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SECTION 15 31 13

PUBLIC SANITARY SEWER GRAVITY MAINS

PART 1.00 - GENERAL

1.01 Description

The work in this Section covers the requirements for furnishing and installation of all piping required to complete the sanitary sewer collection system(s) as shown on the drawings, as described in these specifications, and as directed by the Engineer. Wastewater Utility Pump Stations is specified within Section 15 32 16. Sanitary Sewer Force Mains is specified within Section 15 34 00.

1.02 Quality Assurance

- A. The Contractor shall use sufficient workmen and competent supervisors in the execution of this portion of the work to ensure adequate and proper installation throughout.
- B. The pipe class numbers or pressure ratings shall be clearly shown on the pipe.
- C. Contractor shall follow the procedures and recommendations for receiving, storage, and handling of pipe, fittings, joint lubricant and other items necessary and required to construct the pipeline contained in the UNI-Bell Plastic Pipe Association," Handbook of PVC Pipe," and recommended by the pipe manufacturer.
- D. Storage: Store pipe, fittings, valves and appurtenances off the ground using sound wood blocks, placed on stable foundation or using other appropriate means. Allow space between rows, individual pieces and bundles with clearance below and above to allow full view for inspection purposes.
 - 1. Store in well-drained area away from brush and accessible for inspection.
 - 2. Do not stack pipe higher than 54 inches high; packages shall be supported by racks to prevent damage to the underside of the pipe
 - 3. Keep spigot ends of pipe clean and clear for dimensioning purposes
 - 4. Don not place excavated or other material over or against stored material.
 - 5. PVC pipe shall be stored so that it does not deform or bend. Pipe stored outdoors or otherwise exposed to direct sunlight shall be covered with canvas or other opaque material with provision for adequate air circulation.
- E. Handling: unload and handle materials with crane, backhoe, or equipment of adequate capacity, equipped with appropriate slings or padding to protect materials from damage.
- F. Workmanship: Pipe and fittings shall be homogenous throughout and free from visible cracks, holes, foreign inclusions or other injurious defects. Pipe and fittings shall be as uniform as commercially practical in color, opacity, density and other physical properties.
- G. Non C900 or C905 PVC pipe shall conform to the ASTM standards and testing

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requirements:

- i. Pipe Flattening: ASTM D3034
- ii. Impact Resistance: ASTM D2444
- iii. Pipe Stiffness: ASTM D2412
- iv. Extrusion Quality: ASTM D2152

1.03 Submittal

- A. Prior to the installation of any pipe, the Contractor shall submit and receive the Engineer's approval of shop drawings and/or manufacturer's material certification of compliance with specifications.
- B. Submittals shall be in five (5) copies and shall be provided to the Engineer at least 15 days prior to the planned installation time.

PART 2.00 - PRODUCTS

Allowable materials on this project are as follows:

A. Polyvinyl Chloride (PVC) Pipe

1. Solid Wall Polyvinyl Chloride Pipe (PVC) 4 inch to 15 inch

Allowable standard dimension ratios (SDR) and ASTM Designations shall be determined as follows for all gravity sewer mains and services:

- i. For excavation depths of zero (0) to eight (8) feet the SDR shall not exceed thirty-five (35) and the pipe shall conform to the requirements of ASTM D3034.
- ii. For excavation depths of eight (8) to eighteen (18) feet the SDR shall not exceed twenty-six (26) and shall conform to the requirements of ASTM D3034.
- iii. For excavation depths greater than eighteen (18) but less than twenty two (22) feet the SDR shall not exceed twenty-one (21) and shall conform the requirements of ASTM D2241 or conform with AWWA C900 with a Diameter Ratio (DR) not to exceed eighteen (18).
- iv. PVC sewer pipe shall not be laid in depths greater than twenty-two (22) feet.

2. Solid Wall Polyvinyl Chloride Pipe (PVC) 18 inch to 24 inch

Allowable standard dimension ratios (SDR) and ASTM Designations shall be determined as follows:

- i. For excavation depths of zero (0) to eight (8) feet the SDR shall not exceed thirty-five (35) and the pipe shall conform to the requirements of ASTM F679.

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- ii. For excavation depths of eight (8) to eighteen (18) feet the SDR shall not exceed twenty-six (26) and shall conform to the requirements of ASTM F679.
 - iii. For excavation depths greater than eighteen (18) but less than twenty two (22) feet the conform with AWWA C905 with a Diameter Ratio (DR) not to exceed eighteen (18).
 - iv. PVC sewer pipe shall not be laid in depths greater than twenty-two (22) feet.
 - v. Profile Wall Polyvinyl Chloride Pipe (PVC) 8 inch to 24 inch
3. Profile Wall Polyvinyl Chloride Pipe (PVC) 8 inch to 24 inch

Profile Wall pipe is allowable for excavation depths not to exceed eight (8) feet and shall be in accordance with either ASTM 749, ASTM 949 or ASTM F1803.

4. Pipe Joints

Pipe joints shall meet the requirements or exceed the requirements of ASTM D3212 or D3139 and shall be "push-on" type using elastomeric gaskets in accordance with ASTM F477.

- i. Pipe shall be joined by means of an integral bell formed with a race design to accept the gasket in accordance with ASTM 3212.
- ii. When assembled, the gasket is compressed radially on the pipe spigot so as to affect a positive seal under all combinations of joint tolerances and is the only element depended upon to make the joints flexible and watertight.
- iii. PVC main connection to DIP mains shall be made with a Mechanical Joint Solid Sleeve with transitional gasket to connect DIP to PVC.

B. Ductile Iron (DI) Pipe (Mechanical or Push on Joints, standard application)

1. Pipe shall be manufactured in accordance with AWWA C150 and C151 and shall be a minimum Pressure Class of 350 and Thickness Class 50, except as noted on the plans.
 - i. Pipe joints: Pipe shall be either the "push-on" or "mechanical joint" in accordance with AWWA C111 unless otherwise shown on the plans and specified herein
 - ii. Coatings: Ductile iron pipe shall be bituminous coated outside and cement mortar lined in accordance with ANSI/AWWA Standard C104/A 21.4.
 - iii. Pipe lengths: 18 to 20 feet
 - iv. Ductile iron pipe used within encasements and in aerial lines, shall be furnished with "mechanical" joints according to ANSI/AWWA C151/A 21.51.

C. Connection Appurtenances

1. Connections of 6" and larger will be made by way of a Doghouse Manhole built over existing sewer main per the Standard Details.

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2. For connecting new service laterals to new sewer mains:
 - i. Laterals shall be wye branches of the same material of the pipe.
 - ii. Plugs for stub outs shall be of the same material as the pipe and gasketed with the same gasket material as the pipe joint. The plug shall be secured to withstand test pressures specified hereinafter.
3. Saddles: For connecting sewer house connection to existing sewer main 6" to 15"
 - i. Saddles shall be wye connections unless approved by the Engineer.
 - ii. For PVC Main, follow manufacturer's recommendation
 - iii. FERNCO Flexible Tap with stainless steel bands or approved equal is approved for connecting to asbestos cement, vitrified clay pipe, concrete, cast iron or ductile iron.
4. For point repairs: Fernco Joint Sealer Co. with shear ring
5. For connecting pipes to sewer manholes, see Section 33 39 13

PART 3.00 - EXECUTION

3.01 Preparation

- A. Contact appropriate utility locating agency(ies) prior to any earthwork
- B. Dig test pit to determine size, type, composition and exact location of existing pipe which the proposed pipe network will connect to.
- C. Excavate sufficient trench in advance and test pit all existing underground utilities or structures, whether shown on the drawings or visually identified in the field to verify:
 1. Field verify actual locations
 2. Make reasonable adjustments to line and grade to avoid conflict, with Engineer's approval.
 3. Furnish Engineer with location and elevation information when previously unknown or different underground utilities and structures are encountered.
 4. Additional work performed because above mentioned precautions were not taken will not be compensated by the owner.

3.02 Relation of Water Mains to Sewers

- A. Lateral Separation of Sewers and Water Mains - Sewer mains shall be laid at least 10 feet laterally from existing or proposed water mains, unless local conditions or barriers prevent a 10-foot lateral separation--in which case:
 1. The water main is 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; or
 2. The water main is laid in the same trench as the sewer with the water main located at one side on a bench of undisturbed earth, and with the elevation of the bottom of the water main at least 18 inches above the top of the sewer.

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- B. Crossing a Sewer Main Under a Water Main - Whenever it is necessary for a sewer main to cross under a watermain, the sewer main shall be laid at such an elevation that the bottom of the water main is at least 18 inches above the top of the sewer, unless local conditions or barriers prevent an 18 inch vertical separation in which case both the water main and sewer shall be constructed of ferrous materials and with joints that are equivalent to water main standards for a distance of 10 feet on each side of the point of crossing.
- C. Crossing a Sewer Main Over a Water Main - Whenever it is necessary for a sewer main to cross over a sewer, both the water main and the sewer shall be constructed of ferrous materials and with joints equivalent to water main standards for a distance of 10 feet on each side of the point of crossing. A section of sewer main pipe shall be centered at the point of crossing.

Where it is impossible to maintain a minimum of 10 feet of horizontal clearance between the water and sewer installations, a vertical separation of 18 inches (water main above sewer) must be maintained.

3.03 Trench Excavation

A. General

- 1. Open no more trench in advance of pipe laying than is necessary to expedite the work.

Excavate trenches to a width that will provide adequate working space, but not more than maximum design width so not to undercut trench walls.

Excavate bell holes at each joint to provide full-length barrel support of the pipe and to prevent point loading at the bells or couplings.

Unless trench banks above the top of the pipe are cut back on a stable slope, sheet and brace trenches as necessary to prevent caving and sliding, to provide protection for workmen and the pipe, and to protect adjacent structures and facilities. Do not remove trench sheeting unless the pipe strength is sufficient to support the external loads. The width of the trench at any point below the top of the pipe should not be greater than that necessary to provide adequate room for joining the pipe and compacting the haunching and initial backfill.

During the course of construction, should the trench be over-excavated below a point 6 inches below the bottom of the pipe, fill that area of over-excavation with an acceptable class of embedment material and compact to a minimum of 90 percent.

- 2. Where trench construction conditions require the use of a trench box, the trench box shall be sufficient length to extend four (4) feet beyond both ends of one (1) joint of pipe in order to allow the workmen to make-up the pipe joint inside the protection of the trench box. The workmen required to work inside the trench shall:
 - i. Enter and leave the trench box from the ground surface only
 - ii. Not travel along the trench bottom outside the protection of the trench box

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The trench box shall conform to current OSHA regulations and shall have been designed by a Registered Professional Engineer. The Contractor shall furnish proof of such design to the Engineer upon request.

B. Trench Width

Trench width at the ground surface may vary width and depend upon depth, type of soils, positions of surface structures, or other conditions authorized by the engineers.

The maximum clear width of the trench excluding sheeting shall not exceed the outside diameter of the pipe plus one foot (1') on each side at the top of the area of initial backfill and one foot (1') above the outside top of pipe. The minimum width of the trench at the top of the pipe when placed shall be a width that will permit the proper construction of joints and compaction of backfill around the pipe, but shall be at least equal to the largest outside diameter of the pipe plus eight inches (8") on each side of the pipe. The sides of the trenches shall be vertical unless otherwise approved by the Engineer. In no case shall the vertical walls project less than two inches (2") above the top of the pipe line laid to a grade unless the finished grade fill depth is less than two feet (2'). The maximum allowable width of trench on each side of the pipe shall not exceed twelve inches (12") for pipe which is twelve inches (12") in diameter or smaller; eighteen inches (18") for pipe which is between fourteen inches (14") and thirty-six inches (36") in diameter; and twenty-four inches (24") for pipe diameters greater than thirty-six inches (36"), unless otherwise approved by the Engineer.

C. Parallel Roadway Trenches

Where utility installation is to take place upon the shoulder of any paved street or highway, excavate trench to a width that will provide adequate working space but in no case shall the hard surfaced, traveled portion of roadway be damaged. Where the structural integrity of the roadway pavement is jeopardized, proper sheeting and bracing shall be installed to provide adequate protection to adjacent roadway and structures, and to afford the necessary protection to the workmen and pipe.

Excavation material shall not be stored on the pavement if it can be reasonably handled otherwise. In cases where storing of excavated material on pavement is absolutely necessary, same shall be moved as quickly as practical and the pavement shall be thoroughly cleaned.

Excavation in the immediate vicinity of drainage structures shall be made with special care so as not to damage or interfere with the use of the existing drainage facilities.

Drainage facilities that are inadvertently damaged must be repaired or replaced immediately.

Parallel open trench installations that involve possible damage in event of rain or other falling weather, or which may be hazardous to traffic due to open trench, should be closed without undue delay. In no case should a trench remain open

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longer than a 24- hour period, except with approval of the Engineer.

D. Trenching Within Pavement

Where it is necessary to open-cut asphalt or concrete pavements surface cuts shall be made with a concrete saw with a maximum width of ten (10) feet.

Where excessive depths of pipe installations are encountered and the structural integrity of the roadway surface and/or the safety of the workmen is in doubt, proper sheeting and bracing of the trench shall be required.

Handling and placement of the excavated material within this area shall be handled as in Paragraph 3.03 C.

All excess excavated material shall be removed and disposed of outside the limits of the right-of-way in such a manner as not to interfere with the drainage of highways unless otherwise permitted or directed by the Engineer or his representative.

Compaction test(s) for open-cut crossings may be required at the discretion of the engineer in addition to any supplemental or more stringent testing requirements are specified in the approved North Carolina Department of Transportation Encroachment Agreement. All geotechnical testing required as specified above to meet the compaction requirements within Section 15 05 02 shall be the responsibility of the Contractor, the cost of which shall be included in the price bid for asphalt roadway (remove & replace).

E. Rock Excavation

Rock excavation methods and payment shall be in accordance with Section 15 05 01.

3.05 Preparation of Pipe Foundation

A. General

The pipe foundation shall be true to line and grade and uniformly firm. Where bell and spigot type pipe is used, recesses shall be excavated to receive the pipe bells.

B. Unsuitable Foundation Material

Where the foundation material is found to be of poor supporting value or of rock, the Engineer may make minor adjustment in the location of the pipe to provide a more suitable foundation.

Where this is not practical, the Contractor shall act upon the directions of the Engineer to stabilize the trench bottom by undercutting and installing: (a) soil stabilization woven fabric; and (b) NCDOT Class VI Stone (clean #57) or (c) approved select or borrow material and compacting to a minimum density of ninety (90%) as directed by the Engineer. Compensation for the undercut will be included in the cost of the foundation material furnished. Approved bedding and backfill material is further specified within Section 15 05 02.

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C. Placement of Bedding Material

Stone bedding shall be placed beneath all gravity sewers of 6" diameter or larger. Bedding shall be a minimum of four (4") inches deep beneath the pipe, and shall be along the sides of the pipe at least up to the springline, unless shown otherwise in the Pipe specification or Plans. Bedding width shall be at least the width of the pipe O.D. plus 24 inches. This stone bedding shall not be a separate pay item, but will be included in the unit price bid for Sanitary Sewer Pipe. (Stone required by the Engineer beneath this sewer bedding will be paid for a unit price bid in accordance with Section 15 05 02.

In order to ensure that adequate and uniform support is provided along the entire length of pipe, the Contractor shall carefully bring the bedding material to grade along the entire length of pipe prior to installation. Material used for the formation of the pipe bedding and haunch shall be carefully placed by hand shoveling to ensure that sufficient material has been worked under the pipe to form the haunch and to ensure that the pipe does not become dislodged during backfilling. Contractor's workmen shall fill evenly on both sides of the pipe to the centerline and shall compact the fill using hand shoveling or mechanical tamps. Extreme care shall be taken when using mechanical tamps adjacent to the pipe, when removing sheeting, and removing trench boxes so as to avoid disturbing the pipe.

3.06 Laying Pipe

A. Inspection

After delivery alongside the trench, all pipeline material shall be carefully examined for both soundness and specifications compliance.

B. Installation of Pipe

Installed sewer pipe shall be checked for tolerance to proper line and grade from manhole to manhole as soon as the sewer pipe has been installed and prior to the installation of the next run of pipe. Any tolerance error shall not be cumulative beyond the run of a specific sewer line from manhole to manhole. The invert elevation of the influent pipe of the upstream manhole shall always be taken as the beginning elevation for the next run of sewer pipe to be installed. If the grade tolerance error for the previous run of sewerline from manhole to manhole exceeds the allowable drop in the upstream manhole as shown on the Drawings, then this condition defines an unacceptable sewer line installation and will be re-installed at the Contractor's expense.

Sanitary sewer mains shall be installed in accordance with the minimum grades shown on the approved Drawings but at not time shall mains be installed with grades flatter than the minimum grades mandated by the North Carolina Administrative Code as shown below:

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Diameter of Pipe (inches)	Minimum Slope (feet per 100 feet)
6	0.60
8	0.40
10	0.28
12	0.22
14	0.17
15	0.15
16	0.14
18	0.12
21	0.10
24	0.08
27	0.07
30	0.06
36 & Larger	0.05

Clean joint contact surfaces immediately prior to jointing. Use lubricants, primers, or adhesives as recommended by the pipe or joint manufacturer. All pipe shall be laid on the prepared foundation, bell end up grade with each joint being checked for proper alignment and grade as the work proceeds. Excavate bell holes for each pipe joint. When jointed in the trench, the pipe shall form a true and smooth line. Whenever practicable, start pipe laying at the lowest point.

Four (4) feet minimum cover shall be provided for all PVC sewer pipes. Where the cover is less than four feet (4') the Engineer shall direct the Contractor as to the most acceptable condition; i.e. installation of ductile iron pipe or mounding over the PVC.

C. Steep Slope Protection

Sewers on twenty (20) percent slopes or greater shall be anchored securely with concrete, or approved, equal, with the anchors spaced as follows:

1. Not greater than thirty-six (36) feet center to center on grades 21% to 35%; and
2. Not greater than twenty-four (24) feet center to center on grades 35% to 50%; and
3. Not greater than sixteen (16) feet center to center on grades 50% and over.

D. Cutting and Beveling PVC Pipe

For shorter than standard pipe lengths, field cuts may be made using special pipe cutters for PVC pipe. Pipe ends shall be cut square and perpendicular to the pipe centerline axis. Spigots shall have burrs removed and ends smoothly beveled by a mechanical beveler tool or by hand with a rasp or file. Field spigots shall be stop-marked with a felt tip marker or wax crayon for the proper length of assembly insertion. The angle and depth of field bevels and length to stop-mark shall be comparable to factory pipe spigots.

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E. Dewatering

Keep trenching dry during pipe laying. Divert surface water from the trench area to the greatest extent practicable without causing damage to the adjacent property. Before pipe laying is started remove all water that may have entered the trench and continue to dewater trench by the most expedient method.

3.07 Manhole Installation

Manholes to be furnished and installed per Section 15 39 13

3.07 Backfilling

After the bedding has been prepared and the pipe installed, selected material from excavation or borrow, at a moisture content which will facilitate compaction, shall be placed alongside the pipe in layers not exceeding 6 inches in depth. Care shall be taken to insure thorough compaction of the fill under the haunches of the pipe. Each layer shall be thoroughly compacted by rolling, tamping and mechanical rammers, or by hand tamping with heavy iron tampers, the tamping face area of which shall not exceed 25 square inches. The method of filling and compacting shall be continued until the fill has reached an elevation 12 inches above the top of the pipe. The remainder of the trench shall be backfilled and thoroughly compacted in layers not exceeding 12 inches.

Care shall be taken during backfill and compaction operations to maintain alignment and prevent damage to the joints. The backfill shall be kept free from stone, frozen lumps, chunks of highly plastic clay, or other objectionable material.

All local backfill materials shall be compacted at a moisture content satisfactory to the Engineer, which shall be approximately that required to produce the maximum density. The contractor shall dry or add moisture to the local material when required to provide a uniformly compacted and stable embankment.

When other than local material is used for backfilling above the foundation, such material will be classified as select backfill material as specified in Section 15 05 01 of these specifications. Use of this select backfill material shall be only when directed by the Engineer or his representative.

Backfill over and around the pipe and backfill around and adjacent to all drainage structure shall be compacted to a minimum density of 80 percent as determined by the AASHO Standard Method T-99, except the backfill under pavements and adjacent areas within 4 to 10 feet of the proposed pavement shall be compacted to a minimum density of 100%.

Tests for density of compaction may be made at the option of the Engineer, and deficiencies shall be corrected by the Contractor without additional cost to the Owner. The operation of heavy equipment shall be conducted so that no damage to the pipe shall result.

Heavy equipment shall not be operated over any pipe until it has been properly backfilled and has a minimum cover of three (3) feet, unless approved otherwise by the Engineer.

3.08 Aerial Crossings

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Aerial pipe crossings to include steel casing pipe and pier construction shall be in accordance with the Plans and shall be compensated as per the Bid Schedule.

3.09 Sewer Service Connections

A. Connection to new sewer main shall be done as follows:

- i. Tie into new wye fitting at main and run service at 2 percent minimum grade. If 2 percent cannot be obtained, remand to engineer for resolution.
- ii. Service line material shall be SDR 26 PVC or ductile iron and bedded, backfilled and compacted in accordance as specified for mains hereinabove.
- iii. Place cleanout at the property line or as depicted on the plans or directed by the Engineer. Cleanouts shall be in accordance with the Standard Details and shall be flush to grade. In non traffic areas, a plastic, watertight cap may be installed. For traffic areas, riser section of cleanout shall be protected by cast iron sleeve for the final 18" and a brass plug cap

B. Connection to existing sewer main shall be done as follows:

Tap existing sewer main with motor driven tapping machine utilizing the appropriate drill bit.

3.10 Testing

Testing and television of new sewer mains shall be in accordance with Section 15 31 13.01

3.11 Abandonment of Sewer Mains and/or Services

- A. For abandonment of sewer mains install approved plug or cap at each location where pipe was cut or valve removed; or Contractor may fill severed abandoned pipe with flowable fill.
- B. Abandon house connections with watertight plug at cleanout, along the service line or as shown on the Drawings or as specified below:
 1. If service is to be abandoned at sewer main and connection to sewer main is with tee, wye or saddle, remove house service and install a watertight plug.
 2. If service is to be abandoned at the sewer main and connection to main is with a thimble, remove thimble and perform mainline point repair.

PART 4.00 – MEASUREMENT AND PAYMENT

4.01 Public Sanitary Sewer Gravity Mains

- A. Measurement: By linear foot of various sizes and types provided at the measured depth. The installed pipe shall be measured horizontally along the centerline of the installed pipe from manhole to manhole as part of the completed and accepted work. Depth shall be measured from the invert of the pipe to the top of the ditch bank along the completed and accepted alignment.
- B. Payment: At unit price for each size and type of pipe installed at the measured depth

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as listed in the Bid Schedule.

1. Payment includes work for location of utilities, excavation, trenching, backfilling, removal and replacement of driveway pipes, guardrails and other obstructions, connecting to new and existing mains, abandonment of mains and services, installation of stone bedding, and pressure and mandrel testing of mains, and disinfecting and testing of mains.

4.02 Sewer Services

- A. Measurement: By linear foot of various sizes and types provided, measured horizontally along the centerline of the installed service from the centerline of the main to the property line(or directed location) as part of the completed and accepted work.
- B. Payment: At unit price for each size and type of fitting installed as listed in the Bid Schedule as part of the completed and accepted work.
 1. Payment includes work for location of utilities, excavation, trenching, backfilling, removal and replacement of driveway pipes, guardrails and other obstructions, connecting to new and existing mains, furnishing and installation of fittings, installation of cleanout and associated plugs and fittings, pressure and leakage testing of mains and fittings, and disinfecting and testing of mains and fittings.

END OF SECTION