Technical Specification 020.01

GRAVITY SANITARY SEWER SYSTEM

1.0 General

a) It is the intent of this specification to ensure that all gravity sewer system infrastructure constructed within the service area of the Brunswick County Public Utilities Department meets or exceeds all local, state, and federal rules and regulations as applicable. It is also the intent of this specification to provide the technical guidance needed to the utility contractor to ensure that county gravity sewer system infrastructure is properly constructed, tested, and placed in service. Service laterals shall be installed where shown on the drawings or as directed by the county's representative. Excavation, trenching, and backfilling is covered in TS 013.01: "Excavating, Grading, Trenching, and Backfilling".

2.0 References

a) ASTM D1784 - Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.

b) ASTM D1785 - Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 20.

c) ASTM D2241 - Poly (Vinyl Chloride) (PVC) Pressure-rated pipe (SDR Series).

d) ASTM D2152 - Test Method for Degree of Fusion of Extruded Poly (Vinyl Chloride) (PVC) Pipe and Molded Fittings by Acetone Immersion.

e) ASTM D2321 - Underground Installation of Flexible Thermoplastic Sewer Pipe.

f) ASTM D2412 - External Loading Properties of Plastic Pipe by Parallel-Plate Loading.

g) ASTM D2444 - Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight).

h) ASTM D3034 - Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

i) ASTM D3212 - Elastomeric push-on joints for plastic pipe.

j) AWWA C600 - Installation of Ductile - Iron water mains and appurtenances.

k) AWWA C900 - PVC Pressure Pipe 4 inch through 12 inch.

l) AWWA C905 - PVC Pressure Pipe 14 inch through 36 inch.

m) ASTM D2672 - Bell-End Poly (Vinyl Chloride) (PVC) Pipe.

n) ASTM F477 - Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

o) ASTM F478 - Precast Concrete Manhole Risers and Tops.

p) ASTM C497 - Concrete Pipe, Manhole Sections, or Tile.

q) ASTM F679 - Poly (Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings.

r) ASTM A746 - Ductile Iron Gravity Sewer Pipe.

s) ASTM F794 - Poly (Vinyl Chloride) (PVC) Ribbed Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter.

t) AWWA C600 - Standard for Installation of Ductile Iron Pipe Mains and Appurtenances

3.0 Materials and Requirements for Gravity Sewer Mains

a) General

1) To the maximum extent possible all materials shall be manufactured in the United States. This includes all pipe, valves, fittings, hydrants, meter boxes, etc.

2) All pipe material shall be marked with the manufacturer, type, class, thickness, and date of production in lettering legible to county staff.

3) The engineer is responsible for reviewing all shop submittals for approval. County staff may assist to answer any questions concerning shop submittals.

4) All pipes, manholes, fittings, etc., must conform to AWWA standards.

5) Gravity sewer mains shall be constructed of PVC piping and shall be SDR-35, SDR-26, or DR-18. Ductile iron pipe (DIP) may only be used with express written permission of Brunswick County Public Utilities or Engineering Department.

6) All pipes shall be shipped with gaskets installed inside the pipe bell.

7) PVC sewer mains shall be factory dyed industry standard green.

b) Ductile Iron Pipe (DIP)

1) All sizes of pipe shall be manufactured to a nominal laying length of 18'-0" or 20'-0”, except to make adjustments for bends, tees, and other fittings.

2) DIP shall conform to ANSI / AWWA C150 / A21.50 and ANSI / AWWA C151 / A21.51, with an exterior asphaltic coating for corrosion resistance, and an interior lining of Protecto 401 (or equivalent) unless otherwise shown or specified.

3) Joints shall be the push-on or mechanical joint type conforming to ANSI / AWWA C111 / A21.11 as modified by ANSI / AWWA C151 / A21.51.

4) Rubber gaskets and lubricant shall conform to ANSI/AWWA C111/A21.11.

5) No metric sized pipe shall be permitted.

6) If DIP is required, and the soils are found to be corrosive, then all DIP and fittings shall be wrapped in a polyethylene encasement per ANSI / AWWA A21.5 / C105 *Polyethylene Encasement for Ductile Iron Piping for Water and Other Liquids*.

7) Acceptable products are American Cast Iron Pipe Company, Griffin Pipe Company, U.S. Pipe Company, or approved equal.

c) Polyvinyl Chloride Pipe (PVC)

1) Sewer mains with depth of earth cover three (3) feet to twelve (12) feet:

a) Eight (8) inch through twelve (12) inch PVC mains, unless specified as DIP, shall be SDR-35 or better conforming to ASTM D3034. Joints shall conform to ASTM D3139 or ASTM D3212.

b) Fourteen (14) inch through thirty-six (36) inch PVC mains, unless specified as DIP, shall be AWWA C905 Class 235 (DR-18). Joints shall conform to ASTM D3139 of ASTM D3212.

2) Sewer mains with depth of earth cover thirteen (13) feet to twenty (20) feet:

a) Eight (8) inch through twelve (12) inch PVC mains, unless specified as DIP, shall be SDR-26 or better conforming to ASTM D3034. Joints shall conform to ASTM D3139 or ASTM D3212.

b) Fourteen (14) inch through thirty-six (36) inch PVC mains, unless specified as DIP, shall be AWWA C905 Class 235 (DR-18). Joints shall conform to ASTM D3139 of ASTM D3212.

3) Sewer mains with depth of earth cover greater than twenty (20) feet:

a) Pipes installed at depths greater than twenty (20) feet shall be constructed of C900 per manufacture's recommendations based on depth and soils classification. At a minimum DR-18 shall be used

at depths of 20 feet or greater. DIP may be allowed with the express written permission of Brunswick County Utilities or Engineering Department.

4) All PVC mains shall be manufactured with PVC material conforming to PVC 1120.

5) Fittings shall be molded PVC with joints similar to the PVC pipe. Fabricated fittings using solvent welded joints are not acceptable. Fittings may also be DIP fittings listed and approved for use with PVC pipe and shall have an asphaltic coating on the exterior for corrosion resistance, and an interior lining of ceramic epoxy Protecto 401 (or equivalent), unless otherwise shown or specified.

6) Acceptable products are Diamond Plastics Corporation, J M Eagle Manufacturing Company, National, Certainteed, North American, or approved equal.

d) Installation

1) Contractor shall install PVC gravity sewer mains in accordance with ASTM D2321. Ductile iron mains shall be installed in accordance with AWWA C600. Both types of material installations shall adhere to excavation, trenching, and backfilling standards as covered in TS 013.01: *"Excavating, Grading, Trenching, and Backfilling".*

2) Pipe shall be installed starting from the lowest point and shall be laid with the spigot ends pointing in the direction of flow.

3) Gravity sewer trenches shall be kept free of standing water during installation by use of a pump. If deemed necessary prior to or during construction, well point systems should be used for dewatering.

4) If a segment of gravity sewer main has two separate pipe requirements due to depth of cover, the greater quality of pipe shall be used for the entire segment.

Example: A segment of gravity pipe contains a section with cover greater than twelve (12) feet, requiring it to be minimum SDR-26, as well as a segment with cover less than twelve (12) feet, otherwise allowing for a minimum of SDR-35; Both shall be installed using the better material – minimum SDR-26.

5) All mains shall have locating tape, and shall be as follows:

a) Tape shall be three (3) inches wide, green in color, bearing continuous message "CAUTION SEWER LINE BURIED BELOW".

b) Tape shall be made of plastic or other permanent material.

c) Tape shall be buried continuously above the gravity sewer main at a depth of eighteen (18) inches below finished grade.

6) No sewer line of any type shall pass through any storm drain structure unless first approved by county staff.

7) When a transition is required from a PVC sewer main to ductile iron pipe sewer main, mechanical joints will be used. Mechanical joints shall conform to AWWA C111. Bolts shall be high strength low alloy steel per AWWA C111.

8) When installing a gravity main above or below a water main or storm drain, all minimum separations and material requirements must be met, as outlined below:

a) When a gravity sewer main crosses underneath a water main, eighteen (18) inch minimum separation must be achieved between the invert of the water main and the crown of the sewer main. If this separation cannot be achieved, both the gravity sewer main and water main shall encased within ferrous sleeves for a distance of ten (10) feet in both directions of the crossing. Sleeves shall have sealed ends. If the water main is a ferrous material with joints equivalent to water standards, then the water main does not have to be encased within an additional sleeve.

b) When a gravity sewer main crosses over top of a water main, both materials shall be encased within ferrous sleeves for a distance of ten (10) feet in both directions of the crossing. Sleeves shall have sealed ends.

c) When a gravity sewer main crosses underneath a storm drain, twenty-four (24) inch minimum separation must be achieved. If this separation cannot be achieved, the gravity main shall be constructed in a manner concurrent with Brunswick County standard detail S-15.

d) When a gravity sewer main crosses over top of a storm drain, twenty-four (24) inch minimum separation must be achieved. If this separation cannot be achieved, the gravity main shall be encased within a ferrous sleeve for a distance of ten (10) feet in both directions of the crossing. Sleeves shall have sealed ends.

4.0 Materials and Requirements for Sewer Services

a) General

1) Pipe and fittings for four (4) inch and six (6) inch gravity sewer services shall be constructed of SCH 40 PVC pipe conforming to ASTM D178 with solvent welded joints.

2) Sewer services shall be installed in accordance with county standard details.

3) All services shall be single services. No double services are to be installed.

b) Installation

1) All gravity sewer services are to be installed using a wye angled downstream of the main.

2) The service wye should be turned to the top quadrant of the gravity main – approximately (45) degrees from the top centerline of the main. In no case, shall the service laterals be stacked vertically over the gravity main.

3) Gravity sewer services shall be installed perpendicular to the gravity main.

4) Wherever possible, gravity services shall be tied into a manhole.

5) Services shall be installed so that they meet minimum clearances from existing and proposed utilities, such as eighteen (18) inch minimum separation below a water main.

6) The minimum vertical ground cover over a gravity sewer lateral shall be twenty-four (24) inches (thirty-six (36) inches if in NCDOT right-of-way).

7) Sewer services shall terminate with a wye to a surface cleanout complete with square nut cap, cast iron box, and cover marked “C/O” or “SEWER”. The invert of the wye shall be capped with a watertight plug for future plumbing connection. See county standard details.

8) Install a 4”x4”x 6’ treated timber marker at the property or easement line behind the service cleanout for location of the service. The timber shall be installed with 2’ buried and 4’ visible above final grade.

9) Services shall be installed at a minimum grade of 1/8 inch per foot. Service termination grade shall be at adequate depth for future plumbing connection.

5.0 Materials and Requirements for Manholes

a) General

1) Joint surfaces between bases, risers and cones shall be manufactured to the joint surface design and tolerance requirements of ASTM C76.

2) Flexible joint sealants shall be butyl rubber-based conforming to Federal Specification SS-S-210A, AASHTO M-198, Type B - Butyl Rubber and as follows: maximum of 1% volatile matter and suitable for application temperatures between 10 and 100 degrees F.

3) Pipe to manhole connectors shall conform to ASTM C923. The location of the pipe connectors shall vary from the location shown on the project plans by no more than (1/2) inch vertically and five (5) degrees horizontally. Provide for control of the pipe OD to within the tolerances of the connector on flexible pipes larger than twelve (12) inches.

4) Concrete shall conform to ASTM C478 and as follows:

a) Compressive strength: 4000 psi minimum at 28 days.

b) Air Content: 4 percent minimum.

c) Cementitious Materials: Minimum of 564 pounds per c.y.

d) Coarse Aggregates: ASTM C33.

e) Fine Aggregates: ASTM C33. Free from organic impurities.

f) Chemical Admixtures: ASTM C494. Calcium Chloride or admixtures containing calcium shall not be used.

g) Air Entraining Admixtures: ASTM C260.

5) Mortar shall be Type S conforming to ASTM C270.

6) Brick shall be used to bring manhole rings to grade or filler for forming manhole inverts only and shall conform to ASTM C62 Grade SW or ASTM C32 Grade MS.

7) Manholes shall have an eccentric cone. Manholes four (4) feet deep or less may have a flat top.

8) Manholes shall have a minimum six (6) inch extended base.

9) Manholes shall have a minimum inside diameter of four (4) feet for sewer mains eighteen (18) inches diameter and smaller, and shall be five (5) feet

inside diameter for sewer mains larger than eighteen (18) inches. Larger inside diameters may be required for larger pipe sizes, more than two pipes, or when entrance/exit angles require a larger manhole.

10) Drop manholes shall be inside drop, unless otherwise approved by Brunswick County, with a minimum inside diameter of five (5) feet.

11) Manhole steps shall be provided in bases, risers, and cones and aligned vertically on center. Steps shall be cast in place or, if approved by the County, secured to the wall with a compression fit in tapered holes. Steps shall not be vibrated or driven into freshly cast concrete or grouted in place. The steps shall be Copolymer Polypropylene Plastic reinforced with a ½" diameter grade 60 bar and have serrated tread and tall end lugs. Step pullout strength shall be tested per ASTM C497.

12) Each manhole shall be equipped with an insert of high density copolymer meeting the requirements of ASTM 124. Manholes located in traffic areas shall have stainless steel sewer guards.

13) When a watertight manhole is to be used due to flood plain location, a vent pipe shall be installed for proper ventilation of the manhole. Refer to county standard details.

14) Manhole interiors shall be factory coated with a minimum twenty (20) mils coal tar epoxy or other County approved coating.

15) Where sewer force mains connect to a gravity sewer manhole, the interior of the manhole shall be coated with an interior coating to protect against hydrogen sulfide corrosion. Such coating shall be a minimum of twenty (20) mils in thickness and shall be Raven 405 Lining Systems, Zebron 386, or Sewerkote (Duramar 1030).

16) All manhole frames and covers shall conform to ASTM A48.

17) All manhole covers are to be clearly marked “Sanitary Sewer”.

18) Sanitary sewer covers shall utilize lifting bars instead of pick holes.

19) Standard covers shall have up to four (4), one (1) inch diameter vent holes.

20) Acceptable manufacturers of standard manhole frames and covers are US Foundry, Capitol Foundry, East Jordan, General Foundries, or approved equal.

21) Watertight manhole covers are required for all manholes where the rim elevation is less than one (1) foot above the 100-year flood elevation.

22) Acceptable manufacturers of watertight manhole frames and covers are US Foundry, Capitol Foundry, East Jordan, or approved equal.

b) Installation

1) Structure:

a) All damage to pre-cast sections shall be thoroughly repaired. Repair and patching of minor breaks shall be done by chipping and scarifying the defective area before application of grout. Pre-cast sections shall be subject to rejection on account of failure to conform to any of the specification requirements. In addition, individual sections of manhole sections may be rejected because of fractures or cracks passing through the wall, except for a single end crack that does not exceed the depth of the joint; defects that indicate imperfect proportioning, mixing, and molding; surface defects indicating honey-combed or open texture; damaged or cracked end, where such damage would prevent making a satisfactory joint; and/or any continuous crack having a surface which width of 0.01 inches or more and extending for a length of twelve (12) inches or more, regardless of position in the section wall.

2) Setting:

a) The contractor is responsible for getting the manhole tops to proper grade. The top of the pre-cast manhole may be brought to proper grade for receiving manhole frames by using precast riser rings, unless otherwise approved for masonry. Masonry construction shall be performed by experienced and qualified workmen. All work shall be laid plumb, straight, level, square, and true. Extensions may not be made greater than twelve (12) inches. If needed, manhole riser sections with precast steps shall be used.

b) Manholes shall be set on a minimum of eight (8) inches of #57 crushed stone on a level undisturbed or well compacted subgrade.

c) Manhole structures are to be level upon completion.

d) Butyl rubber sealing shall be placed between each manhole riser section. Backing tape shall be removed prior to application and a sufficient amount of sealant shall be used to completely seal the joint.

e) All joints, cracks, lifting nooks inside the manhole are to be grouted to prevent infiltration. All interior grouting shall be covered in a field coat of coal tar epoxy. All exterior joints are to be wrapped with flat butyl rubber tape.

3) Connections:

a) All in place penetrations into manholes must be by core boring methods including main line and service drops. Properly sized elastomeric boots shall be set in penetrations. The boot and the pipe must be fully mortared on the inside and the outside of the manhole.

b) The invert channels shall be (3/4) the depth of the largest pipe and shall be smooth and semicircular in shape conforming to the inside of the adjacent sewer section. Changes in direction of flow shall be made with a smooth curve of as large a radius as the size of the manhole will permit. Changes in size and grade of channels shall be made gradually and evenly. The invert channels shall be formed directly in the concrete of the manhole base or shall be built up with solid brick and Type S mortar.

c) All main or service connections made above the shelf, not exceeding thirty (30) inches, shall have a slide constructed with brick and type S mortar. Slide shall be formed at the connection in a semicircular fashion conforming to the inside of the connected pipe. The slide shall be gradually angled toward the downstream invert of the gravity main for smooth flow. Connections made above thirty (30) inches will require a drop. Refer to county standard details.

d) All drop manholes are to be inside drops unless otherwise approved by county staff. All hardware used to anchor the drop pipe shall be Type 316 stainless steel. Refer to county standard details.

4) Frames and Covers:

a) Standard manhole frames are to be centered over the precast opening of the manhole, sealed with butyl rubber sealant, and mortared into place inside and out. Mortar inside shall be coated with field coat of coal tar epoxy along with all other grouted surfaces.

b) Standard manhole frames and covers shall have high density copolymer inserts in non-traffic areas, and stainless steel inserts in traffic areas.

c) Watertight manhole frames are to be centered over the precast opening of the manhole, sealed with butyl rubber sealant, bolted down, and mortared into place inside and out. Mortar inside shall be coated with field coat of coal tar epoxy along with all other grouted surfaces.

d) Watertight frames and covers do not require an insert.

6.0 Requirements for Connections to Existing Gravity Sewer Systems

a) Connections to Existing Mains

1) Connection of a new gravity sewer collection main to an existing gravity sewer collection main shall be made by installation of a new "doghouse" manhole at the connection point. Refer to county standard details.

2) Connection of a new gravity sewer service to an existing gravity sewer main shall be made by use of a tapping saddle in accordance with county standard details.

3) Where two or more mains of different diameters enter a sanitary sewer manhole, it is required to match the crown elevations of the different size pipes.

7.0 Requirements for Testing and Completion

a) Preparation

1) All personnel and materials needed for satisfactory testing of gravity systems are to be supplied by the contractor. All procedures will be performed by the contractor except where otherwise indicated.

2) Upon completion of construction of the new gravity collection system, all main lines and manholes are to be cleaned of any silt and debris.

3) All newly constructed gravity systems must be allowed a settling period of thirty (30) days from the date of completion of the system prior to any testing. In lieu of a settling period, contractor may opt to backfill trenches in one (1) foot compacted lifts upon approval from Brunswick County. Intention must be made known at the time of the preconstruction meeting.

4) It is the contractor's responsibility to schedule all testing a minimum of (48) hours in advance. The contractor shall have all testing equipment on site and in place prior to the scheduled start time of the respective test. All lines used to pull the mandrel must be in place prior to the start of testing so that personnel are not waiting for set up to take place before testing can commence.

b) Deflection Test

1) Deflection testing shall be performed on all sections of flexible pipe.

2) The maximum allowable deflection at any point shall be five (5) percent.

3) Deflection will be measured by a pin-type mandrel "GO/No GO" gauge outfitted for the proper pipe material and diameter.

4) The mandrel shall be pulled through the pipe by means of a strong cord or cable. Mandrel shall be pulled by hand.

5) Any section not meeting the five (5) percent deflection requirement shall be excavated, backfilled, re-compacted in one (1) foot lifts, and retested.

c) Air Test

1) Each segment of line shall prove airtight.

2) Test pressure shall be five (5) psi. No pressure loss will be allowed.

3) Testing time, in minutes, shall be calculated as [0.625 x Nominal pipe diameter (in inches)]. Minimum air test time is five (5) minutes.

d) Displacement Test

1) Sewer mains will be checked by county personnel to determine whether displacement has occurred.

2) Displacement will be checked by shining light from manhole to manhole by means of flashlight or reflected sunlight. The line shall be visually inspected directly or with the aid of a mirror. A "full moon" shall be visible.

3) If any displacement is visible, the section of pipe displaced shall be excavated, backfilled, re-compacted in one (1) foot lifts, and retested for airtightness and displacement.

e) Other Testing

1) At the discretion of county staff, the following tests may also be required, at the expense of the contractor, prior to acceptance:

a) Manhole Vacuum Test

1) Vacuum testing shall be performed in accordance with the requirements outlined in ASTM C1244.

b) Soil Compaction Test

1) All trenches suspected of not meeting compaction requirements shall be tested for cconformance by an approved facility for the locations and depths specified by county staff. The facility approval shall be by county staff.