is performed.
 - (2) Seed shall be applied at the rate specified and raked or tilled into the topsoil with the resulting furrows running across the natural slope of the ground. Under no circumstances will any tilling activity be allowed parallel with said slope.

Slopes steeper than 3:1 shall require the use of hydraulic seeding unless otherwise specifically approved by the Engineer.

- d. Mulching: After fertilizing, seeding and raking, dried straw shall be spread uniformly over the area at a rate of 90 pounds per 1000 square feet. Approximately ¼ of the ground should remain visible to avoid smothering seedlings. The straw shall be sprayed with liquid asphalt to bond it together and anchor it in place within road right-of-way and areas subject to erosion.
 - (1) Liquid asphalt, thinned with kerosene, shall be used during freezing weather and shall be either rapid or medium curing. It shall be applied at a rate of 200 gallons per ton of straw or approximately 9 gallons per 1000 square feet.
 - (2) Emulsified asphalt, thinned with water shall be used when temperatures are less severe, shall be rapid curing only, and shall be applied at a rate of 150 gallons per ton of straw or approximately 7 gallons per 1000 square feet.

- e. Maintenance: The Contractor shall maintain the seeded areas until there is a uniform growth three (3) inches high. Maintenance shall consist of watering, weed and pest control within established lawns, fertilization, erosion repair, reseeding and all else necessary to establish a vigorous healthy and uniform stand of grass. All areas and spots, which do not show a uniform stand of grass, for any reason, shall be treated repeatedly until a uniform stand is attained.

Seasonal seeding mixtures and rates of application shall be as follows. All rates are in pounds per 1000 square feet and any rates listed below may be cut by ½ for temporary erosion control measures only.

SEPTEMBER 15 - MARCH 1

Maintained/Established Lawns or road rights-of-way

- 6# Kentucky Fescue No. 31
- 2# Rye Grain
- 30# Fertilizer (10-10-10)
- 100# Lime
- 12# Superphosphate

Open-Field (Anything other than an established lawn)

- 4# Kentucky Fescue No. 31
- 2# Rye Grain
- 20# Fertilizer (5-10-10)
- 100# Lime
- 12# Superphosphate

Open-Field For Slopes 2:1 or greater or areas subject to erosion

- 2# Kentucky Fescue No. 31
- 4# Sericea Lespedeza (Unscarified)
- 2# Rye Grain
- 30# Fertilizer (5-10-10)
- 100# Lime
- 12# Superphosphate

FEBRUARY 1 - OCTOBER 15

Maintained/Established Lawns or road rights-of-way

- 8# Kentucky Fescue No. 31
- 30# Fertilizer (10-10-10)

100# Lime
12# Superphosphate

Open-Field (Anything other than an established lawn)

6# Kentucky Fescue No. 31
2# Sudangrass (May, June, and July only)
20# Fertilizer (5-10-10)
100# Lime
12# Superphosphate

Open-Field For Slopes 2:1 or greater or areas subject to erosion

2# Kentucky Fescue No. 31
4# Sericea Lespedeza (Scarified)
2# Sudangrass (May, June, and July only)
20# Fertilizer (5-10-10)
100# Lime
12# Superphosphate

The Engineer will be consulted prior to seeding for a determination of appropriate seed mixture.

III. DETAILED SPECIFICATIONS FOR SANITARY SEWER PUMP STATION CONSTRUCTION

These standards address the County's requirements for operation and control of connecting pumping stations and include guidelines for sizing new wet wells to accommodate the service conditions. Standards for hydrogen sulfide control for connecting pumping stations are also included herein.

The objectives of these supplemental standards are as follows:

1. Control connecting pumping station operations to prevent simultaneous operation with the lift station upstream of the connection point.
2. Minimize number of connecting pumping stations.
3. Minimize hydrogen sulfide formation in County's collection system.
4. It is the County's intent to minimize the number of new sewage pumping stations connecting to the County's wastewater sewer system. Since it is required to coordinate lift station and pumping station operations to mitigate the sewer system capacity deficit, the addition of numerous small pumping station connections will complicate the County's proposed control plan.

All materials, equipment, and labor for submersible pump station construction shall be furnished in accordance with these specifications and in accordance with the plans prepared by a Registered Professional Engineer licensed to practice in the state of South Carolina.

DESIGN REQUIREMENTS

A. APPLICABLE REGULATIONS AND STANDARDS

The design and construction of sewage pumping stations shall comply with all applicable York County and South Carolina Department of Health and Environmental Control (SC DHEC) standards contained in Regulation 61-67.300. Related buildings and structures shall comply with Building Officials Conference of America (BOCA) and permitting requirements of the York County Building and Codes. Other standards governing facilities, materials, and construction shall include, but shall not be limited to:

American Society for Testing and Materials (ASTM)

American National Standards Institute (ANSI)

American Water Works Association (AWWA)

Hydraulic Institute Standards (HIS)
Institute of Electrical and Electronic Engineers (IEEE)
National Electric Code (NEC)
National Fire Protection Association (NFPA)
National Institute for Occupational Safety and Health (NIOSH)
Occupational Safety and Health Administration (OSHA)
Underwriters' Laboratory (UL)

It is the responsibility of the design engineer to determine the applicability of the design standards and to integrate all applicable criteria and guidelines for sewage pumping stations to be connected into the York County sewer system.

B. PUMPING STATION PRE-APPROVAL

1. To minimize the number of pumping stations connecting to the County's collection system, the design professional shall prepare an evaluation of wastewater collection options for existing and future developments in the vicinity of the proposed development. The evaluation shall consider:
 - a. Adjacent drainage areas that can potentially be served by a new sewage pumping station, including estimated flow projections and future pumping station upgrades.
 - b. Connection to an existing lift station or pumping station, including additional force main length and necessary improvements to the pumping station to accept additional flow.
2. Three (3) originals of the evaluation shall be submitted to the County Engineering Department for review at the preliminary design phase for the project and is required for pre-approval of a new sewage pumping station.
3. Design flow for determining pumping station capacity shall be based on peak hourly flow in accordance with the South Carolina Department of Health and Environmental Control (SC DHEC) regulations. Information for existing pumping stations and possible future developments can be obtained from the County.

C. WET WELL CAPACITY

The pumping station wet well shall be sized to accommodate the influent sewer and pump suction piping or pump submergence as recommended by the Hydraulic Institute Standards. Since pumping shall be restricted when the upstream lift station pumps are

running, additional storage capacity shall be provided to contain wastewater generated during the required pump-off time. Guidelines for determining the required working and storage volumes are given below.

1. Working Volume

a. Required working volume and preferred distances between sewer and control elevations shall be determined as follows:

i) Working Volume (in gallons) = $TQ/4$

With T = Minimum time between motor starts or 7 minutes, whichever is greater; For pumps greater than 30 horsepower, minimum cycle shall be 12 minutes

Q = Ultimate design discharge rate of one pump (lead pump) in operation, gpm

Working Volume (in gallons) = Volume between the elevations of Lead Pump On and Lead Pump Off

ii) Additional Criteria:

a) Working volume shall allow no more than 3 or 4 pump cycles considering the minimum cycle time recommended by the pump manufacturer.

iii) Filling rate shall not exceed 30 minutes at the design average flow rate, unless the facility is designed for storage as described in the following section.

b. Minimum inside width or diameter shall be 8 feet. Considerations shall include retention time and pipe/pump configuration and equipment access.

c. Minimum elevation difference between influent sewer and high water alarm shall be 18-inches.

d. Minimum elevation difference between control elevations shall be 6-inches.

e. Minimum elevation difference between Lead Pump On and bottom of wet well shall be as required for submergence of pumps or pump suction.

i) As a guideline for determining pump suction pipe submergence,

provide 1-foot of submergence for each foot per second of velocity at the suction pipe inlet. Maximum intake velocity shall not exceed 6 feet per second.

2. Storage Volume

Storage volume shall be provided in the wet well for containment of wastewater generated during controlled pump-off periods or for emergency storage. Storage volumes shall be determined as described below.

a. Controlled Pump-Off Storage

- i) For pumping stations connecting to the County's collection system, sufficient storage volume shall be provided in the wet well between the pump-on and high water levels for containment of wastewater generated when the lift station upstream of the pumping station's force main connection is operating (controlled pump-off storage). The volume shall be computed from the maximum pump-on time for the upstream lift station and the peak design flow to the pumping station.
- ii) Cycle times for the County's lift stations are extremely variable. However, it can be assumed that lift station pump-on time will generally be approximately 3 minutes to an estimated maximum of 10 minutes (*subject to verification by County*). Therefore, storage shall be provided for 10 minutes (*subject to verification by County*) of generated wastewater at the design peak flow rate. If emergency storage is provided, as described below, the emergency storage volume can be considered to meet the controlled pump-off storage requirement.

b. Emergency Storage

- i) In accordance with the SC DHEC regulations, auxiliary power using either two separate power substation connections or an on-site standby generator (see Section III; Q, Material Specifications) shall be provided for sewage pumping stations. For emergency storage, additional volume shall be computed for the projected flow from the community during the longest reported power outage in the last five (5) years, excluding power outage from a catastrophic storm. As a minimum, the County requires storage for a two hour period.

D. PUMPING STATION CONTROL AND MONITORING

All new pumping stations in the County's sewer collection system with pump capacities greater than 14 gpm shall be required to coordinate run time with the lift station upstream of the force main connection. The control system installed for coordination pump operations shall also be used for telemetry of pumping station alarm conditions and other parameters as directed by the County. Pumping station alarms shall be activated in the event of power failure, pump failure, unauthorized entry, or other pumping station malfunction.

The project contractor or developer will be required to install an approved computerized supervisory control and data acquisition (SCADA) system at the new pump station site. The work shall include, but not limited to, installing all necessary components to add to York County's existing SCADA system. Work includes installation of instrumentation, controls and communications equipment at the new site and installation and programming of master programmable logic controller (PLC).

At the County's discretion, pump discharge flow metering and chart recording devices shall be provided at pumping stations. Where dedicated flow metering equipment is not required, provisions shall be made for utilizing portable flow metering devices.

1. Remote Terminal Units

- a. Remote terminal units (RTU's) shall be provided for control and monitoring of sewage pumping stations. All equipment and software shall be compatible with the County's system control and data acquisition (SCADA) system (see Section III; P, Material Specifications). The County will provide the design professional with information on existing manufacture(s) and model numbers of equipment and software in use by the County. If needed, the County will also provide information on how the master control screen displays are to be updated and what reports need to be updated by information received from the new RTU. All costs for updating or modifying the County's SCADA system shall be the responsibility of the project contractor or developer.

2. RTU Communications

- a. The design professional shall perform an RTU communications study as part of the project design effort. This study will be used to verify communications reliability between the proposed RTU location and the County's master control center located at the County Water and Sewer Department headquarters or the nearest radio communications hub. The County will furnish the design professional any available information that may be applicable to the project.

3. Telemetry

- a. Where the RTU communications study indicates that it is feasible, spread spectrum (UHF and VHF) radio will be used to transmit signals between the RTU and the master control center.
- b. Where spread spectrum radio cannot be used, communications shall be through the use modems and leased phone lines. The contractor or developer's representative will be responsible for the installation of the modem(s) and the phone lines.

4. Communications Protocol

- a. The RTU's Programmable Logic Controller (PLC) shall be a 16-bit PLC microprocessor-based, stand-alone device with integrated inputs and outputs in the base unit, which the project contractor or developer shall purchase from a County approved vendor.

E. HYDROGEN SULFIDE AND ODOR CONTROL

Control measures shall be provided at pumping stations to minimize the release of odorous gases and the effects of hydrogen sulfide (H₂S) on downstream infrastructure. Such measures are required for the following conditions:

Condition 1: For wet wells with a filling rate in excess of 20 minutes at average flow, including initial flows, it shall be assumed that there is potential for septicity and resulting odors.

Condition 2: For force mains with greater than two-hour detention time, it shall be assumed that H₂S will be produced at a level greater than 5 ppm.

Condition 3: For pumping stations receiving flow from intermediate pumping stations or grinder pump systems, it shall be assumed that sufficient H₂S will be present in the incoming wastewater to cause corrosion and odors at the pumping station.

It is the responsibility of the design professional to determine the conditions at the proposed pumping station. An analyses shall be prepared and submitted for the County's review with the preliminary design submittal.

1. Control Measures

The following control measures shall be provided at pumping stations meeting the above conditions:

a. Condition 1:

- i) Provide either continuous or intermittent mechanical ventilation of the wet well. Air shall be forced into the wet well with a fan. Provide a timer for normal operation. Provide a limit switch to energize the fan whenever the entrance hatch is opened.
- ii) The fan shall be sized to provide a minimum of 30 complete air changes per hour with continuous operation for worker safety. Timer operation of the fan shall allow a minimum of 2 complete air changes per hour.
- iii) The fan shall be direct drive. If the fan is installed outdoors, the fan assembly and housing shall be of corrosion resistant and weatherproof construction.
- iv) Exhaust from the wet well shall be pass through a biofilter before release to the atmosphere. The biofilter shall be composed of suitable organic media with embedded air distribution system in accordance with Standard Detail _____. The biofilter shall be sized to provide _____.

b. Condition 2:

- i) Provide chemical dosing system. Equipment shall include chemical metering units, storage facilities, and related piping and controls to feed chemical solution into pumping station wet well. Approved chemicals for H₂S control are ___ and sodium hydroxide (NaOH).
- ii) Dosing rates:
 - _____ – As specified by the manufacturer
 - NaOH – Min. 2.4 pounds NaOH per 1.0 pound H₂s

c. Condition 3:

- i) Provide mechanical ventilation and exhaust air treatment as described for **Condition 1** and chemical dosing as described for **Condition 2**.

MATERIAL SPECIFICATIONS

DESCRIPTION: All materials, equipment, and labor for submersible pump station construction shall be furnished in accordance with these specifications and in accordance with the plans prepared by a Registered Professional Engineer licensed to practice in the state of South Carolina.

A. REGULATIONS AND STANDARDS

Unless superseded or modified by a Special Provision, all materials, apparatus, supplies, methods of manufacture, or construction shall conform to the specification for same contained in this Section. Publications listed below form part of this specification to extent referenced in the text by basic designation only. Consult latest edition of publications unless otherwise noted.

1. American National Std. Intstitute (ANSI)/ American Water Works Assoc. (AWWA)
 - a. ANSI B16.1 Cast iron pipe flanges and flanged fittings.
 - b. ANSI/AWWA C115/A21.15 Cast/ductile iron pipe with threaded flanges.
 - c. ANSI 253.1 Safety color code for marking physical hazards.
 - d. ANSI B40.1 Gages, pressure and vacuum.
 - e. ANSI C508 Single swing check valves.
2. American Society for Testing and Materials (ASTM)
 - a. ASTM A48 Gray iron castings.
 - b. ASTM A126 Valves, flanges, and pipe fittings.
 - c. ASTM A307 Carbon steel bolts and studs.
 - d. ASTM A36 Structural steel.
3. Institute of Electrical and Electronics Engineers (IEEE)
 - a. ANSI/IEEE Std. 100 Standard dictionary of electrical terms.
 - b. ANSI/IEEE Std. 112 Test procedure for polyphase induction motors.
 - c. ANSI/IEEE Std. 242 Protection of industrial and control power systems.
4. National Electric Code (NEC)/ National Electrical Manufacturers Assoc. (NEMA)
 - a. NEC National Electric Code.
 - b. NEC 701 National Electric Code Article 701.
 - c. NEMA Std. MG1 Motors and generators.
5. Miscellaneous References
 - a. Ten-State Standards Recommended standards for sewage works.
 - b. Hydraulic Institute Std. for centrifugal, rotary and reciprocating pumps.

B. SYSTEM DESCRIPTION

1. Contractor shall furnish and install one electric submersible non-clog wastewater pump station. The station shall be complete with all equipment and appurtenances specified herein and approved by the County. Refer to Section IV; Standard Sewer Details; Lift Station Layout.
2. Principle items of equipment shall include two electric submersible pumps to be supplied with motor, close coupled volute, cast iron discharge elbow, guide bar brackets, power cable and accessories necessary for a wet pit installation, on-site generator, monitoring equipment, and all other appurtenances as shown on the York County Standard Sewer Details

C. PERFORMANCE CRITERIA

1. Pumps must be designed to handle raw, unscreened, domestic sanitary sewage. Each pump shall be selected to perform under operating conditions based on, but not limited to:
 - Capacity (GPM)
 - Total Dynamic Head (ft)
 - Total Discharge Static Head (ft)
2. Site power furnished to pump station shall be three phase, 60 hertz, 460 volts, four wire maintained within industry standards. Voltage tolerance shall be plus or minus 10 percent. Control voltage shall not exceed 132 volts.

D. SUBMITTALS

1. Product Data
 - a. Prior to fabrication, the project's contractor or developer's representative, shall submit 3 copies of the pump station manufacturer's data for review and approval.
 - i) Submittal shall include shop drawings, electrical ladder logic drawings, and support data as follows: Catalog cut sheets reflecting characteristics for major items of equipment, materials of construction, major dimensions, motor data, pump characteristic curves showing the design duty point capacity (GPM), head (ft), net positive suction head required

(NPSHr), and hydraulic brake power (BHP). Electrical components used in the motor branch and liquid level control shall be fully described.

- b. Prior to fabrication, the project's contractor or developer's representative, shall submit 3 copies of the on-site generator manufacturer's data for review and approval.
- c. Prior to fabrication, the project's contractor or developer's representative, shall submit 3 copies of the SCADA system manufacturer's data for review and approval. The submittal data shall include, but not limited to, the RTU Communication's Study as explained in Section III, Design Requirements; 2(a).

2. Operations Maintenance Manuals

- a. Installation shall be in accordance with written instructions provided by the pump station manufacturer. Comprehensive instructions supplied at time of shipment shall enable personnel to properly operate and maintain all equipment supplied. Content and instructions shall assume operating personnel are familiar with pumps, motors, piping and valves, but lack experience on exact equipment supplied.
- b. Documentation shall be specific to the pump station and collated in functional sections. Each section shall combine to form a complete system manual covering all aspects of equipment supplied by the station manufacturer. Support data for any equipment supplied by others, even if mounted or included in overall station design, shall be provided by those supplying the equipment. Instructions shall include the following as a minimum:
 - i. Functional description of each major component, complete with operating instructions.
 - ii. Instructions for operating pumps and pump controls in all modes of operation.
 - iii. Calibration and adjustment of equipment for initial start-up, replacement of level control components, or as required for routine maintenance.
 - iv. Support data for commercially available components not produced by the station manufacturer, but supplied in accordance with the specifications, shall be supported by literature from the prime manufacturer and incorporated as appendices.
 - v. Electrical schematic diagram of the pump station circuits shall be in accordance with NMTBA and JIC standards. Schematics shall illustrate, to the extent of authorized repair, pump motor branch, control and alarm

system circuits including interconnections. Wire numbers and legend symbols shall be shown. Schematic diagrams for individual components, not normally repairable by the station operator, need not be included. Details for such parts shall not be substituted for an overall system schematic. Partial schematics, block diagrams, and simplified schematics shall not be provided in lieu of an overall system diagram.

- vi. Mechanical layout drawing of the pump station and components, prepared in accordance with good commercial practice, shall provide installation dimensions and location of all pumps, motors, valves and piping.
- c. Operation and maintenance instructions, which rely on vendor cut-sheets and literature, which include general configurations, or require operating personnel to selectively read portions of the manual shall not be acceptable. Operation and maintenance instructions must be specific to equipment supplied in accordance with these specifications.

E. QUALITY ASSURANCE

1. Upon request from the engineer, the pump station manufacturer shall prove financial stability and ability to produce the station within the specified delivery schedules. Evidence of facilities, equipment, and expertise shall demonstrate the manufacturer's commitment to long term customer service and product support.
2. The pumps shall be heavy duty, electric submersible centrifugal non-clog units designed for handling raw, unscreened sewage and wastewater. The pumps shall be capable of pumping a 3.0" spherical solid.
3. The pumps provide shall be capable of operating in an ambient liquid temperature of 104 degrees F as specified by the National Electrical Manufacturers Association (NEMA) and Factory Mutual (FM).
4. The pump and motor unit shall be suitable for continuous operation at full nameplate load while the motor is completely submerged, partially submerged or totally non-submerged. The use of shower systems, secondary pumps or cooling fans to cool the motor shall not be acceptable.
5. The pump, mechanical seals and motor units provided under this specification shall be from the same manufacturer in order to achieve standardization of operation, maintenance, spare parts, manufacturer's service and warranty.
6. The manufacturer's technical representative shall inspect the completed

installation, correct or supervise the correction of any defect or malfunction, and instruct operating personnel in the proper operation and maintenance of the equipment as described in Section D; 2(a) of this section.

F. MANUFACTURER’S WARRANTY

1. The pump station manufacturer shall warrant all equipment to be of quality construction, free of defects in material and workmanship. A written warranty shall include specific details described below:
 - a. All equipment, apparatus, and parts furnished shall be warranted for one year, excepting only those items normally consumed in service, such as light bulbs, oils, grease, packing, gaskets, O-rings, ect. The pump station manufacturer shall be solely responsible for warranty of the station and all components.
 - b. The pump shaft seal shall be warranted for a minimum of four years from date of shipment. Should the seal fail within the first year, the manufacturer shall furnish a new seal, without charge to the owner, F.O.B. factory. The warranty replacement cost for seals after the first year will be pro-rated as follows:

<u>Failure Within</u>	<u>Percent New Price</u>
2 Years	25%
3 Years	50%
4 Years	75%

- c. Components failing to perform as specified by the engineer, or as represented by the manufacturer, or as proven defective in service during the warranty period, shall be replaced, repaired, or satisfactorily modified by the manufacturer without cost of parts or labor to the owner.
2. The warranty provided by the developer to the County shall become effective upon the issuance of a Permit to Operate by the SC DHEC.

G. UNITARY RESPONSIBILITY

1. In order to unify responsibility for proper operation of the complete pumping station, it is the intent of these specifications that all system components be furnished by a single supplier (unitary source) approved by the County. The pumping station must be of standard catalog design, totally warranted by the manufacturer. Under no

circumstances will a system consisting of parts compiled and assembled by a manufacturer's representative or distributor be accepted.

H. MANUFACTURER

1. The specifications and project drawings for the pump station depict equipment and materials manufactured by ITT Flyght Company, or approved equal, which are deemed most suitable for the service anticipated.

I. UNIT BASE

1. The unit base shall comprise of a base plate, perimeter flange, and reinforcements. Base plate shall be fabricated of steel not less than 3" thick, and shall incorporate openings for access to all internal cavities to permit complete grouting of unit base after installation. Perimeter flange and reinforcements shall be designed to prevent flexing or warping under operating conditions. Base plate and/or flange shall be drilled for hardware used to secure unit base to concrete pad as shown on the contract drawings. Unit base shall contain provisions for lifting the complete pump unit during shipping and installation.

J. PUMP DESIGN

1. The pumps shall be automatically and firmly connected to the discharge connection, guided by no less than two guide bars extending from the top of the station to the discharge connection. There should be no need for personnel to enter the wet-well.
2. Sealing of the pumping unit to the discharge connection shall be accomplished by a machined metal to metal watertight contact.

K. PUMP CONSTRUCTION

1. Major pump components shall be of gray cast iron, ASTM-48, Class 35B, with smooth surfaces devoid of blow holes or other irregularities.
2. All exposed nuts or bolts shall be AISI type 304 stainless steel construction. All metal surfaces coming into contact with the pumpage, other than stainless steel or brass, shall be protected by a factory applied spray coating of acrylic dispersion zinc phosphate primer with a polyester resin paint finish on the exterior of the pump.

3. Critical mating surfaces where watertight sealing is required shall be machined and fitted with Nitrile or Viton rubber O-rings. Fittings will be the result of controlled compression of rubber O-rings in two planes and O-ring contact of four sides without the requirement of a specific torque limit.
4. The cable entry shall consist of a single cylindrical elastomer grommet, flanked by washers, all having a close tolerance fit against the cable outside diameter and the entry inside diameter and compressed by the body containing a strain relief function, separate from the function of sealing the cable.

L. MOTOR

1. The pump motor shall be induction type with a squirrel cage rotor, shell type design, housed in an air filled, watertight chamber, NEMA B type.
2. The stator windings and stator leads shall be insulated with moisture resistant Class F insulation rated for 155° C (311° F). The stator shall be dipped and baked three times in Class F varnish and shall be heat-shrink fitted in to the stator housing.
3. The motor shall be designed for continuous duty handling pumped media of 40° C (104° F) and capable of up to 15 evenly spaced starts per hour.
4. The motor and pump shall be designed and assembled by the same manufacturer.
5. The motor horsepower shall be adequate so that the pump is non-overloading throughout the entire pump performance curve from shut-off through run-out.

M. IMPELLER

1. The impeller shall be of gray cast iron, Class 35B, dynamically balanced, double shrouded non-clogging design having a long through-let without acute turns.
2. The impeller shall be capable of handling 3” spherical solids, fibrous materials, heavy sludge and other matter found in wastewater.
3. All impellers shall be coated with acrylic dispersion zinc phosphate primer.

N. ELECTRICAL CONTROL COMPONENTS

1. Electrical control equipment shall be mounted within a NEMA 1 steel, dead front type, control enclosure. Door shall be hinged and sealed with a neoprene gasket and equipped with captive closing hardware. Control components shall be mounted on a

removable steel back panel secured to enclosure with collar studs. All control devices and instruments shall be mounted using threaded fasteners, and shall be clearly labeled to indicate function.

2. Pump station controls shall conform to third party safety certification. The enclosure and all components mounted on the subpanel or control cover shall conform to UL descriptions and procedures.
3. Motor branch components to be of highest industrial quality, secured to the sub-plate with machine screws and lockwashers. Mounting holes shall be drilled and tapped; Self-tapping screws shall not be used to mount any component.
4. A properly sized heavy-duty circuit breaker, with RMS interrupting rating of 14,000 amperes at 460 volts, shall be furnished for each pump motor. The circuit breakers must be sealed by the manufacturer after calibration to prevent tampering. An operating mechanism installed on each motor circuit breaker shall penetrate the control panel door. A pad-lockable operator handle shall be secured on the exterior surface. Interlocks must prevent opening the door until circuit breakers are in the "OFF" position.
5. An open frame, across-the-line, NEMA rated magnetic starter with under-voltage release, and overload protection on all three phases, shall be furnished for each pump motor. Starters of NEMA size 1 and above shall allow addition of at least two auxiliary contacts. Starters rated "0", "00", or fractional sizes are not acceptable. Power contacts to be double-break type made of cadmium oxide silver. Coils to be epoxy molded for protection from moisture and corrosive atmospheres. Contacts and coils to be easily replaceable without removing the starter from its mounted position. Each starter shall have a metal mounting plate for durability. Overload relays to be block-type with melting alloy spindles, having visual trip indication with trip free operation. Pressing the overload-reset lever shall not actuate the control contact until after the overload spindle has reset. Resetting the overload reset lever will cause a snap-action control and not convertible to automatic reset. Trip settings shall be governed by the heater element only, and not by adjustable settings. Heater elements must provide NEMA Class 20 trip times, selected in accordance with actual motor nameplate data. An overload-reset pushbutton, mounted through the control panel door, shall permit resetting the overload relays without opening the control panel door.
6. The control panel shall be equipped with a secondary lightning arrester to minimize damage to the pump motors and control from transient voltage surges. The arrester shall utilize silicon-oxide varistors encapsulated in a non-conductive housing. The arrester shall have a current rating of 60,000 Amps, a Joule rating of 1500.
7. The control panel shall be equipped to monitor the incoming power and shut down the pump motors when required to protect the motor(s) from damage caused by phase reversal, phase loss, low voltage, and voltage unbalance. An integral time delay shall be provided to minimize nuisance trips. The motor(s) shall automatically restart when

power conditions return to normal.

8. Control Circuits

- a. A normal duty thermal-magnetic circuit breaker shall protect all control circuits by interrupting control power.
- b. Pump mode selector switches shall permit manual start or stop of each pump set individually, or permit automatic operation under control of the liquid level control system. Manual operation shall override all shutdown systems, except the motor overload relays. Selector switches to be heavy duty, oil-tight design with contacts rated NEMA A300 minimum.
- c. Pump alternator relay to be electro-mechanical industrial design. Relay contacts to be rated 10 amperes minimum at 120 volts non-inductive. A switch shall permit the station operator to select automatic alteration of pumps, to select pump set number one to be "lead" for each pumping cycle, or to select pump set number two to be "lead" pump for each pumping cycle.
- d. Six-digit elapsed time meter (non-reset type) shall be provided for each pump set to indicate total running time of each pump set in "hours" and "tenths of hours." A pilot light shall be wired in parallel to indicate that the motor is energized and should be running.
- e. A high pump temperature protection circuit shall override the level control and shutdown the pump motor(s) when required to protect the pump from excessive temperature. A thermostat shall be mounted on each pump casing and connected to a high pump temperature shutdown circuit. If casing temperature rises to a level sufficient to cause damage, the thermostat causes the pump shutdown circuit to interrupt power to the motor. A visible indicator located on the control panel door shall indicate motor stopped due to high pump temperature. The motor shall remain locked out until the pump has cooled and circuit has been manually reset. Automatic reset of the circuit is not acceptable.
- f. A duplex ground fault receptacle providing 115 VAC, 60 Hz, single phase current, will be mounted on the side of the control enclosure. Receptacle circuit shall be protected by a 15-ampere thermal-magnetic circuit breaker.

O. AUXILIARY POWER TRANSFORMER CONTROLS AND ACCESSORIES

1. The lift station shall be equipped with a 3 KVA step-down transformer to supply 115 volt, AC, Single phase for the control and auxiliary equipment. The primary and secondary side of the transformer to be protected by a thermal magnetic circuit breaker sized to meet the power requirements of the transformer. An operating mechanism shall penetrate the control panel door, and a padlockable

operator handle shall be secured on the exterior surface. Interlocks must prevent opening the door until circuit breakers are in “OFF” position.

2. All wiring, workmanship, and schematic wiring diagrams shall comply with Applicable standards and specifications of the National Electric Code (NEC). All user serviceable wiring shall be type MTW or THW, 600 volts, color coded as follows:

a.	Line and Load Circuits, AC or DC power	Black
b.	AC Control Circuit Less Than Line Voltage	Red
c.	DC Control Circuit	Blue
d.	Interlock Control Circuit from external source	Yellow
e.	Equipment Grounding Conductor	Green
f.	Current Carrying Ground	White
g.	How With Circuit Breaker Open	Orange

3. Control circuit wiring inside the panel, with exception of internal wiring of individual components, shall be 16-gauge minimum, type MTW or THW, 600 volts. Power wiring to be 14-gauge minimum. Motor branch wiring shall be 10-gauge minimum. Motor branch and other power conductors shall not be loaded above 60 degrees Celsius temperature rating, on circuits of 100 amperes or less, nor above 75 degrees Celsius on circuits over 100 amperas. Wires must be clearly numbered at each end in conformance with applicable standards. All wire connectors in the control panel shall be ring tongue type with nylon-insulated shanks. All wires on the sub-plate shall be bundled and tied. All wires extending from components mounted on door shall terminate at a terminal block mounted on the back panel.

4. All wiring outside the panel shall be routed through conduit. Control wires connected to door mounted components must be tied and bundled in accordance with good commercial practice. Bundles shall be made flexible at the hinged side of the enclosure. Adequate length and flex shall allow the door to swing full open without undue stress or abrasion. Bundles shall be held on each side of hinge by mechanical fastening devices. Factory installed conduit shall conform to following requirements:

- a. All conduit and fittings to be UL listed.
- b. Liquid tight flexible metal conduit to be constructed of smooth, flexible galvanized steel core with smooth abrasion resistant, liquid tight polyvinyl chloride cover.
- c. Conduit to be supported in accordance with articles 346,347 and 350 of the National Electric Code.
- d. Conduit shall be sized according to the National Electric Code.

5. Station manufacturer shall ground all electrical equipment inside the pump station to the control panel back plate. All paint must be removed from the ground-mounting surface before making final connections. The contractor shall provide an earth driven ground connection to the pump station at the main grounding lug in accordance with the National Electric Code (NEC).
6. Permanent corrosion resistant name plate(s) shall be attached to the control and include following information:
 - a. Equipment serial number
 - b. Supply voltage, phase and frequency
 - c. Current rating of the minimum main conductor
 - d. Electrical wiring diagram number
 - e. Motor horsepower and full load current
 - f. Motor overload heater element
 - g. Motor circuit breaker trip current rating
 - h. Name and location of equipment manufacturer
7. Control components shall be permanently marked using the same identifications keys shown on the electrical diagram. Labels shall be mounted adjacent to device being identified. Switches indicators, and instruments mounted through the control panel door shall be labeled to indicate function, position, etc. Labels shall be mounted adjacent to, or above the device.
8. Liquid Level Monitoring and Control
 - a. The level monitoring and control system shall start and stop the pump motors in response to changes in wet wall level, as set forth herein.
 - b. The level monitoring and control system shall be capable of operating as a conductivity probe-type system for liquid level control and with a float-ball system for high and low level alarms, as manufactured by ITT Flygt, DEVAR Inc., or manufacturer approved equal by York County.
 - c. The level control system shall utilize the alternator relay to select first one pump set, then the second pump set, to run as lead pump for a pumping cycle. Alternation shall occur at the end of a pumping cycle.
 - d. The level control system shall be provided with pump start and stop delays to prevent simultaneous motor starts and to reduce the potential of hydraulic surges during motor shutdown.
 - e. The level control system shall utilize the conductivity probe-type system which shall continuously, monitor the wet well level, permitting the

operator to read wet well level at any time. Upon operator selection of automatic operation, the conductivity probe-type system shall start the motor for one pump set when the liquid level in the wet well rises to the “lead pump start level”. When the liquid is lowered to the “lead pump stop level”, the conductivity probe-type system shall stop these pumps. These actions shall constitute one pumping cycle. Should the wet well level continue to rise, the conductivity probe-type system shall start the second pump set when the liquid reaches the “lag pump start level” so that all pumps are operating. These levels shall be adjustable as described below.

- f. The conductivity probe-type system shall include integral components to perform all pressure sensing, signal conditioning. EMI and RFI suppression. DC power supply and 120 volt outputs. Components shall be solid state, and shall be integrated with other components to perform as described below.
- g. The conductivity probe-type system shall be capable of operating on a supply voltage of 108 volts to 132 volts AC, 60 hertz, in an ambient temperature range of –10 degrees Celsius (14 degrees Celsius) through +55 degrees Celsius (131 degrees Celsius). Control range shall be 0 to ----
-.0 feet of water with an overall repeat accuracy of (plus/minus) 0.1 feet of water. Memory shall be retained using a non-volatile lithium battery back up.
- h. The conductivity probe-type system shall consist of the following integral components: display, output relays:
 - i) The conductivity probe-type system shall incorporate a digital back-lighted LCD panel display which, upon operator selection, shall indicate liquid level in the wet-well, and the preset start and stop level for both lead and lag pump. The display shall include 20, 0.19 inch high alphanumeric characters calibrated to read out directly in feet of water, accurate to within one-tenth foot (0.1 foot), with a full-scale indication of not less than 12 feet. The display shall be easily convertible to indicate English or metric units.
 - ii) Level adjustments shall be electronic comparator set points to control the levels at which the lead and lag pumps start and stop. Each of the level settings shall be adjustable and accessible to the operator without opening the cover panel. Controls shall be provided to permit the operator to read the selected levels on the

display. Such adjustments shall not require hard wiring, the use of electronic test equipment, artificial level simulation.

- iii) An alarm silence pushbutton and relay shall be provided to permit maintenance personnel to de-energize the audible alarm device while corrective actions are under way. After silencing the alarm device, manual reset of the alarm condition shall clear the alarm silence relay automatically. The pushbutton shall be oil tight design with contacts rated NEMA A300 minimum.
- iv) Station manufacturer will supply one 115-volt AC alarm light fixture with vapor-tight red globe, guard, conduit box, and mounting base. The design must prevent rain water from collecting in the gasketed area of the fixture, between the base and globe. The alarm light will be shipped loose for installation by the contractor.
- v) Station manufacturer will supply one 115-volt AC weatherproof alarm horn with projector, conduit box, and mounting base. The design must prevent rainwater from collecting in any part of the horn. The alarm horn will be shipped loose for installation by the contractor.

P. TELEMETRY

- 1. Each pump station shall be supplied with a Supervisory Control and Data Acquisition (SCADA) Remote Terminal Unit (RTU). The work to be accomplished under this specification shall consist of furnishing the equipment necessary for modifying the existing automatic control and monitoring system. The equipment shall be designed, fabricated, programmed, tested, started-up, and warranted by a single supplier, thus

Q. ON-SITE GENERATOR SYSTEM

- 1. General

All pump stations shall have an automatic standby power generation system conforming to these specifications.

The system shall consist of a diesel-fueled standby generator in a weatherproof enclosure complete with all equipment and accessories required to automatically supply power to the pump station during a utility power failure. The engine

generator set shall start the two wastewater pumps in sequence and will run both simultaneously under full load. Simultaneous starting is not required.

2. Engine
 - Engine block materialCast Iron
 - Cylinder head materialCast Iron
 - Crankshaft materialHardened Steel
 - PistonsAluminum Alloy
 - Valve seatsReplaceable
 - Maximum Rated RPM 1800

3. Engine Governor
 - TypeMechanical
 - No-load to full load frequency regulation..... 5.0%
 - Steady state regulation +/-0.33%
 - Overspeed shutdown..... Automatic solid state

4. Engine Lubrication System
 - Oil pumpGear type
 - Oil filter..... Full flow, cartridge
 - Low oil pressure shutdown Automatic
5. Engine Cooling System
 - Type of systemPressurized, closed recovery
 - High temperature shutdown..... Automatic
 - Low coolant level shutdown Automatic
 - Fan..... Pusher type with guard
 - Engine block heater.....1,000 watts (min), 120 VAC,
thermostatically controlled
 - Coolant..... Water/ethylene glycol (-34° protection)

6. Engine Fuel System
 - Fuel #2 Diesel
 - Fuel filter..... 5 micron
 - Injection type Direct
 - Fuel pump Mechanical, engine driven

- Fuel tank.....integral, UL listed,
double-walled, steel fuel
storage
- Fuel tank capacity 24 (min.) hours @ rated load
- Fuel tank accessories:..... Fuel level indicator
Low fuel indicator switch (on at 20% capacity)
Screened vent for double wall cavity
Drain port
- 7. Engine Exhaust System
 - Silencer Critical
 - Mounting..... External with weather cap
 - Connection Flexible stainless steel pipe
- 8. Engine Combustion Air Intake
 - Air cleaner..... Replaceable dry cartridge
- 9. Engine Electrical
 - Starter motor 12 or 24 volt
 - Battery charge alternator..... 30 amps (min)
 - Crank limiter Solid state
 - Battery..... 2 - 12 volt (series or parallel, as appropriate)
 - Battery mounting Rack inside enclosure
 - Polarity Negative ground
 - Standby charger 10 amp, automatic float
- 10. Generator
 - The generator shall meet the following requirements:
 - a. Generator Specifications:
 - Generator type..... 4 pole, revolving field
 - Output 12 lead, reconnectable

Stator "Skewed" design
 Housing Drip proof design, self-ventilated
 Rotor insulation Class F
 Stator insulation Class F
 Bearings Sealed, pre-lubed
 Engine coupling Direct, flexible disc
 Protection Output circuit breaker (manual reset)

b. Excitation:
 Exciter type Brushless
 Protection Manual circuit breaker

c. Regulation:
 Type Solid state
 Regulation +/-2% steady state
 Voltage adjustment 5% - manual rheostat

11. Generator Set Controls

The engine-generator set shall be equipped with a control panel having the following features:

Engine Controls & Indicators:

Engine Gauges: Oil pressure
 Coolant temperature
 Battery charging ammeter

Annunciator: Low oil pressure shutdown
 High temperature/low coolant
 level shutdown
 Overcrank shutdown
 Overspeed shutdown
 Low fuel

Engine hour meter 99,999.0 hour

Remote engine hour meter
 located at transfer switch 99,999.0 hour

Engine control switch Off/Manual/Automatic

12. Generator Controls & Indicators

Gauges: AC frequency
Output voltage
Output current
Gauge Selector switch:..... 3 position with "off"
Manual voltage adjustment..... Rheostat, 5% adj. range

13. Alarm Output Contacts

Generator Fail
Generator Operating
Low Fuel

Alarm output contacts are to be wired to the local monitoring as explained in Section III, Material Specifications; Q.

14. Generator Set Enclosure & Mounting

The engine-generator set shall be enclosed in a weatherproof housing which meets the following specifications:

Access panels..... Lockable (keyed alike), hinged and removable
Hardware..... Stainless steel
Finish..... Baked enamel over zinc coated steel
Mounting..... Welded steel base with vibration isolators
Mounting location..... Top of fuel tank

15. Automatic Transfer Switch:

The automatic transfer switch to be supplied as part of the standby power system shall meet all applicable requirements set forth by the National Electrical Code and OSHA. The transfer switch shall also conform to the requirements as specified below:

- a. Enclosure:
Mounting type..... Surface
Enclosure type..... NEMA 3R, lockable

- b. Electrical Ratings
Operating voltage..... Compatible with station voltage

- Operating current No less than main disconnect
- Withstand and closing rating 10,000 Amps, RMS, Symm. (min.)

- c. Transfer Switch:
 - Operating mechanismSingle solenoid
 - Holding mechanismMechanical
 - Interlock Mechanical and electrical
 - Contact material Silver alloy
 - Neutral delay 0.1 - 10 seconds

- d. Timer Setting Ranges:
 - Utility dropout70-95%
 - Utility pick-up70-95%
 - Utility interrupt delay0.1-10 sec.
 - Engine min. run5-30 min.
 - Engine warm-up5-180 sec.
 - Return to utility delay1-30 min.
 - Engine cool-down1-30 min.
 - Standby voltage70-90%
 - Standby frequency80-90%
 - Exerciser Once/week

- e. Operation Selectors:
 - Exercise With/Without load
 - Engine warm-up bypass On/Off
 - Neutral delay On/Off
 - Mode selector Manual Test/Standby/Off

16. Standby Power System Capacity:

The standby power system shall be capable of providing continuous standby power for the wastewater pumping station. The generator set shall be capable of starting the two pump motor loads sequentially with the full miscellaneous load applied, with no more than 30% dip. **The *minimum* acceptable generator set rating shall be 25 KW for any station.** The CONTRACTOR shall coordinate the starting requirements

of the exact pumps being furnished on the project with the generator set supplier to insure that the generator set has adequate motor starting capability.

17. Installation:

The generator set shall be mounted and anchored to a reinforced concrete pad, located to provide adequate access for fueling and servicing. The exact dimensions of the pad, conduit entries and anchor bolts shall be based on the manufacturer's shop drawings. The pad shall have outer dimensions 1 foot greater than the footprint of the base tank, to provide 6" of exposure on all sides. The minimum thickness of the pad shall be 12", with a single mat of #6 rebar, 12" OCEW and located in the lower third of the concrete thickness. The weight of the mounting pad shall be equal to or greater than the weight of the generator set. All exposed edges shall be chamfered or rounded with an edging tool.

18. Tests:

The CONTRACTOR shall provide start-up and testing services utilizing personnel specifically authorized to perform such services by the standby power system manufacturer. The start-up services shall be scheduled with the COUNTY with no less than 3 days notice. The start-up and testing service shall include a complete inspection of the installation, initial break-in of the engine, testing the system performance, and servicing the engine. The following tests shall be performed in the presence of the COUNTY or its representative:

- a. Generator output voltage unloaded and loaded, each phase, based on 2-hour load bank test
- b. Voltage dip as loads are applied
- c. Complete operating sequence (simulated utility power failure and restoration)
- d. Pressure test engine cooling system for leaks
- e. Test battery charging systems
- f. Test operation of all safety systems
- g. Upon completion of break-in and testing, the engine shall be serviced as follows:
 - Change engine oil and filter
 - Verify anti-freeze protection (-34° F)

- Refill fuel tank (tank shall be left full)
- Check belt tension
- Check battery connections and state of charge

During this start-up period, the COUNTY’S maintenance personnel shall be fully instructed in the proper maintenance of the standby power system.

19. Manufacturer:

- a. The generator set, controls, and transfer switch shall be furnished by a single supplier. The generator set and accessory equipment shall be supplied by Caterpillar/Olympian, Onan/Cummings, Kohler, or approved equal.
- b. The supplier shall be the authorized dealer of the engine-generator set manufacturer, and shall be fully qualified and authorized to provide service and parts for the engine and generator at any time during the day or night. Parts and service shall be available 24 hours per day 7 days a week, from a location within a 100-mile radius of the location of the installed generator set.

20. Shop Drawings:

Prior to purchase of stand-by power generation equipment, the Contractor shall submit not less than four (5) sets of data to the County Representative for approval, including equipment data, accessories, sizing calculations, etc., as may be appropriate to determine compliance with these Specifications.

21. Operating Instructions:

Six (6) complete copies of operating instructions and parts list shall be provided prior to acceptance of the unit. Parts list shall include schedule of type and quantity of parts recommended for stock.

22. Spare Parts:

The following spare parts shall be furnished:

Engine Fan & Accessory Drive Belts	1 sets
Oil, Fuel & Air Filters.....	2 sets
Spare Indicator Lamps & Fuses	2 sets

Spare parts shall be boxed and labeled with the pumping station identification.

23. Warranty:

The complete standby power generating system shall be warranted for one year after the acceptance of the sewer pump station by the COUNTY. The warranty shall cover all defects in equipment, parts, assembly and installation. The warranty shall be issued in writing by the supplier and delivered to the COUNTY Representative.

INSTALLATION AND APPROVAL REQUIREMENTS

A. HANDLING AND INSTALLATION

1. Contractor shall off-load equipment at installation site using equipment of sufficient size and design to prevent injury or damage.
2. Station manufacture shall provide written instruction for proper handling.
3. Immediately after off-loading, contractor shall inspect complete pump station and appurtenances for shipping damage or missing parts. Any damage or discrepancy shall be noted in written claim with shipper prior to accepting delivery. Validate all station serial numbers and parts list with shipping documentation. Notify the manufacturers representative of any unacceptable conditions noted with shipper.
4. Install, level, align, and lubricate pump station as indicated on project drawings. Installation must be in accordance with written instructions supplied by the manufacture at time of delivery.
5. Suction pipe, connections shall be vacuum tight. Fasteners at all pipe connections must be tight. Install pipe with supports and thrust blocks to prevent strain and vibration on pump station piping. Install and secure all service lines (level control, air release valve or pump drain lines) as required in wet well.

B. TESTING

1. Check motor and control data plates for compatibility to site voltage. Install and test the station ground prior to connecting line voltage to station control panel.
2. ~~Prior to applying electrical power to any motors or control equipment,~~

check all wiring for tight connection. Verify that protective devices (fuses and circuit breakers) conform to project design documents. Manually operate circuit breakers and switches to ensure operation without binding. Open all circuit breakers and disconnects before connecting utility power. Verify line voltage, phase sequence and ground before actual start-up.

3. After all anchor bolts, piping and control connections are installed, completely fill the grout dam in the pump station base with non-shrink grout.
4. Prior to acceptance by owner, an operational test of all pumps, drives, and control systems shall be conducted to determine if the installed equipment meets the purpose and intent of the specifications. Tests shall demonstrate that all equipment is electrically, mechanically, structurally, and otherwise acceptable; it is safe and in optimum working condition; and conforms to the specified operating characteristics.
5. After construction debris and foreign material has been removed from the wet well, contractor shall supply clear water volume adequate to operate station through several pumping cycles. Observe and record operation of pumps, suction, and discharge gage readings, ampere draw, pump controls, and liquid level controls. Check calibration of all instrumentation equipment, test manual control devices, and automatic control systems. Be alert to any undue noise, vibration or other operational problems.

C. START-UP

1. Coordinate station start-up with manufacturers technical representative. The representative or factory service technician will inspect the completed installation. He will calibrate and adjust instrumentation, correct or supervise correction of defects or malfunctions, and instruct operating personnel in proper operation and maintenance procedures.
2. Prior to acceptance, inspect interior and exterior of pump station for dirt, splashed material or damaged paint. Clean or repair accordingly. Remove from the job site all tools, surplus materials, scrap and debris.
3. The pump station should be placed into service immediately. If operation is delayed, drain water from pumps and piping. Open motor circuit breakers and protect station controls and interior equipment from cold and moisture.
4. Prior to pump station operation, contractor to provide weather durable sign with a 24 – hour emergency phone number to be located on the structure

of the pump station. Coordinate sign verbiage and placement with owner.

5. A start-up report must be supplied to York County by the manufacturers technical representative of the pump station's start-up conditions.
6. Operation and maintenance manuals must be supplied to York County by the contractor.