

**Construction
Standard Specifications
& Details**

**SEWER SPECIFICATIONS
LOW PRESSURE SEWER & FORCE MAINS
AND
GRAVITY SEWER**

City of Crossville
Tennessee

WPN 26.0309

APPROVED

THE DOCUMENT BEARING THIS STAMP HAS BEEN RECEIVED AND REVIEWED BY THE

TENNESSEE DEPT. OF ENVIRONMENT & CONSERVATION

DIVISION OF WATER RESOURCES

AND IS HEREBY APPROVED FOR CONSTRUCTION BY THE COMMISSIONER

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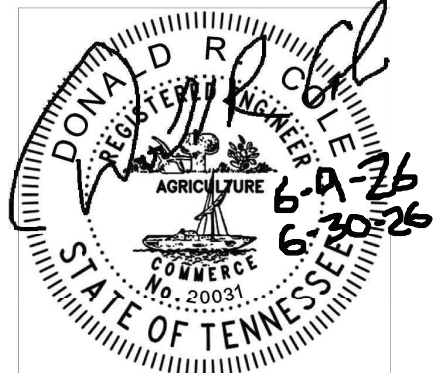
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THIS APPROVAL SHALL NOT BE CONSTRUED AS CREATING A PRESUMPTION OF CORRECT OPERATION OR AS WARRANTING BY THE COMMISSIONER THAT THE APPROVED FACILITIES WILL REACH THE DESIGNED GOALS.

APPROVAL EXPIRES FIVE YEARS FROM ABOVE DATE

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LOW PRESSURE SEWER & FORCE MAINS

Table of Contents

LOW PRESSURE SEWER & FORCE MAINS	4
1. GENERAL REQUIREMENTS	4
1.1 SCOPE OF WORK	4
1.2 STANDARDS	4
1.3 WORK INCIDENTAL TO CONSTRUCTION.....	5
1.4 MATERIAL AND EQUIPMENT	10
1.5 SPECIAL CONDITIONS	10
1.6 TESTING	11
1.7 SUBMITTALS.....	11
1.8 TEMPORARY FACILITIES/UTILITIES	11
1.9 WARRANTY	12
1.10 PROJECT CLOSE-OUT	12
2. PRODUCTS	14
2.1 SCOPE	14
2.2 FORCE MAIN PIPE & LOW PRESSURE PIPE	14
2.3 PIPE JOINTS	15
2.4 DUCTILE IRON FITTINGS.....	15
2.5 MECHANICAL JOINT RESTRAINTS	15
2.6 UNDERGROUND MARKING TAPE	17
2.7 TRACER WIRE	18
2.8 TAPPING SLEEVE	18
2.9 GATE VALVES	18
2.10 ECCENTRIC PLUG VALVES	19
2.11 CONCRETE CRADLES.....	21
2.12 EXCAVATION FOR PIPELINE TRENCHES	21
2.13 DISPOSITION OF EXCAVATED MATERIALS	21
2.14 PIPE BEDDING	21
2.15 LAYING PIPE	22
2.16 CASING PIPE	24
2.17 INSTALLATION OF STEEL CASING PIPE.....	24
2.18 BACKFILLING PIPELINE TRENCHES	24
2.19 SETTLEMENT OF TRENCHES	25
2.20 BITUMINOUS CONCRETE HIGHWAY, STREET & DRIVEWAY.....	25
2.21 PORTLAND CEMENT CONCRETE HIGHWAY, STREET & DRIVEWAY REPLACEMENT ...	25
2.22 UNPAVED DRIVEWAYS.....	26
2.23 EXISTING FACILITIES	26
2.24 SEEDING.....	26
2.25 TESTING FORCE MAINS & LOW PRESSURE SEWER LINE	26

2.26	CLEAN UP	27
2.27	SHORING, SHEETING, AND BRACING	28
2.28	AIR RELEASE VALVES FOR SEWAGE FORCE MAINS	29
2.29	RESIDENTIAL GRINDER PUMPS FOR LOW PRESSURE SEWER SYSTEMS	29
3.	BASIS OF MEASUREMENT & PAYMENT	32
3.1	GENERAL	32
3.2	FORCE MAIN & LOW PRESSURE SEWER	32
3.3	CASING PIPE (BORE & JACK)	33
3.4	CASING PIPE (OPEN CUT)	33
3.5	VALVES	33
3.6	CONNECT TO EXISTING LINE	33
3.7	ASPHALT RESTORATION	33
3.8	GRAVEL RESTORATION	33
4.	DETAIL SHEETS	34

LOW PRESSURE SEWER & FORCE MAINS

1. GENERAL REQUIREMENTS

1.1 SCOPE OF WORK

The sewer mains and appurtenances required on this Contract shall be furnished in compliance with the Contract Specifications and the Contract Drawings.

Work to be performed under the Unit Price Items described subsequently herein shall include for each item all excavation (including rock excavation, if any) the removal of existing pavements, curb and gutter, sidewalks, driveways, brush and timber, structures and piping to be relocated or abandoned; also sheeting, diking, well pointing, bailing, dewatering; the furnishing and placing of bulkheads, the restoration of any utilities, parkways, trees, shrubbery, culverts, fences and any other items not covered under subsequent items disturbed by construction operations; backfilling and removal of excess excavated materials; and testing.

The cost of all such work and the cost of other work necessary for the complete sewer main installation not specifically included for payment under the item of unit price payment Nos. described herein shall be merged with the various unit prices for the Unit Price Construction Items.

1.2 STANDARDS

Where material and methods are indicated in the Specifications as being in conformance with the standard specification, it shall refer in all cases to the latest edition of the Specifications and shall include all interim revisions. Listing of a standard specification without further reference indicates that the particular material or method shall conform to such listed specification.

1.3 WORK INCIDENTAL TO CONSTRUCTION

- A. Work to be performed under this heading includes all the work designated as “Incidental to Construction” and shall be done in compliance with the Contract Drawings. The Contractor is hereby referred to the Agreement, General and Special Conditions, Sections of these Specifications and the Contract Drawings. All work herein there are not specified pay items shall be considered “Incidental to Construction and no additional compensation will be allowed.

- B. In addition to the above-referenced requirements, and unless otherwise noted below, listed work shall be considered incidental to construction.

- C. Public and Private Utilities

Utilities Where any utilities, such as water, sewer, telephone, power, oil and gas transmission or any other, either public or private are encountered, the Contractor shall provide adequate protection for them and will be held responsible for any damage to such utility from their operations. When it is apparent that construction operations may endanger the foundation of any utility conduit, pole, or the support of any structure, the Contractor shall notify the utility owner of this possibility and shall take steps as may be required to provide temporary bracing or support of conduits, poles or structures.

The cost of any bracing or support of conduits, poles or structures as shown on the Contract Drawings shall be merged into the unit price per linear foot of gravity sewer. The Contractor shall be reimbursed for the bracing or supporting of utilities due to the realignments of the gravity sewer to meet field conditions. Any realignment which eliminates any bracing or supporting necessary according to the Contract Drawings shall be credited to the Owner by the Contractor.

When in order to carry out the work, a pole (power or telephone) must be removed to a new location or moved and replaced after construction, the Contractor shall arrange for the moving of such pole or poles and lines thereof.

Where it is the policy of any utility owner to make his own repairs to damaged conduit or other structures, the Contractor shall cooperate to the fullest extent with the utility owner and shall see his operations interfere as little as possible with the utility owner's operations.

- D. Existing Water, Sewer and Drain Facilities. In some instances, existing water, sewer, or drains may be encountered along the line of work. In all such cases, the Contractor shall perform his operations in such manner that such service will not be interrupted and shall, at his own expense, make all temporary provisions to maintain such services.

Where it is necessary to cut, remove and/or replace existing storm sewers and drain tiles, the Contractor shall make specific arrangements to maintain the flow of sewer and shall not place permanent bulkheads in any conduit. Temporary earth dams may be used to confine and/or channel the flow and shall be removed upon completion of the crossing.

The Contractor shall receive no extra compensation for replacement of sewers or drains encountered and for re-laying same at a new grade or line.

- E. Existing Sewer Facilities. Where existing sewer mains are encountered in the work, they shall be maintained in operation.

F. Dewatering

The Contractor shall perform all pumping, well pointing, ditching or any other necessary procedure to keep excavation clear of groundwater, storm water, or sewage during the progress of the work until the completed work is safe from injury.

The Contractor shall maintain dewatering operations such that no groundwater, storm water, or sewage will be allowed to build up over any concrete and/or masonry at manholes or structures for a period of 6 hours. This time period will be adjusted by the Engineer should temperature and curing conditions warrant.

All water pumped or drained from the work shall be disposed of in a manner satisfactory to the Engineer without damage to adjacent property or to other work under construction. The Contractor shall not dispose of storm or surface water through new or existing sanitary sewerage facilities.

It shall be the Contractor's responsibility to take all necessary precautions to protect all construction against flooding and/or floatation from hydrostatic uplift.

All dewatering procedures and maintenance thereof shall be considered an integral part of pipe laying and sewer main construction operations and no separate payment will be allowed therefore.

Dewatering operations for manhole and/or structure construction shall be such that the groundwater or surface water is not being pulled over, around, or through the freshly placed concrete or masonry. The use of multiple pumps placed on each side of the manhole and/or at points in the trench downstream might be required. When required to protect the freshly placed concrete and/or masonry, timber or plywood forms will be positioned around the concrete or masonry so that the dewatering operations will not cause a separation of cement and aggregate. The cost of these

dewatering and/or protection procedures shall be merged into the appropriate manhole or structure bid items.

G. Barricades and Warning Signs

The Contractor shall furnish, erect, and maintain such barricades, fences, lights, and danger signals and take other precaution measures that will ensure the protection of persons, property, and the work.

Traffic control devices shall meet the requirements of the "Manual of Uniformed Traffic Control Devices" (MUTCD).

H. Maintenance and Access of Traffic

Portions of the work are located in developed areas requiring the access for fire and other departments to be provided for and at least one free lane shall be available for all traffic. Contractors are to arrange operations in these areas to meet these requirements and secure operating procedures from the City of Crossville, Tennessee, Tennessee Department of Transportation, Cumberland County Road Commission, or as the case may be.

Where sewer mains are constructed under paved roadway surfaces within public right-of-way, the Contractor will restore the asphalt or crushed stone pavement and/or shoulder between shoulder lines. It shall be the responsibility of the Contractor, upon completion of the sewer main installation, to regrade the street with flowable fill or crushed stone backfill to the template that existed prior to construction. This regrading shall be satisfactory to the City of Crossville (Department of Public Works) before the street is released for paving operations.

The Contractor shall further be responsible for the maintenance of disturbed streets until repaving operations have been completed.

The Contractor shall restore all curbs, gutters, sidewalks, ramps and private driveways, or parking lots. Compensation for this work is detailed in other portions of this document and any item must be removed as was evidence and necessary for the installation of the proposed sewer main, for which there is no specific pay item(s), shall be considered as incidental to the construction of the proposed sewer and therefore, no additional compensation will be allowed for the restoration of this (these) item(s).

The Contractor shall also be required to restore, at his own expense, all pavements disturbed by his operations where the sewer main was not constructed under pavements. He shall further be required to replace at his own expense all pavements disturbed in the connection of sewer and/or force main deficiency discovered after restorations have been completed.

I. Erosion & Sediment Control

The Contractor is responsible for erosion and sediment control on the project. The Contractor shall use the Tennessee Erosion Prevention and Sediment Control Handbook as a technical guide for construction best management practices to prevent, minimize, and treat sediment-laden stormwater discharges during construction.

A TDEC NPDES Stormwater Permit may be required for the project. If so, the CONTRACTOR will be required to sign the NOI and Stormwater Pollution Prevention Plan (SWPPP). A TDEC ARAP Permit may also be required for the project. **The CONTRACTOR shall be required to adhere to the terms and requirements of the stormwater permit and/or ARAP permit if required for the project.**

The Contractor shall adhere to the stormwater regulations and the stormwater ordinance of the City of Crossville when working within the city limits.

J. Project Engineer Responsibility

Project Engineer attached to the sewer project must provide sealed engineering plans and hydraulic calculations for approval by the city and TDEC, and prior to construction of the project.

1.4 MATERIAL AND EQUIPMENT

Materials, equipment, and products shall be properly containerized, packaged, boxed, and protected to prevent damage during transportation and handling.

Provide suitable, temporary weather-tight storage facilities as may be required for materials or equipment which will be damaged by storage in the open.

Protect from damage all materials delivered at the site. Do not use damaged material on the work.

Manufactured articles, materials and equipment shall be applied, installed, connected, erected, used, cleaned, and conditioned as directed by the respected manufactures unless directed otherwise by the provisions of these Specifications

1.5 SPECIAL CONDITIONS

- A. The Contractor shall perform his work in such a manner that normal service on existing sewer lines and service to customers is maintained to the maximum extent possible. Such service shall be disrupted at such times and in such a manner as approved by the Engineer.
- B. The Contractor shall submit a work schedule to the Engineer for approval prior to beginning work. The schedule shall establish the planned sequence of line installation, service switch-over if required, and property restoration for the project.
- C. The Contractor shall maintain access to businesses and residences to the maximum extent possible.

- D. Easement Restrictions – The Contractor, upon request, will be furnished with plans showing easements obtained for the construction of sewer mains and appurtenances. The Contractor shall exercise due care in staying within the easement indicated and will be held strictly accountable for violations thereof. Any desired access points not shown on the drawings must be acquired by the Contractor by negotiation with the property owner involved.

1.6 TESTING

The Specifications for Materials designate the testing applicable for materials incorporated in the work. Testing shall be done by the manufacturer in accordance with the applicable ASTM specification. Manufacturer shall furnish the Engineer three (3) certified copies of the test results.

The Owner may, at his option, elect to have an independent testing laboratory test materials to be furnished for incorporation in the work. Such testing, when done, shall be in accordance with provisions of the Specifications for Materials.

Acceptance testing for installed sewer line will be limited to visual testing and pressure testing unless otherwise directed by the Engineer.

1.7 SUBMITTALS

Submittals for this work include: pipe supplier, with information on pipe to be used, including the joint design, recommended laying methods and material testing reports; manufacturer's data on valves, valve boxes, fire hydrants, and any necessary equipment for complete installation. Such submittals are to be made for approval by the Engineer prior to incorporation of any materials into the work.

1.8 TEMPORARY FACILITIES/UTILITIES

Contractor shall be required to maintain suitable sanitary facilities for his workers.

1.9 WARRANTY

The work to be performed under this Contract shall be guaranteed against defects in materials or workmanship for a period of one year following the date of formal acceptance of the project. In the event defects in materials or workmanship should appear, the Contractor shall promptly make the necessary correction. When the defects are not of an emergency nature, the Contractor will be notified and shall be given a period of two weeks in which to make the necessary corrections. Should the defect be of an emergency nature, which in the opinion of the Owner or the Engineer requires immediate correction, the Contractor will be notified and requested to make the necessary repairs immediately. Should this be impractical, or if the Contractor should fail to respond to the request for corrective action within the specified period, the Owner may proceed to have the defects corrected and shall bill the Contractor for all charges in connection therewith including labor, materials and equipment rental. Such charges may be deducted from amounts due the Contractor if any of the Contractor's money has been withheld. In the event the Contractor fails, refuses, or neglects to pay the Owner, the Surety shall be liable for such charges.

1.10 PROJECT CLOSE-OUT

The premise of the job site shall be maintained in a reasonable neat and orderly condition and kept free from an accumulation of waste materials and rubbish during the entire construction period. Remove crates, cartons and other flammable waste materials or trash from the work areas at the end of each working day.

When the Contractor requests a final inspection, the Engineer will inspect the work for completeness in accordance with the Contract Documents. Any deficiencies shall be promptly corrected by the Contractor.

Final acceptance cannot be made until the Contractor furnished to the Owner a notarized certification in a form suitable to the Owner that all labor and material costs for the work have been paid by the Contractor and there are no liens against the work.

Payment in full of the Final Application for Payment shall constitute acceptance of the work by the Owner subject to conditions of the Contract Documents.

END OF SECTION

2. PRODUCTS

2.1 SCOPE

The work to be accomplished under this section of the specifications consists of the furnishing of ALL labor, materials, equipment, and services necessary for the construction of a force main or low pressure sewer line as shown on the drawings and more fully described hereinafter.

2.2 FORCE MAIN PIPE & LOW PRESSURE PIPE

PVC Pipe

All PVC pipe shall be pressure rated Class 200 pipe having a maximum standard dimension ratio of 21. In addition, PVC pipe shall meet all requirements as established by ASTM D1748 and D2241. All fittings shall be ductile iron meeting all requirements as established by ANSI 21.10 or 21.53.

Laying lengths shall not exceed 20 feet except with the approval of the Engineer.

HIGH DENSITY POLYETHYLENE (HDPE)

All HDPE pipe shall conform to the requirements of ASTM F714 and shall be manufactured with premium, highly engineered PE4710 resin suitable for use in transporting potable water.

All HDPE pipe shall be pressure rated for 200 psi.

Maximum standard dimension ratio (DR) of 11 for HDPE pipe.

Type of HDPE pipe shall be Iron Pipe Size (IPS), ASTM 3035 (O.D. Controlled), unless otherwise shown on construction plans.

All HDPE Pipe Joints to be connected by heat fusion.

All HDPE pipe shall be clearly mark with the manufacturer's name, nominal size and OD base, material code, dimension ratio, pressure class, current AWWA C906 (if applicable), ASTM F714 (if applicable), and production date (day, month, & year).

2.3 PIPE JOINTS

Joints for PVC pipe shall be push-on type with integral thickened wall bells. All joints shall meet the requirements as set forth in ASTM Standard Specification D3139 and shall maintain a standard dimension ratio of SDR 21 throughout the bell or coupling section. Gasket materials shall meet the requirements as set forth in ASTM F477. Lubricant shall be non-toxic and shall not promote biological growth.

2.4 DUCTILE IRON FITTINGS

Fittings shall be ductile iron in accordance with ANSI A21.53 and shall conform to the details and dimensions shown therein. Fittings shall have interior cement-mortar lining as specified for ductile iron pipe.

Plugs, where required, shall be mechanical joint dished or flat plugs in accordance with AWWA C110. Joints for plugs shall be restrained with the use of ductile iron mechanical joint retainer glands.

Joints for fittings shall be mechanical joint type only.

2.5 MECHANICAL JOINT RESTRAINTS

Fittings for all force mains shall be ductile iron in accordance with ANSI A21.53 and shall conform to the details and dimensions shown therein. Fittings shall have interior cement-mortar lining as specified for ductile iron pipe.

Restraint devices for mechanical joint fittings and appurtenances conforming to either ANSI/AWWA C111/A21.11 or ANSI/AWWA C153/A21.53, shall conform to the following:

Design:

1. Restraint devices for nominal pipe sizes 3 inch through 54 inch shall consist of multiple gripping wedges incorporated into a follower gland meeting the applicable requirements of ANSI/AWWA C110/A21.10.

2. The devices shall have a working pressure rating of 350 psi for 3 – 16 inch, 250 psi for 18-48 inch and 200 psi for the 54 inch size. Ratings are for water pressure and must include a minimum safety factor of 2 to 1 in all sizes.

Material:

1. Gland body, wedges and wedge actuating components shall be cast from grade 65-45-12 ductile iron material in accordance with ASTM A536.
2. Ductile iron gripping wedges shall be heat treated within a range of 370 to 470 BHN.
3. Three (3) test bars shall be incrementally poured per production shift as per Underwriter's Laboratory (U.L.) specifications and ASTM A536. Testing for tensile, yield and elongation shall be done in accordance with ASTM E8.

Traceability:

1. An identification number consisting of year, day, plant and shift (YYDDD) (Plant Designation) (Shift Number), shall be cast into each gland body.
2. All physical and chemical test results shall be recorded such that they can be accessed via the identification number on the casting. These Material Traceability Records (MTR's) are to be made available, in hard copy, to the purchaser that requests such documentation and submits his gland body identification number.
3. Production pieces that are too small to accommodate individual numbering, such as fasteners and wedges, shall be controlled in segregate inventory until such time as all quality control tests are passed. These component parts may then be released to a general inventory for final assembly and packaging.
4. All components shall be manufactured and assembled in the United States. The purchaser shall, with reasonable notice, have the right to plant visitation at his/her expense.

Installation:

1. Mechanical joint restraint shall require conventional tools and installation procedures per AWWA C600, while retaining full mechanical joint deflection during assembly as well as allowing joint deflection after assembly.

2. Proper actuation of the gripping wedges shall be ensured with torque limiting twist off nuts.

Approvals:

1. Restraint devices shall be Listed by Underwriters Laboratories (3" through 24" inch size) and Approved by Factory Mutual (3" through 12" inch size).
2. Mechanical joint restraint shall be Megalug Series 1100 produced by EBAA Iron Inc. or approved equal.

Restraint Coating System:

Coating for restraint devices shall consist of the Following:

All wedge assemblies and related parts shall be processed through a phosphate wash, rinse and drying operation prior to coating application. The coating shall consist of a minimum of two coats of liquid thermoset epoxy coating with heat cure to follow each coat.

All casting bodies shall be surface pretreated with a phosphate wash, rinse and sealer before drying. The coating shall be electrostatically applied and heat cured. The coating shall be a polyester based powder to provide corrosion, impact and UV resistance.

The coating system shall be MEGA-BOND by EBAA Iron, Inc. or approved equal. Requests for approved equal must submit coating material and process details for review prior to bid.

2.6 UNDERGROUND MARKING TAPE

Install underground marking tape in trench with all force main lines. Marking tape shall be installed at a depth of 12 inches minimum above the top of the pipe.

The underground marking tape shall be TERRA-TAPE (detectable) or an approved equal and shall be three inches in width. All underground marking tape shall be imprinted to read "CAUTION BURIED SEWER LINE BELOW."

No separate pay item will be made for the installation of marking tape. The cost is to be included in the unit price for force main installation.

2.7 TRACER WIRE

Install 12 gauge underground tracer wire directly below pipe in trench with all force main sewer lines. In addition, tracer wire will be joined using underground electrical connectors. Connectors shall be "wire nut", twisted DB plus.

No separate pay item will be made for the installation of tracer wire. The cost is to be included in the unit price for force main installation.

2.8 TAPPING SLEEVE

Tapping sleeves shall be stainless steel, Mueller H-304, or approved equal, and a valve with mechanical joint outlet, Mueller T-2361, or approved equal. The valve shall conform to all applicable specifications for gate valves in Section 2.11.

2.9 GATE VALVES

Gate valves shall be resilient wedge design, manufactured to meet or exceed the requirements of AWWA C515, latest revision. Design working pressure shall be minimums 250 psi for all sizes. Gate valves shall be Mueller, M & H, American Flow Control, or equal.

All gate valves shall be furnished with mechanical joint end-connections, unless otherwise shown on the Plans or specified herein. The end-connections furnished shall be suitable for connection to the pipe furnished.

Valves shall have an unobstructed waterway equal to or greater than the full nominal diameter of the valve.

The stem sealing shall be by an O-ring.

The valve body, bonnet, and bonnet cover shall be ductile iron ASTM A536.

All valves are to be tested in strict accordance with AWWA C515, latest revision.

Buried valves shall be equipped with a 2" square operating nut and shall be complete with a valve box as specified herein. Valves shall open to the left.

The inside and outside of the gate valve shall be coated with an epoxy coating. Coating materials, application and testing shall comply with AWWA C550, latest revision.

All gate valves shall have the name or monogram of the manufacturer, the year the valve casting was made, the size of the valve, and the working water pressure cast on the body of the valve. They shall be painted by the manufacturer and touched up in the field as required.

For ease of location outside of paved areas an 18 inch square by 4-inch thick concrete pad shall be installed around the valve box and cover as shown on the Standard Detail Sheet or a precast concrete valve box collar with a 24 inch outside diameter unless noted otherwise on the plans.

2.10 ECCENTRIC PLUG VALVES

Eccentric plug valves shall be of the tight closing, resilient faced, non-lubricating variety and shall be of eccentric design such that the valves pressure member (plug) rises off the body seat contact area immediately upon shaft rotation during the opening movement. Valves shall be drop-tight at the rated pressure (175 psi through 12", 150 psi 14" and above) and shall be satisfactory for applications involving throttling service as well as frequent or infrequent on-off service. The valve closing member should rotate approximately 90 degrees from the full-open to full-close position and vice-versa.

The valve body shall be constructed of cast iron conforming to ASTM A126, Class B. Body ends shall be:

1. Flanged with dimensions, facing, and drilling in full conformance with A – ANSI B16.1, Class 125.
2. Mechanical Joint, meeting the requirements of AWWA C111/ANSI AS1.111.
3. Grooved, meeting the requirements of AWWA C606

Eccentric plug valves shall have a rectangular shaped port. Port areas for 3” – 29” valves shall be at least 80% of full pipe area.

Valve seat surface shall be welded-in overlay, cylindrically shaped, and of not less than 90% pure nickel. The seat area shall be raised, with the raised area completely covered with weld to ensure proper seat contact. The machined seat area shall be a minimum of .125” thick and .500” wide.

The valve plug shall be constructed of cast iron conforming to ASTM-A126, Class B. The plug shall have a cylindrical seating surface that is offset from the center of the plug shafts. The plug shafts shall be integral. The plug shall be 100% encapsulated with Buna-N rubber in all valve sizes. The rubber compound shall be approximately 70 (Shore A) durometer. The rubber to metal bond must withstand 75 lbs of pull under test procedure ATM D-429 Method B.

Shaft bearings, upper and lower, shall be sleeve type metal bearings which are sintered, oil impregnated, and lubricated type 316 stainless steel conforming to ASTM A743 Grade CF-8M. Thrust bearings shall be Nylatron.

Plug valve shaft seals shall be of the multiple V-ring type (Chevron) and shall be adjustable. All packing shall be replaceable without removing the bonnet or actuator and while the valve is in service. Shaft seals shall be made of Buna-N.

Each valve shall be seat tested at the full rated working pressure and hydrostatically shell tested at 1-1/2 the rated working pressure. Certified copies of individual tests shall be submitted when requested. Certified copies of proof of design tests shall be submitted upon request.

Manual valves shall have lever or worm gear type actuators with a handwheel, a 2” square nuts or a chainwheel attached. Lever actuators shall be furnished on valves 8” and smaller where the maximum unseating pressure is 25 psig or less. Worm gear type actuators shall be furnished on all 4” or larger valves where the maximum unseating pressure is 25 psig or more.

All eccentric plug valves shall be Clow F4512 (flanged), F5413 (mechanical joint), or F5414 (grooved) or approved equal.

For ease of location outside of paved areas an 18 inch square by 4-inch thick concrete pad shall be installed around the valve box and cover as shown on the Standard Detail Sheet or a precast concrete valve box collar with a 24 inch outside diameter unless noted otherwise on the plans.

2.11 CONCRETE CRADLES

Concrete cradle, anchors, or encasement of force main shall be placed where shown on the drawings, required by the specifications, or as directed by the Engineer. Concrete shall be Class "C" (2500 psi) and shall be mixed sufficiently wet to permit it to flow under the pipe to form a continuous bed. In tamping concrete, care shall be taken not to disturb the line of the pipe or injure the joints. Concrete placed outside the specified limits or without authorization from the Engineer will be at the contractor's expense.

2.12 EXCAVATION FOR PIPELINE TRENCHES

A minimum cover of 24 inches shall be provided for the force main and low pressure line.

2.13 DISPOSITION OF EXCAVATED MATERIALS

Excess material not needed for force main trench backfilling purposes shall be disposed of at the contractor's expense. Where disposal is on private property, written permission shall be obtained.

2.14 PIPE BEDDING

If the foundation is in good firm earth, the earth shall be pared or molded to give full support to the lower third of each pipe. Where bell and spigot is involved, bell holes shall be excavated during this operation to prevent bell from being supported on undisturbed earth.

In wet, yielding mucky locations where pipe is in danger of sinking below grade or floating out of line or grade, or where backfill material is of such a fluid nature that such movements of the pipe might take place during the placing of the backfill, the pipe must be weighted or secured permanently in place by such means as will prove effective. When ordered by the engineer, yielding and mucky materials in subgrades shall be removed below ordinary trench depth in order to prepare a

proper bed for the pipe. Crushed stone or other such granular material shall be placed and compacted, if necessary, as determined by the engineer to replace poor subgrade material.

Where trench is excavated in rock or shale, 6" space below pipe shall be backfilled with approved bedding material firmly compacted to form a cushion for pipe and appurtenances.

2.15 LAYING PIPE

All pipes shall be laid with ends abutting and true to line. Supporting of pipes shall be as set out hereinbefore under "Pipe Bedding" and in no case shall the supporting of pipes on blocks be permitted.

Fittings for the force main shall be provided and laid as and where directed by the Engineer, or shown on the drawings.

Before each piece of pipe is lowered into the trench, it shall be thoroughly inspected. Each piece of pipe shall be lowered separately unless special permission is given otherwise by the Engineer. No piece of pipe or fitting which is known to be defective shall be laid or placed in the lines. If any defective pipe or fitting shall be discovered after the pipe is laid, they shall be removed and replaced with a satisfactory pipe or fitting WITHOUT additional charge. In case a length of pipe is cut to fit in a line, it shall be so cut as to leave a smooth end at right angles to the longitudinal axis of the pipe.

Irregularities in subgrade in an earth trench shall be corrected by use of granular material as specified in Paragraph 3.08 (above) at the contractor's expense, a supply of which shall be available at the trench side whenever pipe is being laid.

When laying of pipe is stopped for any reason, the exposed end of such pipe shall be closed with a plywood plug fitted into the pipe bell, so as to exclude earth or other material, and precautions taken to prevent flotation of pipe by runoff into trench.

No backfilling (except for securing pipe in place) over pipe will be allowed until the Engineer has had an opportunity to make an inspection of the joints and alignment in the section laid, but such inspection shall not relieve the contractor of further liability in case of defective joints, misalignment caused by backfilling, and other such deficiencies that are noted later.

When sewer lines are to be constructed near water lines, horizontal and vertical separation shall be maintained in accordance with the following guidelines:

Parallel Installations

1. For parallel installations, line separation is to be at least 10 feet edge to edge. If this cannot be obtained, the top of the sewer line shall be at least 18 inches below the bottom of the water line.
2. If this condition is also unobtainable, the sewer line is to be constructed of materials and have a joint design equivalent to water main standards as approved by the Utility Department and the approved Standard Water Specifications and Details, and shall be pressure tested in accordance with the requirements for water mains approved by the Utility Department and the approved Standard Water Specifications and Details to assure water tightness.

Crossing Installations

1. Where the water line crosses house sewers, storm sewers, or sanitary sewers, a separation of at least 18 inches shall be provided between the bottom of the water line and the top of the sewer.
2. Sewers lines passing over or under water lines without the vertical separation shall be shall be constructed of materials, and have a joint design equivalent to water main standards as approved by the Utility Department and the approved Standard Water Specifications and Details, and shall be pressure tested in accordance with the requirements for water mains approved by the Utility Department and the approved Standard Water Specifications and Details to assure water tightness.
3. Water mains passing under sewers shall be protected (in addition to the above sewer line construction) by providing:
 - a. at least 18 inches between the bottom of the sewer and the top of the water line;
 - b. adequate structural support to prevent excessive joint deflection or damage to the water line when crossing a gravity or storm sewer; Install the water line in a steel casing to prevent excessive joint deflection or damage to the water line if crossing a gravity sewer or storm sewer. Center up the steel casing on the crossing and extend in both direction a minimum of five feet or as shown on the approved plans.
 - c. adequate structural support to prevent excessive joint deflection or damage to the water line when crossing a force main or low pressure sewer; Install the force main or low pressure sewer line in a PVC casing pipe to prevent excessive joint deflection or damage to the

water line if crossing a gravity sewer or storm sewer. Center up the PVC casing on the crossing and extend in both direction a minimum of five feet or as shown on approved plans. The PVC casing pipe shall be equivalent to water main standards as approved by the Utility Department.

- d. centering of the water line section to result in the water line joints being removed from the sewer line to the maximum possible extent.

No water line shall pass through or come into contact with any part of a sewer or sewer manhole.

2.16 CASING PIPE

Casing pipe shall be steel, plain end, uncoated and unwrapped, have a minimum yield point strength of 35,000 psi and conform to ASTM A252 Grade 2, or ASTM A139 Grade B, without hydrostatic tests. The steel pipe shall have welded joints and be in at least 18-foot lengths.

The wall thickness of the pipe shall be a minimum of 0.250 inches. The diameter of the pipe shall be as noted in the Bid Proposal.

2.17 INSTALLATION OF STEEL CASING PIPE

Steel casing pipe for highway crossings shall be open cut, or jack and bored to the elevations shown on the drawings. All joints between lengths shall be solidly welded with a smooth non-obstructing joint inside. The casing pipe shall be installed without bends. The force main shall be installed after the casing pipe is in place.

At each end of the casing pipe, the force main pipe shall be wrapped with two layers of roofing felt. The wrapping shall extend a minimum of 12 inches in each direction from the end of the casing pipe. After the force main has been installed, inspected, tested and wrapped as specified, both ends of the casing pipe shall be closed with brick or concrete block masonry in a manner acceptable to the Engineer. Casing spacers shall be utilized on the carrier pipe.

2.18 BACKFILLING PIPELINE TRENCHES

Backfilling shall be accomplished in accordance with the details set as shown in the Standard Detail Sheet.

Trenches outside existing sidewalks, driveways, streets, and highways shall be

backfilled in accordance with the Standard Detail Sheet.

Before final acceptance, the contractor will be required to level off all trenches or to bring the trench up to grade. The contractor shall also remove from roadways, rights-of-way, and/or private property all excess earth or other materials resulting from construction.

In the event that pavement is not placed immediately following trench backfilling in streets and highways, the contractor shall be responsible for maintaining the trench surface in a level condition at proper pavement grade at all times.

2.19 SETTLEMENT OF TRENCHES

The contractor shall be responsible for any trench settlement which occurs in the project within one year from the time of final acceptance of the work. If paving shall require replacement because of trench settlement within this time, it shall be replaced by the contractor at NO extra cost to the Owner. Repair of settlement damage shall meet the approval of the Engineer, the City of Crossville, Cumberland County, and/or the State of Tennessee as applicable.

2.20 BITUMINOUS CONCRETE HIGHWAY, STREET & DRIVEWAY

The contractor shall replace those sections of existing roads, streets, and driveways required to be removed to install the pipelines under this contract. He shall construct same to the original lines and grades and in such manner as to leave all such surfaces in as good (or better) condition than that which existed prior to the operations.

Prior to trenching, the pavement shall be scored or cut to straight edges at least 12 inches outside each edge of the proposed trench to avoid unnecessary damage to the remainder of the paving. Edges of the existing pavement shall be recut and trimmed to square straight edges after the pipeline has been installed and prior to placing the new base and pavement.

2.21 PORTLAND CEMENT CONCRETE HIGHWAY, STREET & DRIVEWAY REPLACEMENT

Wherever Portland cement concrete streets and driveways are removed, they shall be reconstructed to the original lines and grades and in such manner as to leave all such surfaces in fully as good or better condition than existed prior to the operation.

The existing concrete paving shall be sawed or cut to straight edges 12 inches outside edges of the trench or broken out to an existing joint, as directed by the Engineer. The concrete pavement shall be equal to the existing pavement thickness but not less than 6 inches and 4 inches in thickness for street and driveways, respectively.

Pavement replacement shall be accomplished with 3000 psi concrete in accordance with the details shown on the drawings.

2.22 UNPAVED DRIVEWAYS

Where unpaved streets, driveways, and parking areas are disturbed during the construction work, they shall be replaced to as good (or better) condition than that which existed prior to the contractor's operations.

Backfilling of the pipeline trench shall be in accordance with Method "B."

2.23 EXISTING FACILITIES

Existing mail boxes, drainage culverts, clothes line posts, fences, and the like shall NOT be molested or disturbed unless necessary, in which case they shall be replaced in as good condition as found as quickly as possible. Existing materials shall be reused in replacing such facilities when materials have not been damaged by the contractor's operation. Existing facilities damaged by the contractor's operation shall be replaced with new materials of the same type at the contractor's expense. Work in this category is NOT a pay item.

2.24 SEEDING

Lawns and other grassed areas shall be seeded after force main installation and grading to the original ground surface has been completed.

2.25 TESTING FORCE MAINS & LOW PRESSURE SEWER LINE

On all projects involving the installation of force main, the finished work shall comply with the provisions listed below:

- (a) All force main extensions shall be subjected to a pressure test. The section to be tested shall be valved off by gate valves, after having been filled with water, and a positive displacement test pump shall be used to pump clean water into the section to build up a test pressure of the greater of 1.5 times the working pressure or 150 psi. The test pump shall then be valved off from the system and the pressure shall be observed over a period of two hours. A drop in pressure of 5 psi or more during the two-hour test period shall be taken as an indication of leakage.
- (b) Where practicable, pipelines shall be tested between line valves or plugs in length of not more than 1500 feet.
- (c) Pipelines shall be tested before backfilling at joint except where otherwise required by necessity, local ordinance, or public convenience.
- (d) Duration of test shall not be less than two hours.
- (e) A digital gauge shall be used during pressure testing.
- (f) Where leaks are visible at exposed joints and/or evident on the surface where joints are covered, the joints shall be recaulked, repoured, bolts tightened, or relaid, and leakage minimized, regardless of total leakage as shown by test.
- (g) All pipe, fittings, and other materials found to be defective under test shall be removed and replaced at the contractor's expense.
- (h) Lines which fail to meet tests shall be repaired and retested as necessary until test requirements are complied with.
- (i) Where nonmetallic joint compounds are used, pipelines should be held under normal operating pressure for at least three days before testing.
- (j) The Owner will provide initial water for testing. Should the first test fail to pass all additional water required for subsequent tests shall be furnished at the contractor's expense.

2.26 CLEAN UP

Upon completion of the installation of the force main and appurtenances the contractor shall remove all debris and surplus construction materials resulting from the work. The contractor shall grade the ground along each side of the pipe trench in a uniform and neat manner, leaving the construction area in a shape as near as possible to the original ground line.

2.27 SHORING, SHEETING, AND BRACING

The contractor shall furnish and install all temporary sheeting, shoring, and bracing required to maintain the excavation in a safe working condition and to permit the safe and efficient installation of all items of contract work.

Sheeting, shoring, and bracing shall be used in wet, saturated or flowing ground, ground subject to slides, cave-ins, settlement or movement, and/or locations shown on the contract drawings.

Where excavations are made adjacent to existing buildings or other structures or in paved streets or alleys, the contractor shall take particular care to sheet, shore, and brace the sides of the excavation adequately so as to prevent any undermining or settlement beneath such structures shall be done when necessary and reviewed by the Engineer.

All sheeting, shoring, and bracing shall have sufficient strength and rigidity to withstand the pressure exerted and to maintain the wall of the excavation in place.

Lumber used may be any species which will satisfactorily withstand driving. It shall be sawed with square corners, and shall be free from worm holes, loose knots, wind shakes, decay, and unsound portion which might impair its strength. Minimum thickness shall be 2-inch nominal. Lumber shall be No. 2 common yard lumber in less than 6-inch size and common structural grade on timber 6 inches and over. Steel sheet piling of an approved design and type may be used.

Sheeting, shoring, and bracing shall not be left in place unless shown on the contract drawings or necessary for the safety and protection of new or existing work.

The sheeting, shoring, and bracing shall be removed as the work progresses in such a manner as to prevent caving in of the sides of the excavation, or damage to the new or existing work. While sheeting, shoring, and bracing are being removed, all voids left shall be filled and compacted. The contractor may elect to use a portable steel box in lieu of the above if approved by the Engineer.

All sheeting, shoring, and bracing shall be considered an integral part of the

excavation work and NO separate payment will be allowed.

2.28 AIR RELEASE VALVES FOR SEWAGE FORCE MAINS

Sewage air and vacuum and air release valves shall be furnished and installed on the force mains at the locations specified and indicated on the drawings, and in accordance with the standard details.

Valves shall be standard sewage air release valves and shall have provisions for backflushing from an approved water supply for blowing off accumulated sediment.

Air release valves are to be located with coordination with inspector to be installed on highest elevation of pipe available.

2.29 RESIDENTIAL GRINDER PUMPS FOR LOW PRESSURE SEWER SYSTEMS

Installation of the residential grinder pump units will be in accordance with the following specifications and installations detail.

Residential Grinder Pump

Residential Grinder Pump shall be a 2-horsepower submersible grinder pump, 3450 rpm, 220/230 Volt, single phase, 1 1/4" discharge, 30-foot power cord and cast-iron construction, Liberty Model LSG202M-C submersible grinder pump or EOne Extreme series Grinder Pump or current approved annual bid supplier for the city.

Fiberglass Basin - Minimum Requirements

42 inch diameter fiberglass basin system having a depth of 42 inches shall include the following: straight wall (with anti-float), solid fiberglass cover with max load limit 300 lb per square foot, anti-siphon valve, quick disconnect discharge assembly with stainless steel riser pipe, flex hose, cast iron ball check valve and extension handle, gate valve assembly to include a stainless steel sealing flange adapter, 1-1/4" brass gate valve and stainless steel pipe nipple, 1-1/4" stainless steel NPT discharge hub, 2" and 4" adaptaflex grommet to be supplied for field installation.

Control Panel - Minimum Requirements

Simplex control panel for 220/230 volt single phase service to operate the grinder pump unit. Control panel to include the following: NEMA 4X enclosure, red beacon and horn/buzzer, exterior test normal silence switch, three level float switches with 30' cord with weight. Panel is to have lockable latches.

INSTALLATION AND MAINTENANCE POLICY – CITY OF CROSSVILLE

Developers, contractors, and/or homeowners will purchase grinder pump units from the city to insure that all units are compatible with standards required by the City.

Homeowner Responsibilities:

- Pay a sewer tap fee and purchase a grinder pump at cost from the City of Crossville.
- Provide a 220/230-volt, 30 amp, 4 wire, weatherproof electrical disconnect on the outside wall of the house within 5 feet of the location where the sewer service line leaves the house, except as otherwise permitted below. This disconnect must be installed at a location approved in advance by the City Utility Inspector.
- Install the grinder pump in a clear area away from any decks or other structures that impede access and space for removal/replacement of pump.
- Pay the monthly cost of the electrical service for the grinder pump unit.
- Pay the monthly cost for sewer service
- Pay a service charge plus costs for parts and materials for repairs required due to negligence or intentional acts on the part of the homeowner and/or its tenants.
- This charge will be added to the customer's monthly bill for services.
- Pay a service charge for requests for service where no malfunction is found.
- Allow the City access at all times for construction and maintenance of the grinder pump unit and service line running from the unit to the City's sewer main.
- Provide water for cleaning and checking of the pumps.
- Limit the amount of landscaping around the pump system to keep the tank and electrical service easily accessible for maintenance.

City's Responsibilities:

- Upon payment of tap fee, provide the homeowner a tap and installation inspection for connection to the City sewer system.
- Provide the City-approved grinder pump unit, upon purchase, inspect the installation of the initial grinder pump unit, connect such unit to the City sewer system, and maintain the grinder pump unit.
- Allow the homeowner to have the grinder pump unit installed at a location other than where the sewer line exits the house, provided he/she assumes the additional cost incurred to the City for the change.
- Provide a replacement grinder pump unit as may be needed from time to time at no cost to the homeowner, except in the case of negligence or intentional acts. In the case of negligence or intentional acts, City will provide a replacement grinder pump unit with the cost paid by the homeowner. Service will be provided when replacement or repair to the existing unit is necessitated. However, costs arising from negligent or intentional acts by the homeowner or other persons at the home shall be incurred at the homeowner's full expense including a service charge. Operational procedures and guidelines will be provided to each homeowner and negligent or intentional acts will necessitate a repair fee. If homeowner is found to be negligent or intentional, City-approved maintenance fees will apply. This charge will be added to the customer's monthly bill for services.
- Conduct, at no cost to the homeowner, preventative maintenance inspections of each grinder pump unit at least once a year to identify and correct potential future problems and to help extend the life of the pumps. Most corrections relate to adjustments of floats and the dissolving of grease buildup.
- City will be responsible for setting the pump and floats for the grinder pumps, after the contractor/developer/homeowner has installed the piping, electrical, basin, control panels, etc. See attached Grinder Pump Installation Detail in Standard Details.

END OF SECTION

3. BASIS OF MEASUREMENT & PAYMENT

(for Projects Bid out by the city only)

3.1 GENERAL

The Contractor shall furnish all labor, tools, and materials to construct the proposed improvements complete as shown on the Drawings and described in these Specifications. The work shall be measured for payment in accordance with the applicable provisions to these Specifications and payment shall be made on the basis of the unit prices or lump sum prices bid. The sum of the payments for eligible pay items contained in the proposal form shall be the compensation to be paid for the completed project, provided however, that changes in the work covered by written change orders, properly executed, may result in additions or deductions from the Contract price.

The Contractor's attention is called to the fact that although the pay items shown shall be the basis for establishing the Contract price, the description of the pay items does not necessarily reflect the extent of the work to be performed. The cost of incidental work such as clearing and grubbing, trenching, backfilling, testing, etc., which is necessary but which is not specifically listed as one of the pay items, shall be included in the prices bid for the pay items to which the incidental work is most closely related.

3.2 FORCE MAIN & LOW PRESSURE SEWER

Payment for furnishing and installing force main and fittings (including adapters) of the various sizes and types of pipe will be made at the contract unit price per linear foot, complete in place, which shall include compensation for furnishing, hauling, trenching (including rock excavation), bedding, fittings, concrete thrust blocking and anchors for fittings and pipe, laying, jointing, installing marking tape, tracer wire, testing, backfilling, ground restoration (except pavement replacement), disinfecting and clean up. The quantity of force main to be paid for shall be the length of the completed force main measured along its centerline without any deduction for lengths of fittings or valves.

3.3 CASING PIPE (BORE & JACK)

Payment for casing pipe (jack and bore) will be made at the contract unit price per foot. This item includes installing the casing at grade per the drawings and includes end seals. This item does not include the carrier pipe which will be paid additionally.

3.4 CASING PIPE (OPEN CUT)

Payment for casing pipe (open cut) will be made at the contract unit price per foot. This item includes installing the casing at grade per the drawings and includes end seals. This item does not include the carrier pipe which will be paid additionally.

3.5 VALVES

Payment for valves will be made at the contract unit price per each, complete and in place.

3.6 CONNECT TO EXISTING LINE

Payment for connection to existing line will be made at the contract unit price per each, complete and in place.

3.7 ASPHALT RESTORATION

Payment for asphalt restoration will be made at the contract unit price per square yard.

3.8 GRAVEL RESTORATION

Payment for gravel restoration will be made at the contract unit price per square yard.

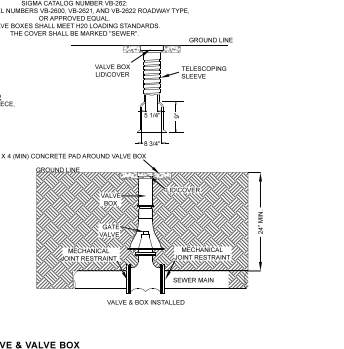
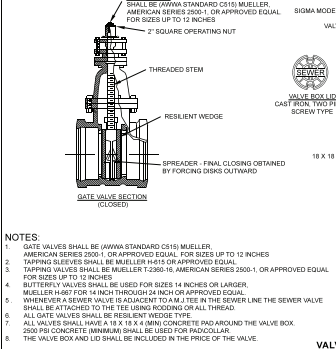
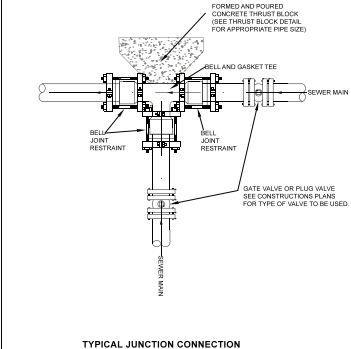
END OF SECTION

4. DETAIL SHEETS

See attached Detail Sheets.

CITY OF CROSSVILLE LOW PRESSURE SEWER GENERAL NOTES:

- PVC PIPE (CLASS 200 PSI) SHALL BE USED UNLESS SPECIFIED OTHERWISE. ALL FITTINGS AND APPURTENANCES INCLUDING SERVICES FOR WATER LINE INSTALLATIONS SHALL HAVE A MINIMUM PRESSURE RATING OF 200 PSI.
- LOW PRESSURE SEWER MAINS SHALL HAVE A MINIMUM OF 24" OF COVER, EXCEPT ON TIGHT RIGHT OF WAY WITH A MINIMUM OF 36" OF COVER IS REQUIRED.
- TRENCH WIDTHS (WHERE THE KICK IS ENCOUNTERED DURING EXCAVATIONS) SHALL BE A MINIMUM OF 27" PLUS THE WIDTH OF THE LOW PRESSURE SEWER MAIN.
- ALL LOW PRESSURE SEWER MAINS (EXCLUDING THOSE IN A CASING) SHALL HAVE A MINIMUM OF 4" OF BEDDING BELOW ON EACH SIDE IN SLOPE (WITH A MINIMUM OF 12" ON EACH SIDE IN ROCK) AND 12" OF BEDDING ABOVE THE SEWER MAIN. ALL BEDDING MATERIAL SHALL BE FREE OF ROCK LARGER THAN 2" DIAMETER AND ORGANIC DEBRIS, AND SHALL BE INSTALLED IN WELL COMPACTED LIFTS. NO ROCK LARGER THAN 1/2" IN DIAMETER SHALL BE USED AS BACKFILL IN THE REMAINDER OF THE TRENCH.
- NEW LOW PRESSURE SEWER MAINS SHALL BE INSTALLED 2" ABOVE ROAD RIGHT OF WAY (TYPICALLY ON AS SHOWN ON PLANS).
- SUBMITTALS FOR APPROVED EQUIPMENT MUST BE PRE-APPROVED IN WRITING BY THE CITY OF CROSSVILLE ENGINEERING DEPARTMENT PRIOR TO INSTALLATION.
- MECHANICAL JOINT TESTMENTS SHALL BE USED ON ALL FITTINGS (UNLESS SPECIFIED OTHERWISE) AND SHALL BE EBAA IRON, INC., MEGALUG SERIES 2000P FOR PVC PIPE AND EBAA IRON, INC., MEGALUG SERIES 1100 FOR DUCTILE IRON PIPE OR APPROVED EQUAL.
- ALL LOW PRESSURE SEWER MAINS AND SEWER SERVICE LINES CROSSING STREETS/ROADS SHALL BE ENCASED UNLESS OTHERWISE SPECIFIED BY THE CITY OF CROSSVILLE ENGINEERING DEPARTMENT. TRACKER WIRE AND LOCATOR TAPE SHALL BE INSTALLED IN EACH STREET 1' ROAD CROSSING WHETHER IT BE A MAIN LINE OR A SERVICE LINE. LOCATOR WIRE SHALL BE PLACED IN THE CASING WITH THE CARRIER PIPE.
- STEEL CASINGS SHALL BE USED IN ALL BORE AND JACK CROSSINGS, AND WHEN THE TOP OF THE CASING PIPE IS LESS THAN 24" BELOW ROAD SURFACE OR WHEN THE CASING SHALL BE INSTALLED GREATER THAN 7' DEEP FROM THE ROAD SURFACE, STEEL CASINGS SHALL HAVE A MINIMUM CLEARANCE OF 2" BETWEEN THE CASING AND THE CARRIER PIPE. SPACERS SHALL BE INSTALLED NO MORE THAN 12" FROM EITHER END OF THE CASING.
- STEEL CASINGS SHALL MEET ASTM A 252, SHALL BE BUTTWELDED COATED INSIDE AND OUT AND SHALL HAVE A MINIMUM YIELD STRENGTH OF 35,000 PSI. THE STEEL CASINGS SHALL ALSO MEET A SHIELD H 20 LOADING REQUIREMENTS.
- TRENCHES SHALL BE OPENED SUFFICIENTLY TO ALLOW INSTALLATION AND REMOVAL OF CARRIER PIPE IN MANUFACTURED LENGTHS FROM EITHER END OF THE CASING PIPE. SPACERS SHALL BE USED IN ALL CASINGS UNLESS OTHERWISE NOTED. WHERE CARRIER PIPE IS 2" OR GREATER, SPACERS SHALL BE A MINIMUM OF 2" APART (OR AS SPECIFIED BY THE MANUFACTURER) AND WITHIN 2' OF EACH BELL WITH A MINIMUM 2" SPACE BETWEEN THE CASING AND THE CARRIER PIPE. CASING SPACERS SHALL BE BWM COMPANY MODEL BWM 52 (STEEL) AND SHALL BE BWM COMPANY MODEL BWM 40 (PVC) MODEL BWM-WP WITH SHIELDING STEEL BARS OR APPROVED EQUAL.
- CASING END SEALS SHALL BE USED AND SHALL BE BWM COMPANY MODEL BWM 40 OR MODEL BWM-WP WITH SHIELDING STEEL BARS OR APPROVED EQUAL.
- THE CONTRACTOR SHALL NOTIFY THE CITY OF CROSSVILLE ENGINEERING DEPARTMENT A MINIMUM OF 24 HOURS IN ADVANCE OF ALL NEW CONSTRUCTION/INSTALLATION WHICH SHALL REQUIRE INSPECTION, SURVEY LOCATION, OR PRESSURE TESTING.



- NOTES:**
- GATE VALVES SHALL BE (PERMANENT STANDARD C911) MUELLER AMERICAN SERIES 2500-1 OR APPROVED EQUAL FOR SIZES UP TO 12 INCHES.
 - TAPPING SLEEVES SHALL BE MUELLER H 405 OR APPROVED EQUAL.
 - TAPPING VALVES SHALL BE MUELLER 1-2500-16, AMERICAN SERIES 2500-1, OR APPROVED EQUAL FOR SIZES UP TO 12 INCHES.
 - BUTTERFLY VALVES SHALL BE USED FOR SIZES 14 INCHES OR LARGER.
 - MUELLER H 405 FOR 14 INCH THROUGH 24 INCH OR APPROVED EQUAL.
 - WHENEVER A SEWER VALVE IS ADJACENT TO A 90° TEE IN THE SEWER LINE THE SEWER VALVE SHALL BE ATTACHED TO THE TEE USING ROAD TEE ALL THREADS.
 - ALL GATE VALVES SHALL BE RESILIENT WEDGE TYPE.
 - ALL VALVES SHALL HAVE A 18 X 18 X 4 (MIN) CONCRETE PAD AROUND THE VALVE BOX.
 - 2500 PSI CONCRETE (MINIMUM) SHALL BE USED FOR PAD/COLLAR.
 - THE VALVE BOX AND LID SHALL BE INCLUDED IN THE PRICE OF THE VALVE.

TYPICAL JUNCTION CONNECTION
NOT TO SCALE

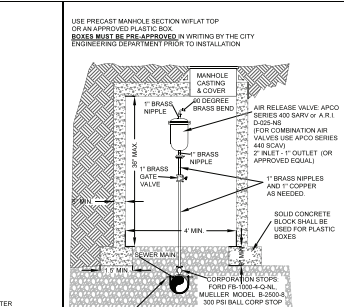
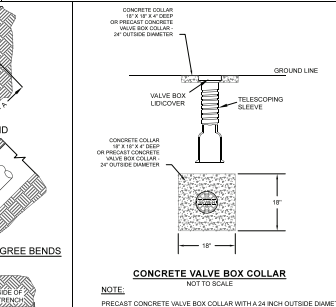
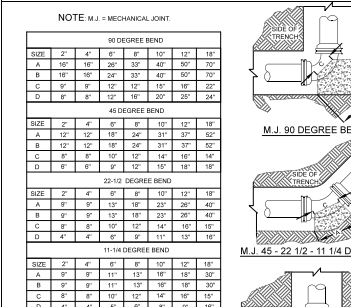
NOTE: M.J. = MECHANICAL JOINT

90 DEGREE BEND	
SIZE	2" 4" 6" 8" 10" 12" 14" 16"
A	10" 16" 20" 24" 40" 50" 70"
B	10" 16" 24" 30" 40" 50" 70"
C	8" 8" 12" 12" 15" 15" 22"
D	8" 8" 12" 12" 15" 15" 22" 24"

45 DEGREE BEND	
SIZE	2" 4" 6" 8" 10" 12" 14" 16"
A	12" 12" 18" 24" 31" 37" 52"
B	12" 12" 18" 24" 31" 37" 52"
C	8" 8" 10" 12" 14" 16" 18"
D	8" 8" 10" 12" 14" 16" 18"

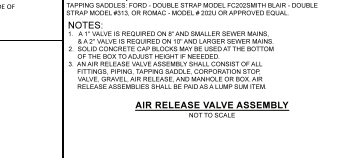
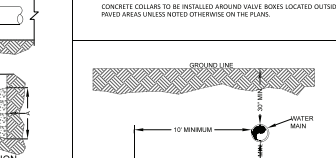
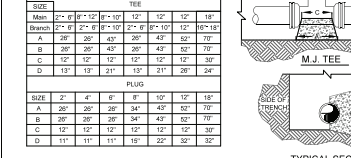
22-1/2 DEGREE BEND	
SIZE	2" 4" 6" 8" 10" 12" 14" 16"
A	8" 8" 12" 12" 15" 15" 20" 40"
B	8" 8" 12" 12" 15" 15" 20" 40"
C	8" 8" 10" 12" 14" 16" 18"
D	8" 8" 10" 12" 14" 16" 18"

11-1/4 DEGREE BEND	
SIZE	2" 4" 6" 8" 10" 12" 14" 16"
A	8" 8" 11" 11" 13" 13" 16" 30"
B	8" 8" 11" 11" 13" 13" 16" 30"
C	8" 8" 10" 12" 14" 16" 18"
D	8" 8" 10" 12" 14" 16" 18"



LOW PRESSURE SEWER PRESSURE TEST:

EACH SECTION OF THE COMPLETED SEWER MAIN EXTENSIONS SHALL BE SUBJECTED TO A PRESSURE TEST. THE SECTION TO BE TESTED SHALL BE VALVED OFF BY GATE VALVES AFTER HAVING BEEN FILLED WITH WATER AND A POSITIVE DISPLACEMENT TEST PUMP SHALL BE USED TO PUMP WATER INTO THE SECTION TO BUILD UP A TEST PRESSURE OF THE GREATER OF 2 TIMES THE WORKING PRESSURE OR 150 PSI. THE TEST PUMP SHALL THEN BE VALVED OFF FROM THE SYSTEM AND THE PRESSURE SHALL BE OBSERVED A MINIMUM OF TWO HOURS. A DROP IN PRESSURE OF 5 PSI OR MORE DURING THE TWO HOUR TEST PERIOD SHALL BE TAKEN AS AN INDICATION OF LEAKAGE. IN THE EVENT LEAKS ARE FOUND AND CORRECTED, THE PRESSURE TEST SHALL BE REPEATED USING THE SAME PROCEDURE AS DESCRIBED.



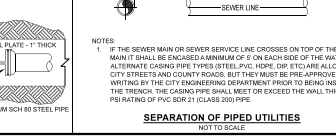
FORCE MAIN SEWER PRESSURE TEST:
THE TESTING PROCEDURE SHALL BE THE SAME AS LOW PRESSURE TESTING, WITH THE EXCEPTION THAT THE TEST PRESSURE SHALL BE 100 PSI.

LOW PRESSURE LINES ACCEPTANCE:
SEWER MAINS AND SERVICES SHALL BE ACCEPTED ONLY AFTER ALL CITY OF CROSSVILLE INSTALLATION AND TESTING REQUIREMENTS HAVE BEEN MET. THE CITY OF CROSSVILLE ENGINEERING DEPARTMENT SHALL VERIFY THAT ALL THE CRITERIA HAS BEEN ACCOMPLISHED FOR THE ACCEPTANCE OF THE SEWER MAINS AND SERVICES BEFORE BEING PLACED INTO THE EXISTING SEWER SYSTEM.

NOTES:

- PIPE AND FITTINGS SHALL BE WRAPPED IN 5 MIL PLASTIC WHERE THURST BLOCKS ARE INSTALLED.
- THURST BLOCKS SHALL BE POURED AGAINST UNDISTURBED EARTH OR ROCK.
- 2500 PSI (MINIMUM) CONCRETE SHALL BE USED FOR THURST BLOCKS.

THRUST BLOCK DETAILS & DIMENSIONS
NOT TO SCALE



SEPARATION OF PIPED UTILITIES
NOT TO SCALE

NOTES:

- IF THE SEWER MAIN OR SEWER SERVICE LINE CROSSES ON TOP OF THE WATER MAIN IT SHALL BE ENCASED A MINIMUM OF 5' ON EACH SIDE OF THE WATER MAIN. ALTERNATE CASING PIPE (VPI, STEEL, PVC, HDPE, OR ETC) ARE ALLOWED ON CITY STREETS AND COUNTY ROADS, BUT THEY MUST BE PRE-APPROVED IN WRITING BY THE CITY ENGINEERING DEPARTMENT PRIOR TO BEING INSTALLED IN THE TRENCH. THE CASING PIPE SHALL MEET OR EXCEED THE WALL THICKNESS AND PSI RATING OF PVC FOR 24" CLASS 200 PIPE.

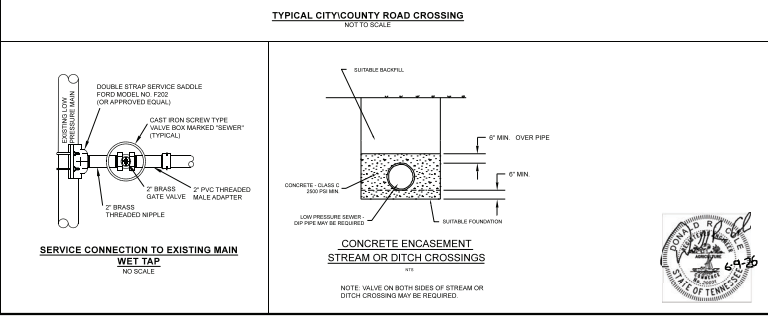
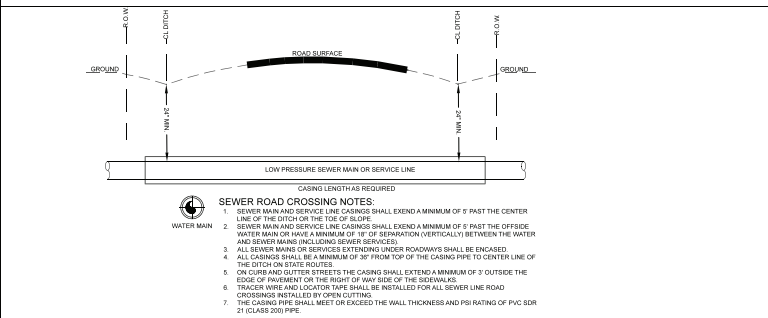
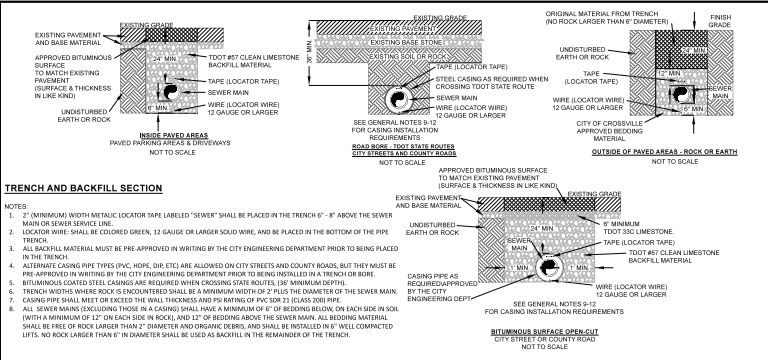
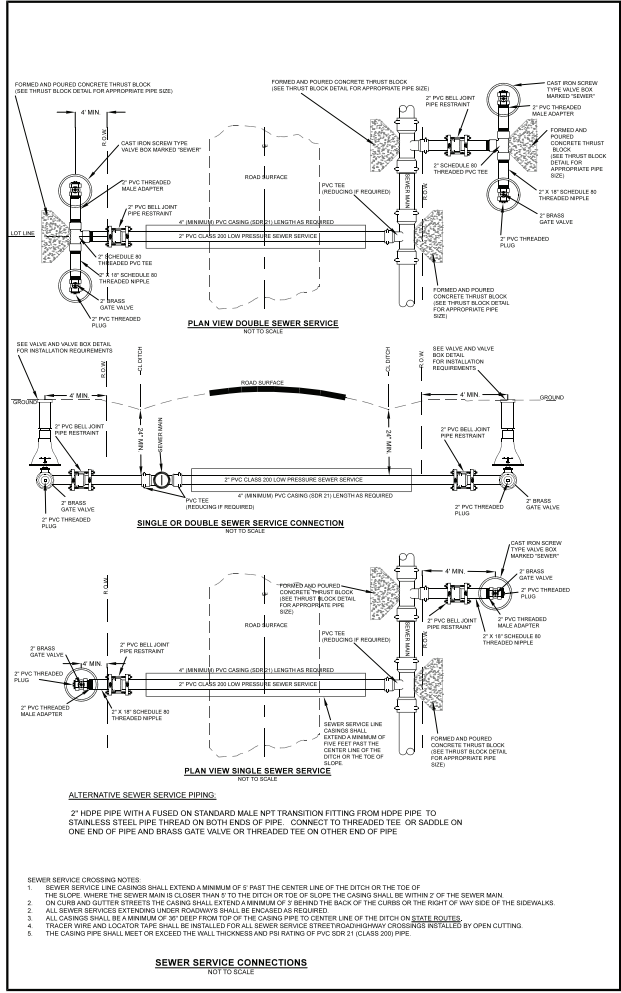
REVISION DESCRIPTION

NO.	DATE	DESCRIPTION

FILE NAME: DETAIL SHEET GRAVITY SEWER
 DRAWN BY: [Signature] CFC
 CHECKED BY: [Signature] CFC
 DATE: PROJECT NO. 42038
 SHEET NO. 1 OF 4
 SHEET TITLE: DETAIL SHEET

APPROVED BY: [Signature] CFC
 TITLE OF ENGINEER: [Signature] CFC
 STATE OF TENNESSEE

DETAIL SHEET
LOW PRESSURE SEWER

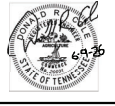


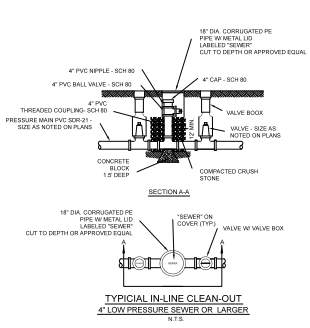
REVISION RECORDATION

NO.	DATE	DESCRIPTION

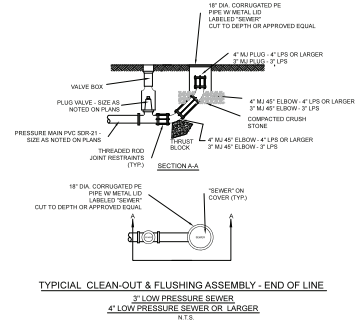
FILE NAME: DETAIL SHEET GRAVITY SEWER
DRAWN BY: [Signature] CPC
CHECKED BY: [Signature] PE
DATE: PROJECT NO. 42035

SHEET NO. 2 OF 4
SHEET TITLE: DETAIL SHEET

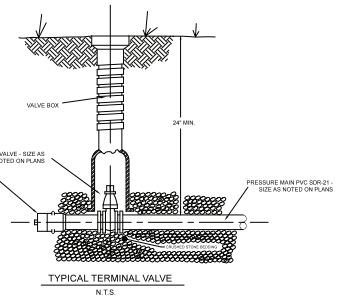




TYPICAL IN-LINE CLEAN-OUT
4" LOW PRESSURE SEWER ON LARGER
N.T.S.

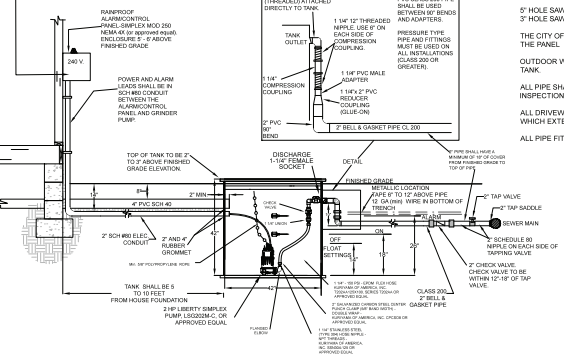


TYPICAL CLEAN-OUT & FLUSHING ASSEMBLY - END OF LINE
3" LOW PRESSURE SEWER
4" LOW PRESSURE SEWER ON LARGER
N.T.S.



TYPICAL TERMINAL VALVE
N.T.S.

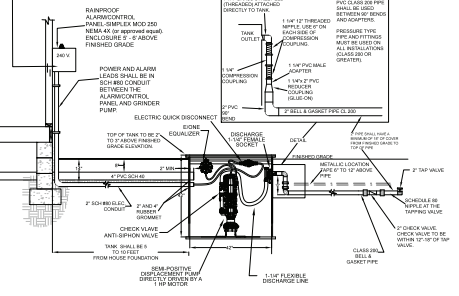
PANEL SHALL BE POWERED BY 10-3 WIRE WITH GROUND AND A 30 AMP 220 BREAKER BETWEEN THE ELECTRIC PANEL AND THE ALARM CONTROL PANEL. ALSO A SEPARATE 15 AMP 120 VOLT POWER SUPPLY FOR A SEPARATE ALARM CIRCUIT SHALL BE INSTALLED.



ALTERNATIVE CONFIGURATION FOR LIBERTY PUMP
TYPICAL GRINDER PUMP INSTALLATION
LIBERTY (2HP) MODEL LSG202M-C

NOTES
ALL ELECTRICAL SHALL MEET STATE ELECTRICAL CODES
5" HOLE SAW NEEDED FOR 4" PVC HOLE
3" HOLE SAW NEEDED FOR 2" PVC CONDUIT HOLE
THE CITY OF CROSSVILLE WILL CONNECT THE WIRES FROM THE PUMP TO THE PANEL
OUTDOOR WATER FACET TO BE AVAILABLE WITHIN 20' OF GRINDER PUMP TANK
ALL PIPE SHALL BE UNCOVERED AND VISIBLE FOR THE PRELIMINARY INSPECTION BY THE CITY REPRESENTATIVE
ALL DRIVEWAY CROSSINGS SHALL HAVE A SCHEDULE 40 - 4" PVC CASING WHICH EXTENDS A MINIMUM OF 2' BEYOND EDGE OF DRIVEWAY.
ALL PIPE FITTING BENDS SHALL HAVE A CONCRETE KICKER

PANEL SHALL BE POWERED BY 10-3 WIRE WITH GROUND AND A 30 AMP 220 BREAKER BETWEEN THE ELECTRIC PANEL AND THE ALARM CONTROL PANEL.



TYPICAL GRINDER PUMP INSTALLATION
E/ONE PUMP OR APPROVED EQUAL

E/ONE EXTREME SERIES GRINDER PUMP OR APPROVED EQUAL
MOTOR 1HP 1725 RPM 240 V, 1 PHASE
DISCHARGE 1.5 gpm at 0' piping 11 gpm at 40' piping 7.8 gpm at 80' piping

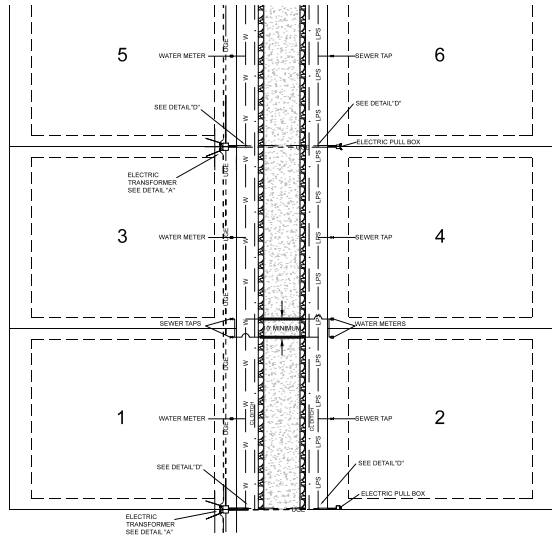


**DETAIL SHEET
LOW PRESSURE SEWER**

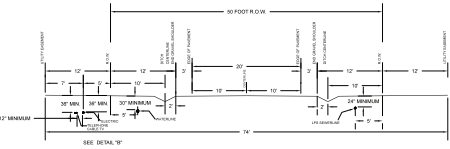
REVISION INFORMATION

FILE NAME:
DETAIL SHEET
GRAVITY SEWER
DRAWN BY: DRC
CHECKED BY: R
DATE: 4/23/05
PROJECT NO.:

SHEET NO.
4 OF 4
SHEET TITLE
DETAIL SHEET

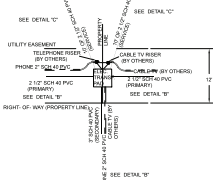


**TYPICAL LOT & UTILITY LAYOUT
WITH UNDERGROUND ELECTRIC
SERVICE**

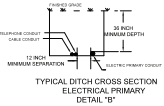


TYPICAL ROAD CROSS SECTION

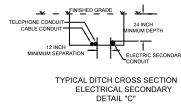
NOTE:
ELECTRIC PRIMARY SHALL BE INSTALLED OFF THE ROAD IN THE UTILITY EASEMENT AND THE
UTILITY DISTRIBUTION SHALL BE INSTALLED ON THE SAME SIDE OF THE ROAD AS THE R.O.W.
WITHIN TEN FOOT SEPARATION FROM THE ELECTRICAL PRIMARY. ALL WATER TAPS ON THIS SIDE OF
THE ROAD SHALL BE INSTALLED IN THE CENTER OF EACH LOT AS SHOWN IN THE OPPOSITE SIDE
OF THE ROAD. THE LOW PRESSURE SEWER SHALL BE INSTALLED IN THE R.O.W. WITH THE TAPS
LOCATION IN THE CENTER OF THE LOT.



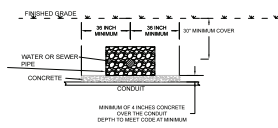
**TYPICAL TRANSFORMER
INSTALLATION DETAIL
DETAIL "A"**



**TYPICAL DITCH CROSS SECTION
ELECTRICAL PRIMARY
DETAIL "B"**



**TYPICAL DITCH CROSS SECTION
ELECTRICAL SECONDARY
DETAIL "C"**



**TYPICAL TRENCH CROSS SECTION
CONDUIT AND UTILITY LINE CROSSING
DETAIL "D"**

MINIMUM OF 6 INCHES OF
BEDDING SHALL BE INSTALLED
BETWEEN THE TOP OF THE
CONCRETE AND THE BOTTOM OF
THE PIPE AND A MINIMUM OF 4
FOOT OF BEDDING ON EACH SIDE
AND TOP OF THE PIPE

MINIMUM OF 4 INCHES CONCRETE
DEPTH TO BEE COVER MINIMUM

GRAVITY SEWER

Table of Contents

GRAVITY SEWER	3
1. GENERAL REQUIREMENTS	3
1.1 SCOPE OF WORK	3
1.2 STANDARDS/DEFINITIONS	3
1.3 WORK INCIDENTAL TO CONSTRUCTION	4
1.4 MATERIAL AND EQUIPMENT	8
1.5 SPECIAL CONDITIONS	9
1.6 TESTING	9
1.7 SUBMITTALS.....	10
1.8 TEMPORARY FACILITIES/UTILITIES	10
1.9 WARRANTY	10
1.10 PROJECT CLOSE-OUT	11
2. PRODUCTS	12
2.1 SCOPE	12
2.2 DUCTILE IRON PIPE	12
2.3 DUCTILE IRON FITTINGS.....	17
2.4 POLYVINYL CHLORIDE (PVC) PLASTIC PIPE	18
2.5 POLYVINYL CHLORIDE PLASTIC (PVC) FITTINGS	18
2.6 MECHANICAL JOINT FITTING RESTRAINT DEVICES	19
2.7 FLEXIBLE EXPANSION JOINT	20
2.8 UTILITY WARNING TAPE	21
2.9 SEWER MANHOLES	21
2.10 CASING PIPE	24
2.11 CONCRETE CLASSIFICATIONS	28
2.12 SHORING, SHEETING, AND BRACING	28
2.13 SURVEYING AND FIELD ENGINEERING.....	29
2.14 EXCAVATION FOR GRAVITY SEWERS.....	31
2.15 INSTALLATION OF GRAVITY SEWERS	32
2.16 BACKFILLING	36
2.17 STANDARD PRE-CAST CONCRETE MANHOLES	38
2.18 MANHOLE RINGS AND COVERS.....	39
2.19 RUBBER ADJUSTMENT RISERS FOR INCLINES	39
2.20 DROP MANHOLE ASSEMBLIES	39
2.21 STUBOUTS FOR FUTURE USE.....	40
2.22 CONNECTIONS TO EXISTING LINES	40
2.23 SETTLEMENT OF TRENCHES	41
2.24 BITUMINOUS CONCRETE HIGHWAY, STREET & DRIVEWAY.....	41
2.25 PORTLAND CEMENT CONCRETE HIGHWAY, STREET & DRIVEWAY REPLACEMENT ...	42
2.26 UNPAVED DRIVEWAYS.....	42
2.27 EXISTING FACILITIES	42

2.28	SEEDING	43
2.29	TESTING OF GRAVITY SEWERS	43
2.30	VISUAL INSPECTION OF MISCELLANEOUS MATERIALS	47
2.31	DEFLECTION TESTING FOR PVC AND HDPE PIPE	47
2.32	CLEANUP	48
3.	BASIS OF MEASUREMENT & PAYMENT	49
3.1	GENERAL	49
3.2	GRAVITY SEWER	49
3.3	SEWER MANHOLES	49
3.4	CASING PIPE (BORE & JACK)	50
3.5	CASING PIPE (OPEN CUT)	50
3.6	CONNECT TO EXISTING LINE	50
3.7	ASPHALT RESTORATION	50
3.8	GRAVEL RESTORATION	50
4.	DETAIL SHEETS	51

GRAVITY SEWER

1. GENERAL REQUIREMENTS

1.1 SCOPE OF WORK

The gravity sewer and appurtenances required on this Contract shall be furnished in compliance with the Contract Specifications and the Contract Drawings.

Work to be performed under the Unit Price Items described subsequently herein shall include for each item all excavation (including rock excavation, if any) the removal of existing pavements, curb and gutter, sidewalks, driveways, brush and timber, structures and piping to be relocated or abandoned; also sheeting, diking, well pointing, bailing, dewatering; the furnishing and placing of bulkheads, the restoration of any utilities, parkways, trees, shrubbery, culverts, fences and any other items not covered under subsequent items disturbed by construction operations; backfilling and removal of excess excavated materials; and testing.

The cost of all such work and the cost of other work necessary for the complete sewer main installation not specifically included for payment under the item of unit price payment Nos. described herein shall be merged with the various unit prices for the Unit Price Construction Items.

1.2 STANDARDS/DEFINITIONS

Where material and methods are indicated in the Specifications as being in conformance with the standard specification, it shall refer in all cases to the latest edition of the Specifications and shall include all interim revisions. Listing of a standard specification without further reference indicates that the particular material or method shall conform to such listed specification.

The following are industry abbreviations for metal and plastic materials:

1. DIP: Ductile Iron Pipe
2. PVC: Polyvinyl Chloride
3. HDPE: High Density Polyethylene

Buried piping shall be of the bell and spigot, butt fusion, or electrofusion type.

Non-buried piping shall have flanged ends, unless otherwise noted on the Drawings.

1.3 WORK INCIDENTAL TO CONSTRUCTION

- A. Work to be performed under this heading includes all the work designated as "Incidental to Construction" and shall be done in compliance with the Contract Drawings. The Contractor is hereby referred to the Agreement, General and Special Conditions, Sections of these Specifications and the Contract Drawings. All work herein there are not specified pay items shall be considered "Incidental to Construction" and no additional compensation will be allowed.
- B. In addition to the above-referenced requirements, and unless otherwise noted below, listed work shall be considered incidental to construction.
- C. Public and Private Utilities

Utilities Where any utilities, such as water, sewer, telephone, power, oil and gas transmission or any other, either public or private are encountered, the Contractor shall provide adequate protection for them and will be held responsible for any damage to such utility from his operations. When it is apparent that construction operations may endanger the foundation of any utility conduit, pole, or the support of any structure, the Contractor shall notify the utility owner of this possibility and shall take steps as may be required to provide temporary bracing or support of conduits, poles or structures.

The cost of any bracing or support of conduits, poles or structures as shown on the Contract Drawings shall be merged into the unit price per linear foot of gravity sewer. The Contractor shall be reimbursed for the bracing or supporting of utilities due to the realignments of the gravity sewer to meet field conditions. Any realignment which eliminates any bracing or supporting necessary according to the Contract Drawings shall be credited to the Owner by the Contractor.

When in order to carry out the work, a pole (power or telephone) must be removed to a new location or moved and replaced after construction, the Contractor shall arrange for the moving of such pole or poles and lines thereof.

Where it is the policy of any utility owner to make his own repairs to damaged conduit or other structures, the Contractor shall cooperate to the fullest extent with the utility owner and shall see his operations interfere as little as possible with the utility owner's operations.

- D. Existing Water, Sewer and Drain Facilities. In some instances, existing water, sewer, or drains may be encountered along the line of work. In all such cases, the Contractor shall perform his operations in such manner that such service will not be interrupted and shall, at his own expense, make all temporary provisions to maintain such services. Where it is necessary to cut, remove and/or replace existing storm sewers and drain tiles, the Contractor shall make specific arrangements to maintain the flow of sewer and shall not place permanent bulkheads in any conduit. Temporary earth dams may be used to confine and/or channel the flow and shall be removed upon completion of the crossing.

The Contractor shall receive no extra compensation for replacement of sewers or drains encountered and for re-laying same at a new grade or line.

- E. Existing Sewer Facilities. Where existing sewer mains are encountered in the work, they shall be maintained in operation.

- F. Dewatering

The Contractor shall perform all pumping, well pointing, ditching or any other necessary procedure to keep excavation clear of groundwater, storm water, or sewage during the progress of the work until the completed work is safe from injury.

The Contractor shall maintain dewatering operations such that no groundwater, storm water, or sewage will be allowed to build up over any

concrete and/or masonry at manholes or structures for a period of 6 hours. This time period will be adjusted by the Engineer should temperature and curing conditions warrant.

All water pumped or drained from the work shall be disposed of in a manner satisfactory to the Engineer without damage to adjacent property or to other work under construction. The Contractor shall not dispose of storm or surface water through new or existing sanitary sewerage facilities.

It shall be the Contractor's responsibility to take all necessary precautions to protect all construction against flooding and/or floatation from hydrostatic uplift.

All dewatering procedures and maintenance thereof shall be considered an integral part of pipe laying and sewer main construction operations and no separate payment will be allowed therefore.

Dewatering operations for manhole and/or structure construction shall be such that the groundwater or surface water is not being pulled over, around, or through the freshly placed concrete or masonry. The use of multiple pumps placed on each side of the manhole and/or at points in the trench downstream might be required. When required to protect the freshly placed concrete and/or masonry, timber or plywood forms will be positioned around the concrete or masonry so that the dewatering operations will not cause a separation of cement and aggregate. The cost of these dewatering and/or protection procedures shall be merged into the appropriate manhole or structure bid items.

G. Barricades and Warning Signs

The Contractor shall furnish, erect, and maintain such barricades, fences, lights, and danger signals and take other precaution measures that will ensure the protection of persons, property, and the work.

Traffic control devices shall meet the requirements of the “Manual of Uniformed Traffic Control Devices” (MUTCD).

H. Maintenance and Access of Traffic

Portions of the work are located in developed areas requiring the access for fire and other departments to be provided for and at least one free lane shall be available for all traffic. Contractors are to arrange operations in these areas to meet these requirements and secure operating procedures from the City of Crossville, Tennessee, Tennessee Department of Transportation, Cumberland County Road Commission, or as the case may be.

Where sewer mains are constructed under paved roadway surfaces within public right-of-way, the Contractor will restore the asphalt or crushed stone pavement and/or shoulder between shoulder lines. It shall be the responsibility of the Contractor, upon completion of the sewer main installation, to regrade the street with flowable fill to the template that existed prior to construction. This regrading shall be satisfactory to the City of Crossville (Department of Public Works) before the street is released for paving operations.

The Contractor shall further be responsible for the maintenance of disturbed streets until repaving operations have been completed.

The Contractor shall restore all curbs, gutters, sidewalks, ramps and private driveways, or parking lots. Compensation for this work is detailed in other portions of this document and any item must be removed as was evidence and necessary for the installation of the proposed sewer main, for which there is no specific pay item(s), shall be considered as incidental to the construction of the proposed sewer and therefore, no additional compensation will be allowed for the restoration of this (these) item(s).

The Contractor shall also be required to restore, at his own expense, all pavements disturbed by his operations where the sewer main was not

constructed under pavements. He shall further be required to replace at his own expense all pavements disturbed in the connection of sewer and/or force main deficiency discovered after restorations have been completed.

I. Erosion & Sediment Control

The Contractor is responsible for erosion and sediment control on the project. The Contractor shall use the Tennessee Erosion Prevention and Sediment Control Handbook as a technical guide for construction best management practices to prevent, minimize, and treat sediment-laden stormwater discharges during construction.

A TDEC NPDES Stormwater Permit may be required for the project. If so, the CONTRACTOR will be required to sign the NOI and Stormwater Pollution Prevention Plan (SWPPP). A TDEC ARAP Permit may also be required for the project. **The CONTRACTOR shall be required to adhere to the terms and requirements of the stormwater permit and/or ARAP permit if required for the project.**

The Contractor shall adhere to the stormwater regulations and the stormwater ordinance of the City of Crossville when working within the city limits.

J. Project Engineer Responsibility

Project Engineer attached to the sewer project must provide sealed engineering plans and hydraulic calculations for approval by the city and TDEC, and prior to construction of the project.

1.4 MATERIAL AND EQUIPMENT

Materials, equipment, and products shall be properly containerized, packaged, boxed, and protected to prevent damage during transportation and handling.

Provide suitable, temporary weather-tight storage facilities as may be required for materials or equipment which will be damaged by storage in the open.

Protect from damage all materials delivered at the site. Do not use damaged material on the work.

Manufactured articles, materials and equipment shall be applied, installed, connected, erected, used, cleaned, and conditioned as directed by the respected manufactures unless directed otherwise by the provisions of these Specifications

1.5 SPECIAL CONDITIONS

- A. The Contractor shall perform his work in such a manner that normal service on existing sewer lines and service to customers is maintained to the maximum extent possible. Such service shall be disrupted at such times and in such a manner as approved by the Engineer.
- B. The Contractor shall submit a work schedule to the Engineer for approval prior to beginning work. The schedule shall establish the planned sequence of line installation, service switch-over if required, and property restoration for the project.
- C. The Contractor shall maintain access to businesses and residences to the maximum extent possible.
- D. Easement Restrictions – The Contractor, upon request, will be furnished with plans showing easements obtained for the construction of sewer mains and appurtenances. The Contractor shall exercise due care in staying within the easement indicated and will be held strictly accountable for violations thereof. Any desired access points no shown on the drawings must be acquired by the Contractor by negotiation with the property owner involved.

1.6 TESTING

The Specifications for Materials designate the testing applicable for materials incorporated in the work. Testing shall be done by the manufacturer in accordance with the applicable ASTM specification. Manufacturer shall furnish the Engineer three (3) certified copies of the test results.

The Owner may, at his option, elect to have an independent testing laboratory test materials to be furnished for incorporation in the work. Such testing, when done, shall be in accordance with provisions of the Specifications for Materials.

Acceptance testing for installed sewer line will be limited to visual testing and pressure testing unless otherwise directed by the Engineer.

1.7 SUBMITTALS

Submittals for this work include: pipe supplier, with information on pipe to be used, including the joint design, recommended laying methods and material testing reports; manufacture's data on valves, valve boxes, fire hydrants, and any necessary equipment for complete installation. Such submittals are to be made for approval by the Engineer prior to incorporation of any materials into the work.

1.8 TEMPORARY FACILITIES/UTILITIES

Contractor shall be required to maintain suitable sanitary facilities for his workers.

1.9 WARRANTY

The work to be performed under this Contract shall be guaranteed against defects in materials or workmanship for a period of one year following the date of formal acceptance of the project. In the event defects in materials or workmanship should appear, the Contractor shall promptly make the necessary correction. When the defects are not of an emergency nature, the Contractor will be notified and shall be given a period of two weeks in which to make the necessary

corrections. Should the defect be of an emergency nature, which in the opinion of the Owner or the Engineer requires immediate correction, the Contractor will be notified and requested to make the necessary repairs immediately. Should this be impractical, or if the Contractor should fail to respond to the request for corrective action within the specified period, the Owner may proceed to have the defects corrected and shall bill the Contractor for all charges in connection therewith including labor, materials and equipment rental. Such charges may be deducted from amounts due the Contractor if any of the Contractor's money has been withheld. In the event the Contractor fails, refuses, or neglects to pay the Owner, the Surety shall be liable for such charges.

1.10 PROJECT CLOSE-OUT

The premise of the job site shall be maintained in a reasonable neat and orderly condition and kept free from an accumulation of waste materials and rubbish during the entire construction period. Remove crates, cartons and other flammable waste materials or trash from the work areas at the end of each working day.

When the Contractor requests a final inspection, the Engineer will inspect the work for completeness in accordance with the Contract Documents. Any deficiencies shall be promptly corrected by the Contractor.

Final acceptance cannot be made until the Contractor furnished to the Owner a notarized certification in a form suitable to the Owner that all labor and material costs for the work have been paid by the Contractor and there are no liens against the work.

Payment in full of the Final Application for Payment shall constitute acceptance of the work by the Owner subject to conditions of the Contract Documents.

END OF SECTION

2. PRODUCTS

2.1 SCOPE

The work to be accomplished under this section of the specifications consists of the furnishing of ALL labor, materials, equipment, and services necessary for the construction of a gravity sewer line as shown on the drawings and more fully described hereinafter.

2.2 DUCTILE IRON PIPE

- A. Ductile iron pipe shall conform to the requirements of ANSI 21.151/AWWA C151 latest revision for ductile iron pipe centrifugally cast in metal or sand-lined molds. It shall be made and tested in accordance with ASTM A536, latest revision.
- B. The design thickness shall be that specified by ANSI A21.50/AWWA C150 latest revision except that all pipe with a diameter of 12 inches or less shall be Pressure Class 350 and all pipe with a diameter 14 inches or greater shall be Pressure Class 250 unless determined otherwise by the Owner or Engineer.
- C. Coatings and Lining:
 - 1. Pipe shall be lined with thin cement as specified in ANSI A21.4/AWWA C104. In addition, an asphaltic coat approximately 1 mil thick shall be applied to the cement lining in accordance with the pipe manufacturer's standard practices. The outside coating shall be an asphaltic coating approximately 1 mil thick in accordance with ANSI A21.51/AWWA C151.
 - 2. Protecto 401: The interior of ductile iron pipe and fittings shall have an epoxy coating meeting the following requirements:
 - a. Condition of Items Prior to Surface Preparation: All ductile iron pipe and fittings shall be delivered to the application facility without asphalt, cement lining, or any other lining on the interior surface. Because removal of old linings may not be possible, the intent of this specification is that the entire interior of the ductile iron pipe (DIP) and fittings shall not have been lined with any substance prior to the application of the specified lining material and no coating shall have been applied to the first six inches of the exterior of the spigot ends.
 - b. Lining Material: The standard of quality is Protecto 401 Ceramic Epoxy. The material shall be an amine cured novalac epoxy containing at least 20% by volume of ceramic quartz pigment. Any request for substitution must be accompanied by a successful history of lining pipe and fittings for sewer service, a test report verifying the following properties, and a

certification of the test results.

- 1) A permeability rating of 0.00 when tested according to Method A of ASTM E-96-66, Procedure A with a test duration of 30 days.
- 2) The following test must be run on coupons from factory lined ductile iron pipe:
 - a) ASTM B-117 Salt Spray (scribed panel) – Results to equal 0.0 undercutting after two (2) years.
 - b) ASTM G-95 Cathodic Disbondment 1.5 volts at 77 degrees F. Results to equal no more than 0.5mm undercutting after 30 days.
 - c) Immersion Testing rated using ASTM D-714-87.
 - 20% Sulfuric Acid – No effect after two (2) years.
 - 25% Sodium Hydroxide – No effect after two (2) years.
 - 160 degrees F Distilled Water – No effect after two (2) years.
 - 120 degrees F Tap Water (scribed panel) – 0.0 undercutting after two (2) years with no effect.
 - d) An abrasion resistance of no more than 4 mils (0.10mm) loss after one million cycles – European Standard EN 598: 1994 Section 7.8 Abrasion Resistance.

c. Application:

- 1) Applicator: The lining shall be applied by a competent firm with a successful history of applying linings to the interior of ductile iron pipe and fittings.
- 2) Surface Preparation: Prior to abrasive blasting, the entire area to receive the protective compound shall be inspected for oil, grease, etc. Any areas - where oil, grease, or any substance which can be removed by solvent is present - shall be solvent cleaned using the guidelines outlined in DIPRA-1 Solvent Cleaning. After the surface has been made free of grease, oil, or other substances, all areas to receive the protective compounds shall be abrasive blasted using compressed air nozzles with sand or grit abrasive media. The entire surface to be lined shall be struck with the blast media so that all rust, loose oxides, etc. are removed from the surface. Only slight stains and tightly adhering annealing oxide may be left on the surface. Any area where rust reappears before lining must be reblasted.
- 3) Lining: After the surface preparation and within 8 hours of surface preparation, the interior of the pipe shall receive 40 mils nominal dry film thickness of Protecto 401. No lining shall take place when the substrate or ambient temperature is below 40 degrees Fahrenheit. The surface also must be dry and dust free. If flange pipe or fittings are included in the project, the lining shall not be used on the face of the flange.
- 4) Coating of the Bell Sockets and Spigot Ends: Due to the tolerances involved, the gasket area and spigot end, up to 6

inches back from the end of the spigot end, must be coated with 6 mils nominal, 10 mils maximum, of Protecto Joint Compound. The Joint Compound shall be applied by brush to ensure coverage. Care should be taken that the Joint Compound is smooth without excess buildup in the gasket seat or on the spigot ends. Coating of the gasket seat and spigot ends shall be done after the application of the lining.

5) Number of Coats: The number of coats of lining material applied shall be as recommended by the lining manufacturer. However, in no case shall this material be applied above the dry thickness per coat recommended by the lining manufacturer in printed literature. The maximum or minimum time between coats shall be that time recommended by the lining material manufacturer. No material shall be used for lining which is not indefinitely recoatable with itself without roughening of the surface.

6) Touch-Up & Repair: Protecto Joint Compound shall be used for touch-up or repair in accordance with manufacturer's recommendations.

d. Inspection and Certification:

1) Inspection:

a) All ductile iron pipe and fitting linings shall be checked for thickness using a magnetic film thickness gage. The thickness testing shall be done using the method outlined in SSPC-PA-2 Film Thickness Rating.

b) The interior lining of all pipe barrels and fittings shall be tested for pinholes with a non-destructive 2,500 volt test. Any defects found shall be repaired prior to shipment.

c) Each pipe joint and fitting shall be marked with the date of application of the lining system along with its numerical sequence of application on that date – with records maintained by the applicator.

2) Certification: The pipe or fitting manufacturer must supply a certificate attesting to the fact that the applicator met the requirements of this specification, and that the material was as specified.

e. Handling: Protecto 401 lined pipe and fittings must be handled only from the outside of the pipe and fittings. No forks, chains, straps, hooks, etc. shall be placed inside the pipe and fittings for the lifting, positioning, or laying.

D. The bell of each pipe shall have a tapered annular opening and a cast or machined retaining groove for the gasket. The gasket shall have a flared design so that maximum deflection will be provided. The plain spigot end of the pipe shall be beveled in order to simplify its entry into and centering within the bell and compression of the gasket.

E. Gaskets:

1. Gaskets shall be Styrene Butadiene Copolymer (SBR) or Ethylene Propylene Diene Monomer (EPDM) in accordance with ANSI A21.11/AWWA C111, latest revision made in the form of a solid ring to exact dimensions.
 - a. Push-on Joint Gaskets: The design of the gasket groove in the bell of the pipe and the design, hardness, and other properties of the gasket itself shall be such that the joint is liquid tight for all pressures from a vacuum to a maximum rating of 350 psi of internal liquid pressures.
 - 1) Manufacturer / Model:
 - a) American Ductile Iron Pipe "Fastite,"
 - b) U.S. Pipe "Tyton," or
 - c) Approved equal.
 - d)
 - b. Push-on Restrained Joint Gaskets: Restrained pipe and fittings are as shown on the Drawings. Retainer glands and similar devices will not be allowed unless otherwise noted or shown on the Drawings or approved by the Engineer. Push-on joint restraint shall be incorporated in the design of the pipe bell and gasket. The restraint shall be provided by the wedging action developed between pairs of hardened high-strength, stainless steel elements spaced around the gasket. The push-on restrained joint shall be rated for 250 psi working pressure.
 - 1) Manufacturer / Model:
 - a) American Ductile Iron Pipe "Fast-Grip" (for pipe sizes 24-inch and less),
 - b) U.S. Pipe "Field Lok" Gaskets (for pipe sizes 24-inch and less),
 - c) American Ductile Iron Pipe "Flex-Ring" (for pipe sizes 30 and 36 inch),
 - d) American Ductile Iron Pipe "Lok-Ring" (for pipe sizes greater than 46 inches),
 - e) U.S. Pipe "TR Flex" (for pipe sizes 24-inch and larger), or
 - f) Approved equal.
 - g)
 2. Lubricant: Lubricant shall be furnished with each order to provide for the proper installation of the pipe supplied with said order. This lubricant shall be nontoxic, impart no taste or smell to the water, and have no harmful effect on the rubber gasket. It shall have a consistency that will allow it to be easily applied to the pipe in either hot or cold weather and that will enable it to adhere to either wet or dry pipe.
- F. Welded-on Outlets:
1. Welded-on outlets shall be limited to branch outlets having a nominal diameter less than 70 percent of the nominal diameter of the main line pipe or 30-inch whichever is smaller as shown in the following table.

Main Line Nominal Diameter	Branch Outlet Nominal Diameter
10 inch	6 inch
12 inch	8 inch
14 inch	8 inch
16 inch	10 inch
18 inch	12 inch
20 inch	14 inch
24 inch	16 inch
30 inch	20 inch
36 inch	24 inch
42 inch	30 inch
48 inch	30 inch
54 inch	30 inch

2. Parent pipe and branch outlet candidate pipe shall be centrifugally cast ductile iron designed in accordance with ANSI A21.50/AWWA C150 and manufactured in accordance with ANSI A21.51/AWWA C151. Minimum classes shall be: for sizes 4-inch through 54-inch, Special thickness Class 53; for sizes 60-inch through 64-inch, Pressure Class 350.
3. Welded-on outlets may be provided as a radial tee outlet, tangential outlet, or lateral outlet fabricated at a specific angle to the main line pipe in 1 degree increments between 45 degrees and 90 degrees from the axis of the main line pipe as shown on the Drawings.
4. All welded-on outlets shall be rated for a working pressure of 250 psi and must have a minimum safety factor of 2.0 based on proof of design hydrostatic test results.
5. The joints on welded-on branch shall meet, where applicable, the requirements of ANSI A21.11/AWWA C111 and/or ANSI A21.15/AWWA C115. The joint materials (glands, gaskets, and studs) shall be furnished where applicable.
6. Weldment for welded-on outlets shall be based on the method described in Section VIII of the ASME Unfired Pressure Vessel Code. Reinforcing welds shall be placed using Ni-Rod 55 cored wire or Ni-Rod 55 electrodes manufactured by INCO Alloys (or an electrode with equivalent performance properties). Carbon Steel electrodes are not acceptable.
7. Prior to the application of any coating or lining in the outlet area all weldments for branch outlets to be supplied on this project shall be subjected to an air pressure test of at least 15 psi. Air leakage is not acceptable. Any leakage shall be detected by applying an appropriate soapy water solution to the entire exterior surface of the weldment and adjoining pipe edges or by immersing the entire area in a vessel of water and visually inspecting the weld surface for the presence of air bubbles. Any weldment that shows signs of visible leakage shall be repaired and retested in accordance with the manufacturer's written procedures.
8. Welded-on outlets shall be fabricated by the pipe manufacturer at the

same facility where the pipe is produced. The pipe manufacturer shall have a minimum of 5 years of experience in the fabrication and testing of outlets of similar size and configuration.

9. The manufacturer shall have a fully documented welding quality assurance system and maintain resident quality assurance records based on ANSI/AWS D11.2, the Guide for Welding Iron Castings. The manufacturer shall maintain appropriate welding procedure specifications (WPS), procedure qualification (PQR), and welder performance qualification test (WPQR) records as well as appropriate air test logs documenting air leakage tests.
10. Manufacturer:
 - a. American Ductile Iron Pipe,
 - b. Griffin Pipe Products,
 - c. McWane,
 - d. U.S. Pipe, or
 - e. Approved equal.

2.3 DUCTILE IRON FITTINGS

- A. Standard and special fittings shall be Pressure Class 350 ductile iron. Use standard mechanical joint fittings. All fittings shall conform to the specifications of ANSI A21.10/AWWA C110 (Full Body) or ANSI A21.53/AWWA C153 (Compact), latest revisions.
- B. All buried fittings shall be push-on or mechanical joint. Non-buried fittings shall be flanged unless otherwise shown on Drawings or directed by the Engineer. Where flanged pipe is shown, no substitution of a Uni-Flange type joint will be used without prior approval of the Engineer. Where push-on joint fittings are used, the fittings must be rodded to an anchor (i.e. dead-man, valve, etc.), have a mechanical joint fitting restraining device, or push-on restrained joint gasket.
- C. Coatings and Lining:
 1. Cement/Asphalt Fittings: Shall be lined with cement as specified in ANSI A21.4/AWWA C104. In addition, an asphaltic coat approximately 1 mil thick shall be applied to the cement lining in accordance with the pipe manufacturer's standard practices. The outside coating shall be an asphaltic coating approximately 1 mil thick in accordance with ANSI A21.51/AWWA C151.
 2. Protecto 401: Coating shall be in accordance with 2.1.C.2 of this specification section.
- D. Manufacturer:
 1. Tyler/Union,
 2. American Ductile Iron pipe, or
 3. Approved equal.

2.4 POLYVINYL CHLORIDE (PVC) PLASTIC PIPE

- A. PVC plastic pipe shall conform to the latest edition of ASTM Specification – D3034 for 4" through 15" diameter pipe, ASTM Specification F679 for 18" through 27" diameter pipe, AWWA C900, and/or AWWA C905, as appropriate; Standard Dimension Ratios (SDR); Maximum Length – 14 feet; made from Class 12454 B polyvinyl chloride plastic as defined in ASTM D 1784.
- B. Joints shall be integral bell and spigot type joints conforming to ASTM D-3212. Elastomeric gasket shall conform to the requirements of ASTM F-477. Gaskets shall be part of a complete pipe section and purchased as such. Lubricant shall be as recommended by the pipe or fitting manufacturer.
- C. PVC pipe shall have the following SDR and pipe stiffness ratings unless specified otherwise:

SDR	Pipe Stiffness (psi)
26	115

- D. PVC plastic pipe for service laterals shall be SDR 26 conforming to ASTM D-3034.
- E. Marking: PVC pipe shall be clearly marked at 5-foot intervals with the following:
 - 1. Manufacturer's name or trademark and code.
 - 2. Nominal pipe size.
 - 3. PVC cell classification, 12454 B.
 - 4. SDR 26 PVC sewer pipe.
 - 5. ASTM D 3034.
- F. Manufacturer:
 - 1. Diamond,
 - 2. Vulcan Plastic Corporation,
 - 3. North American Pipe Corporation, or
 - 4. Approved equal

2.5 POLYVINYL CHLORIDE PLASTIC (PVC) FITTINGS

- A. Unless otherwise noted on the Drawings, all fittings shall be ductile iron and PVC for sewer taps

- B. PVC fittings shall be constructed of the same plastic material and have the same minimum pressure rating as the pipe being connected. The fittings shall be the molded type or machined from extruded stock.
- C. PVC fittings, adaptors, or appurtenances shall be furnished, as required, to connect the plastic pipe to cast or ductile iron valves, fittings, and pipe.

2.6 MECHANICAL JOINT FITTING RESTRAINT DEVICES

- A. Ductile Iron Pipe Restraint Devices:
 - 1. Restraint devices for nominal pipe sizes 3 inch through 48 inch shall consist of multiple gripping wedges incorporated into a follower gland meeting the applicable requirements of ANSI/AWWA C110/A21.10. Restraint device shall have torque limiting twist-off nuts.
 - 2. Restraint devices shall have a working pressure rating of 350 psi for 3 through 16 inch and 250 psi for 18 through 48 inch. Ratings are for water pressure and must include a minimum safety factor of 2 to 1 in all sizes.
 - 3. Gland body, wedges and wedge actuating components shall be cast from grade 65-45-12 ductile iron material in accordance with ASTM A536.
 - 4. Manufacturer / Model:
 - a. EBAA Iron Inc. Megalug Series 1100, or
 - b. Approved equal.
- B. Polyvinyl Chloride Pipe Restraint Devices:
 - 1. Restraint devices shall consist of multiple gripping wedges incorporated into a follower gland meeting the applicable requirements of ANSI/AWWA C111/A21.11. Restraint device shall have torque limiting twist-off nuts.
 - 2. The devices shall have a working pressure rating equal to that of the pipe on which it is used. Ratings are for water pressure and must include a minimum safety factor of 2 to 1 in all sizes.
 - 3. Gland body, wedges and wedge actuating components shall be cast from grade 65-45-12 ductile iron material in accordance with ASTM A536.
 - 4. Manufacturer / Model:
 - a. EBAA Iron, Inc. Megalug Series 2000PV, or
 - b. Approved equal.
- C. Plain End to Plain End Pipe Restraint Device:
 - 1. Joint restraint to prevent axial separation shall be incorporated into the design of the sleeve or coupling used to connect two plain ends of same or dissimilar materials, such as ductile iron pipe, steel pipe, PVC pipe (C900, C905, or ASTM D2241) and or high density polyethylene (HDPE) pipe.
 - 2. To prevent movement causing fitting to slide or rotate, internal pipe wall stiffeners must be used. The stiffeners must be sized to encompass the entire bearing length of the restraint devices.
 - 3. Restraint devices shall consist of multiple gripping wedges incorporated

into a follower gland. Restraint device shall have torque limiting twist-off nuts.

4. The coupling sleeve shall be coated internally with a minimum of 15mils of fusion bonded epoxy conforming to the applicable requirements of ANSI/AWWA C213.
5. Ductile Iron components shall meet or exceed the requirements of ASTM A536.
6. The restrained joining system shall meet the applicable requirements of AWWA C219, ANSI/AWWA C111/A21.11, and ASTM D2000.
7. Manufacturer / Model:
 - a. EBAA Iron, Inc. Series 3800, or
 - b. Approved equal.

2.7 FLEXIBLE EXPANSION JOINT

- A. Flexible expansion joints shall be installed in the locations indicated on the Drawings. Flexible expansion joints shall be cast from grade 65-45-12 ductile iron conforming to the material requirements of ASTM A536 and ANSI/AWWA C153/A21.53.
- B. Each flexible expansion joint shall be pressure tested at the factory against its own restraint to a minimum of 350 psi (250 psi for 30" diameter and larger.) A minimum 2:1 safety factor shall apply.
- C. Each flexible expansion joint shall consist of an expansion joint designed and cast as an integral part of a ball and socket type flexible joint, having a minimum per ball deflection of: 20 degrees, 3 inch – 12 inch; 15 degrees, 14 inch – 36 inch; 12 degrees, 48 inch and 4-inches minimum expansion. Additional expansion sleeves shall be available and easily added or removed at the factory or in the field. Both standardized mechanical joint and flange end connections shall be available.
- D. All internal surfaces (wetted parts) shall be lined with a minimum of 15 mils of fusion bonded epoxy conforming to the applicable requirements of ANSI/AWWA C213. Sealing gaskets shall be constructed of EPDM. The coating and gaskets shall meet ANSI/NSF-61.
- E. All external surfaces shall be coated with a catalyzed coal tar epoxy conforming to the material requirements of AWWA C210. Appropriately sized polyethylene sleeves, meeting ANSI/AWWA C105/A21.5, shall be included for direct buried applications.
- F. Manufacturer / Model:
 1. EBAA Iron, Inc. FLEX-TEND, or
 2. Approved equal.

2.8 UTILITY WARNING TAPE

- A. Detectable underground utility warning tape, which can be located from the surface by a pipe detector, shall have of a minimum thickness of 0.35 mils solid aluminum foil encased in a protective inert plastic jacket that is impervious to all known alkalis, acid, chemical reagents and solvents found in the soil. The tape shall have a minimum overall thickness of 5.0 mils and a minimum width of 3 inches with a minimum unit weight of 2-1/2 pounds/ 1 inch x 1,000 foot. The tape shall be color coded green in accordance with APWA National Color Code and permanently imprinted "Buried Sewer Line Below" and located approximately 12 inches above the sewer pipe.
- B. Manufacturer / Model:
 - 1. Allen Systems, "Detect Tape",
 - 2. Empire Level Mfg. Corp., "Magnatec", or
 - 3. Approved equal.

2.9 SEWER MANHOLES

- A. PRECAST CONCRETE MANHOLES
 - 1. AASHTO M-199 SR or ASTM C-478.
 - 2. Resilient pipe connectors shall be manufactured in accordance with ASTM C923 and shall consist of a durable rubber boot. Boots shall be cast in the manhole to provide for the required number and size pipes and shall be marked to insure installation at proper locations.
 - 3. Flexible plastic sealant for joints in precast manhole sections, grade rings and castings shall provide permanently flexible watertight joints, shall remain workable over a wide temperature range, and shall not shrink, harden, or oxidize upon aging. Material shall be butyl resin sealant ConSeal CS-102 or CS-202 as manufactured by Concrete Sealants, Inc. of New Carlisle, Ohio, RUB'R-NEK L-T-M manufactured by K. T. Snyder Co., Inc. of Houston, Texas, or other approved equal. A minimum of two (2) strips of joint sealant shall be required at each joint and shall conform to AASHTO M198B. Rubber gaskets conforming to the physical properties of ASTM C443 may be used in lieu of butyl sealant.
 - 4. Manholes shall be coated by the manufacturer with two coats of asphaltic water proofing with the coats applied at 90 degree angles to each other, or the concrete shall have a waterproofing admixture, such as Xypex or AKIM so that the finished product absorbs less than one percent water.

5. Unless otherwise specified, all manholes shall have an inside diameter of not less than 4 feet and a vertical wall height of not less than 2.5 feet.
6. The clear opening in the manhole shall not be less than 2 feet.

B. MANHOLE STEPS

1. ASTM C-478.
2. Manhole steps shall be nonskid injection molded copolymer polypropylene plastic encapsulating a one-half (1/2") inch diameter grade sixty (60) steel reinforcing rod as manufactured by M.A. Industries, Inc., Peachtree City, Georgia or Press-Seal Gasket Corp., Fort Wayne, Indiana, or approved equal.
3. Spacing of approximately twelve (12"max) inches between steps, and shall comply with OSHA subpart D "Fixed Ladders" section 1910-27 and/or ASTM C478 Precast Reinforced Concrete Manhole Sections.
4. Manhole steps shall be corrosion resistant, free from sharp edges, burrs, or other projections that may be a safety hazard and shall be of sufficient strength to be a live load of 300 pounds imposed at any point.
5. The minimum width of cleat shall be 12".
6. The legs and struts shall be of sufficient length for the cleat to project a minimum clear distance of 4" from the wall when the step is securely imbedded in the manhole wall.
7. The top surface of the cleats shall be designed to prevent foot slippage.

C. PIPE ENTRANCE COUPLINGS FOR MANHOLES

1. Resilient pipe connectors shall be manufactured in accordance with ASTM C923 and shall consist of a durable rubber boot which shall be clamped securely to the cutout in the manhole wall and to the pipe by means of stainless steel clamps or bands. Or, a compression ring gasket cast in to the manhole wall, pipe is inserted and held by compression. (A-LOK) Resilient connectors shall be as manufactured by the NPC INC, KOR-N-SEAL Co. of Milford, New Hampshire, Press-Seal Gasket Corp., PRESS-BOOT of Fort Wayne, Indiana, A-LOK Products of Tullytown, PA, or approved equal.

D. MANHOLE VACUUM TESTING

1. All manholes shall be negative air pressure (vacuum) tested in accordance with ASTM C1244.
2. The complete manhole including the frame and cover assembly shall be installed prior to testing. The testing system shall be equipped with an

inflatable bladder to effect the seal to the manhole, an air pressure gauge, a safety valve for filling the bladder, a 30-inch Hg liquid-filled vacuum gauge, a double air exhaust manifold with quarter turn ball valves, three bolt-on feet, and a bridge assembly with height adjustment rod.

3. The CONTRACTOR shall plug all pipe openings, taking care to securely brace the plugs and the pipe. The plugs shall be placed a minimum of 6" beyond the manhole wall.
4. The vacuum tester shall be placed on the manhole casting and operated in accordance with the manufacture's recommendation to evacuate the manhole to 10" Hg and monitor the vacuum for the specified time period. If the vacuum does not drop in excess of 1" Hg over the specified time period, the manhole is considered acceptable and passes the test. If the manhole fails the test, identify the leaking areas by removing the head assembly, coating the interior surfaces of the manhole with a soap and water solution, and repeating the vacuum test for approximately thirty seconds. Once the leaks have been identified, complete all necessary repairs with an OWNER approved method, and repeat test procedures until satisfactory results are obtained.
5. Upon the approval of the OWNER, the CONTRACTOR may test manholes 72- inches and greater in diameter at a reduced negative pressure.
6. The OWNER reserves the right to reject any and all manholes that do not pass vacuum testing requirements, and replacement shall be at the CONTRACTOR's expense.

VACUUM TEST TIMETABLE						
Manhole Diameter - Inches						
Depth - Feet	48"		60"		72"	
4'	10	sec.	13	sec.	16	sec.
6'	15	sec.	20	sec.	25	sec.
8'	20	sec.	26	sec.	32	sec.
10'	25	sec.	33	sec.	41	sec.
12'	30	sec.	39	sec.	48	sec.
14'	35	sec.	46	sec.	57	sec.
16'	40	sec.	52	sec.	64	sec.
18'	45	sec.	59	sec.	73	sec.
20'	50	sec.	65	sec.	80	sec.
22'	55	sec.	72	sec.	89	sec.
24'	60	sec.	78	sec.	97	sec.
26'	64	sec.	85	sec.	105	sec.
28'	69	sec.	91	sec.	113	sec.
30'	74	sec.	98	sec.	121	sec.

2.10 CASING PIPE

A. SCOPE

1. The Work to be performed herein shall consist of the installation of a casing pipe for the purpose of installing a carrier pipe as shown on the drawings or as called for in these specifications. It shall include the excavation of a boring pit, auger boring between the points specified on the drawings, or as directed by the OWNER, installation of the carrier pipe, and disposing of the excavated materials in the manner herein provided.

B. STEEL CASING PIPE

Material for casing pipe used in highway or railroad crossings shall be steel conforming to ASTM A139, Grade B. Minimum yield strength shall be 35,000 psi unless otherwise noted. Nominal casing diameter shall be as indicated on the Plans. Joints shall be continuously welded. Casing pipe and joints shall be leakproof and capable of withstanding Cooper E-80 loading. Casing pipe shall be coated as specified herein.

The minimum wall thickness of casing pipe shall be as shown in the table below.

Nominal Diameter (Inches)	Minimum Wall Thickness (Inches)	
	With Coating	Without Coating
Under 14	0.188	0.251
14 and 16	0.219	0.282
18	0.250	0.313
20	0.281	0.344
22	0.312	0.375
24	0.344	0.407

26	0.375	0.438
28 and 30	0.406	0.469
32	0.438	0.501
34 and 36	0.469	0.532
38, 40, 42	0.500	0.563
54	0.500	0.563

All steel casing pipe installed below ground shall be coated with a bituminous coating inside and out.

C. BITUMEN COATING

1. Bituminous Coating – Bituminous Coating shall be an asphalt type bitumen conforming to TDOT Standard Specifications.
2. Primer – Primer shall conform to the requirements of AASHTO M116.
3. All surfaces to be coated with bitumen shall be dry and thoroughly cleaned of dust and loose materials. No primer or bitumen shall be applied in wet weather, nor when the temperature is below 50°F.
4. Application of the primer coat shall be with a brush or other approved means and in a manner to thoroughly coat the surface with a continuous film of primer. The purpose of the primer is to provide a suitable bond of the bitumen coating to the steel. The primer shall completely dry through before the bituminous coating is applied.
5. Bitumen shall be applied uniformly at a temperature of not less than 300°F, not more than 350°F and shall be applied either by mopping, brushing, or spraying. The bituminous coating shall be applied to a minimum thickness of 60 mils.
6. If splices are required, no coating shall be applied for 12” on either side of the splice location. After splicing has been completed, the uncoated area shall be coated with bituminous material in accordance with the requirements of this specification.
7. Bitumen coated casings shall be stored, protected from sunlight and heat. Coatings shall not be exposed to damage during storage, hauling, or handling. The use of steel cables wrapped around the coated part of the pile will not be permitted. The Contractor shall take appropriate measures to preserve and maintain the bituminous coating. At the time of installation, the bituminous coating shall have the minimum thickness of 60 mils.

D. CARRIER PIPE

1. The carrier pipe shall be the same material as the pipeline unless otherwise directed by the OWNER
2. All carrier pipes shall be restrained joint in the casing.

E. CASING SPACERS

Casing spacers shall be utilized on PVC and ductile iron carrier pipe. Casing spacers to be centered restrained and shall be BWM Company Model BWM-SS-8 (Stainless Steel) for up to 24 inch diameters and Model BWM-SS-12 (Stainless Steel) for larger sizes or approved equal.

F. CASING END SEALS

Casing End Seals on all carrier pipes shall be BWM Company Model BWM-PO or BWM-WR with stainless steel bands or approved equal.

G. INSTALLATION OF CARRIER PIPE (See Figure 1-02445-a)

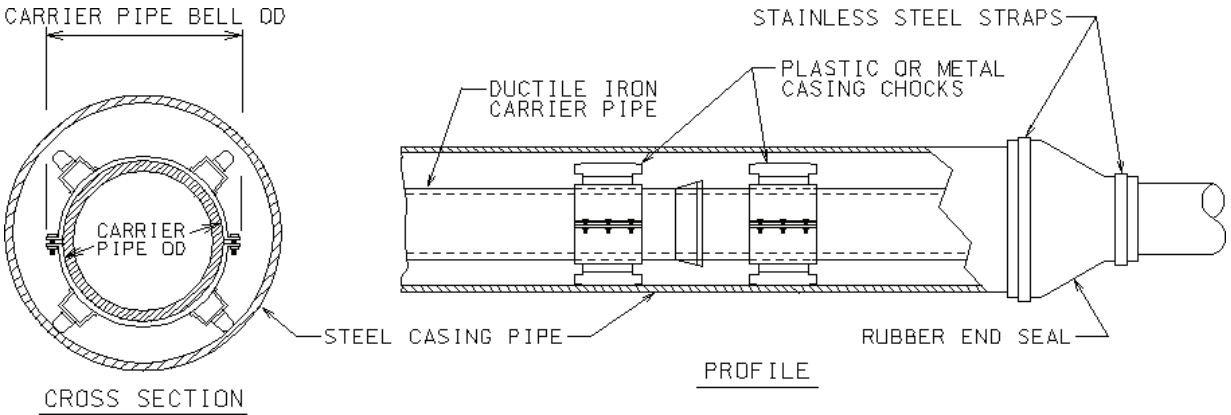
Entire length of casing shall be installed complete and inspected and approved by OWNER before any carrier pipe is placed therein. Repair defects in casing pipe or leakage at joints.

Install a minimum of three casing spacers to each length of carrier pipe in such a manner that electrical continuity will not occur between casing pipe and carrier pipe. Spans between spacers shall be as shown on Drawings or as directed by the OWNER.

Check each joint makeup and pipe segment prior to pushing carrier pipe segments into casing.

When the carrier pipe is a ductile iron or PVC pressure pipe install restrained joint pipe or mechanical joint with restrainers, unless otherwise directed by OWNER.

Casing end seals shall be provided at the end of the casing pipe after installation of the carrier pipe.



2.11 CONCRETE CLASSIFICATIONS

Class A

Structural Concrete: Unless otherwise specified and shown on the Plans, all concrete shall be Structural.

Coarse Aggregates—sizes as follows: Size No. 57—Structural Concrete.

Minimum Compressive Strength: 28 day, 4000 psi.

Slump: 4 inches, +/- 1/2 inch for mass concrete and heavy reinforced section; 2 to 4 inches for slabs, columns, girders, walls, etc. High range plasticizer: 7 inches, +/- 1/2 inch.

Class B

Concrete (Base and Pavement):

Fine Aggregate: do not use sand manufactured from limestone for traffic lane pavements.

Coarse Aggregate: Size No. 467.

Minimum Compressive Strength: 28 day, 3500 psi.

Slump: 2 inches, +/- 1/2 inch, workable consistency.

Class C

Incidental Concrete: Use for anchors, kickers, encasement for pipelines, subfoundations, mass footings, and fill, unless otherwise specified.

Coarse Aggregate: Size No. 57.

Minimum Compressive Strength: 28 day, 3000 psi.

Slump: 7 inches, +/- 1/2 inch for pipe encasements, and 4 inches, +/- 1/2 inch in sub foundations and other specified areas.

2.12 SHORING, SHEETING, AND BRACING

The contractor shall furnish and install all temporary sheeting, shoring, and bracing required to maintain the excavation in a safe working condition and to permit the safe and efficient installation of all items of contract work, and to protect the workers in accordance with Federal and State safety requirements.

Sheeting, shoring, and bracing shall be used in wet, saturated or flowing ground, ground subject to slides, cave-ins, settlement or movement, and/or locations

shown on the contract drawings.

Where excavations are made adjacent to existing buildings or other structures or in paved streets or alleys, the contractor shall take particular care to sheet, shore, and brace the sides of the excavation adequately so as to prevent any undermining or settlement beneath such structures shall be done when necessary and reviewed by the Engineer.

All sheeting, shoring, and bracing shall have sufficient strength and rigidity to withstand the pressure exerted and to maintain the wall of the excavation in place.

Lumber used may be any species which will satisfactorily withstand driving. It shall be sawed with square corners, and shall be free from worm holes, loose knots, wind shakes, decay, and unsound portion which might impair its strength. Minimum thickness shall be 2-inch nominal. Lumber shall be No. 2 common yard lumber in less than 6-inch size and common structural grade on timber 6 inches and over. Steel sheet piling of an approved design and type may be used.

Sheeting, shoring, and bracing shall not be left in place unless shown on the contract drawings or necessary for the safety and protection of new or existing work.

The sheeting, shoring, and bracing shall be removed as the work progresses in such a manner as to prevent caving in of the sides of the excavation, or damage to the new or existing work. While sheeting, shoring, and bracing are being removed, all voids left shall be filled and compacted. The contractor may elect to use a portable steel box in lieu of the above if approved by the Engineer.

All sheeting, shoring, and bracing shall be considered an integral part of the excavation work and NO separate payment will be allowed.

2.13 SURVEYING AND FIELD ENGINEERING

- A. The Contractor shall employ a surveyor registered in the State of Tennessee and acceptable to the Engineer to establish the horizontal alignment of the sewer line. The surveyor shall also establish the vertical alignment of the sewer line and the ground elevation along the route of the sewer line and prepare cut sheets.
- B. Prior to the commencement of trench excavation, the Contractor shall prepare and submit to the Engineer for review six (6) copies of detailed Cut

Sheets showing the beginning and ending manholes of each segment including invert elevation; the distance between manholes; the angle between all inlet and outlet pipes at each manhole; the ground elevation; the pipe invert; the grade, size and type of line; the depth of cut between the existing ground, and the invert of the gravity sewer line. The maximum distance between surveyed points along the alignment shall be 50 feet and shall include abrupt grade changes such as ditches. All expenses for the preparation of Cut Sheets shall be borne by the Contractor and be included in the unit price bid per foot of pipe.

1. Cut Sheets must be reviewed and approved by the Engineer in writing before trenching operations may be permitted. It shall be the responsibility of the Contractor to prepare Cut Sheets in advance of his anticipated trenching schedule. The information on the approved Cut Sheets will be the basis for payment for construction of the sewer line.
- C. On request of the Engineer, the Contractor shall submit documentation verifying accuracy of survey work.
- D. Survey control points for horizontal and vertical benchmarks have been established and are shown on the Drawings.
- E. The locations and accuracy of all survey control points shall be verified by the Contractor (base lines and benchmarks) prior to starting work. The Contractor shall promptly notify the Engineer of any discrepancies before proceeding with the Work.
- F. The Contractor shall protect control points prior to starting site work and preserve permanent reference points during construction.
- G. The Contractor shall provide field engineering services using recognized engineering survey practices.
- H. The Contractor shall establish elevations, lines, and levels for:
 1. Site improvements including stakes for grading, access roadway survey, fill and cut, utility locations, and slopes and inverts.
 2. Grids for structure location.
- I. Pipeline installation: The Contractor shall be responsible for setting all grade stakes, lines and levels and preparation of cut sheets. The Contractor shall provide level, level rod and tripod on the job site at all times for the purpose of checking grades as deemed necessary by the Engineer.
- J. The Contractor shall survey the as-constructed invert elevations and top of cover elevations of all manholes and wetwells and provide that information to the Engineer. Coordinates and station numbers of all manholes shall be provided to the Engineer as part of the as-construction information. The construction will not be considered complete and the Project will not be closed until this requirement has been fulfilled.

2.14 EXCAVATION FOR GRAVITY SEWERS

- A. Unclassified excavation for pipelines shall consist of the excavation necessary for the construction of sewer lines and their appurtenances (including manholes, collars, concrete saddles, and pipe protection) that are called for by the drawings. It shall include clearing and grubbing where necessary, backfilling and tamping pipe trenches and around structures, and disposing of waste materials, all of which shall conform to the applicable provisions set forth elsewhere in these specifications.
- B. Unless the construction of lines by tunneling or boring is called for by the drawings or specifically authorized by the Engineer, make excavation for pipelines in open cut and true to the lines and grades shown on the drawings or established by the Engineer on the ground. Cut the banks of trenches between vertical parallel planes equidistant from the pipe centerline. The horizontal distance between the vertical planes (or, if sheeting is used, between the inside faces of that sheeting) shall vary with the size of the pipe to be installed, but shall not be more than the distance determined by the following formula: $4/3d + 15$ inches, where "d" represents the internal diameter of the pipe in inches. When approved in writing by the Engineer, the banks of trenches from the ground surface down to a depth not closer than 1 foot above the top of the pipe may be excavated to non-vertical and nonparallel planes, provided the excavation below that depth is made with vertical and parallel sides equidistant from the pipe centerline in accordance with the formula given above. Any cut made in excess of the formula $4/3d + 15$ inches shall be at the expense of the Contractor and may be cause for the Engineer to require that stronger pipe and/or a higher class of bedding be used at no cost to the Owner.
- C. If material unstable or unsuitable in the opinion of the Engineer is present in a trench, the Contractor may be required to remove the material and construct a firm foundation for the pipe. The trench bottom shall be constructed to the required elevation with TDOT No. 7 or No. 57 crushed stone.
- D. For all pipes provide a minimum 6 inches of TDOT No. 7 or No. 57 crushed stone for bedding.
- E. Do not excavate pipe trenches more than 400 feet ahead of the pipe installation, and not more than 400 feet of open ditch shall be left behind the pipe installation, and perform all work so as to cause the least possible inconvenience to the public. Construct temporary bridges or crossing when and where the Engineer deems necessary to maintain vehicular or pedestrian traffic.
- F. In all cases where materials are deposited along open trenches, place them

so that in the event of rain no damage will result to the work and/or to adjacent property.

2.15 INSTALLATION OF GRAVITY SEWERS

- A. All pipe installation shall be in the presence of the Engineer's Representative.
- B. Before placing sewer pipe in position in the trench, carefully prepare the bottom and sides of the trench, and install any necessary bracing and sheeting as required in this Specification.
- C. Wherever necessary to provide satisfactory bearing surface, place concrete cradles as shown on the drawings or as required by the Engineer. Cradles shall be of concrete and conform to the dimensions shown on the drawings. Concrete placed outside the dimensions shown shall be at the Contractor's expense.
- D. Lasers shall be used to establish the alignment and grade of the sewer line. When lasers are used, set reference points for both line and grade at each manhole. Where grades are 0.6 percent or less, check the elevation of the beam each 100 feet with an offset point or engineer's level.
- E. Do not allow water to run or stand in the trench while the installation of pipe is in progress or before the trench has been backfilled. Do not at any time open up more trench than the available pumping facilities are able to dewater.
- F. Correct trench bottoms found to be unsuitable for foundations after pipe installation operations have started by bringing them to exact line and grade with crushed stone as necessary.
- G. Carefully inspect each piece of pipe and special fitting before it is placed, and install no defective pipe in the trench. Pipe installation shall proceed upgrade, starting at the lower end of the grade and with the bell ends pointing upgrade. When pipe installation is not in progress, keep the ends of the pipe tightly closed with an approved temporary plug.
- H. Bell holes shall be large enough to allow ample room for the pipe joints to be properly made. Carefully grade bottom of the trench between bell holes so each pipe barrel rests on a solid foundation for its entire length. Install each pipe joint so as to form a close concentric joint with adjoining pipe and to avoid sudden offsets or inequalities in the flow line.
- I. Before constructing or placing any joints, demonstrate to the Engineer, by completing at least one sample joint, that the methods to be used conform to the specifications and will provide a watertight joint and further that the

workmen to be involved in this phase of work are thoroughly familiar and experienced with the type of joint proposed.

- J. No other type of joint may be used unless authorized in writing by the Engineer.
- K. Jointing:
 - 1. Clean ends of pipe, bell interior, and coupling components before jointing.
 - 2. Apply joint lubricant to pipe ends, bell interior, and elastomeric seals of coupling. Use only lubricants approved by the pipe manufacturer.
 - 3. Use suitable equipment and end protection to push or pull the pipes and/or couplings together. Do not exceed forces recommended by the pipe and coupling manufacturers.
- L. Install wye-tee branches in sewer lines to serve properly each lot facing or abutting on the street or alley in which sewer is being installed at such other locations as may be designated by the Engineer. If wye-tee branches are not to be used immediately, close them with approved plugs that are held in place to prevent infiltration and withstand all test requirements.
- M. For all wye-tees that are plugged and installed in rock, blast a minimum of six linear feet of ditch line in the direction and to the approximate grade of the future lateral as required by the Engineer, but do not excavate the material. This shall be done at no extra cost to the Owner. Furnish the Engineer with a record of the exact location of each tee installed.
- N. If the work consists of constructing a new sewer to replace an existing one, connect existing service lines to the new line. Sewer service piping size to match existing pipe size with a 4 inch minimum pipe size.
- O. Typical 4-inch schedule 40 PVC sewer service clean-outs shall be installed as per Standard Details. The clean-out consists of a 4"x 4" schedule 40 PVC clean-out double sweep tee. The 4-inch plug or cap shall be contained in a meter type or valve box.
- P. Valve boxes used in traffic areas are to be made of pre-cast concrete sections measuring 11"x13-1/4" inside dimensions and 17"x19-1/4" outside dimensions with the height of 12 to 15 inches. Reinforcement shall be placed and shall conform to the requirements of ASTM A-15 and ASTM A-305 for intermediate grade or approved equal. The cover shall be marked "SEWER".
- Q. Valve boxes for cleanouts used in non-traffic areas are to be made of injection molded of structural foam polyolefin. The **NDS Standard Series 10" Round Valve Box** or approved equal is to be used for all sewer laterals in non-traffic areas.
- R. All PVC sewer service line extensions on this project shall be with 6" ASTM

D-3034 (SDR 26) PVC pipe material. The Contractor shall install an SDR 26 PVC pipe material to Schedule 40 PVC pipe material reducer coupling immediately before the 4" schedule 40 PVC clean-out double sweep tee to transition to Schedule 40 PVC service pipe.

- S. The minimum grade on service pipes shall be one percent or 1/8" per foot. (1/4" per foot preferred) for 6" sewer service lines. The minimum grade on service pipes shall be two percent or 1/4" per foot for 4" sewer service lines.
- T. As the work progresses, thoroughly clean the interior of the pipe in place. After each piece of pipe has been installed, carefully inspect it, and remove all earth, trash, rags, and other foreign matter from its interior.
- U. After the joints have been completed, they shall be inspected by the Engineer before being covered. The pipe shall meet the test requirements for water-tightness; immediately repair any leak or defect discovered in the pipeline. Any pipe that has been disturbed after joints were formed shall be taken up, the joints cleaned and remade, and the pipe re-installed at the Contractor's expense. Carefully protect all pipes in place from damage until backfilling operations are completed.
- V. Do not begin the backfilling of trenches until the pipe in place has been inspected and approved by the Engineer.
- W. Line Separation:

When sewer lines are to be constructed near water lines, horizontal and vertical separation shall be maintained in accordance with the following guidelines:

Parallel Installations

1. For parallel installations, line separation is to be at least 10 feet edge to edge. If this cannot be obtained, the top of the sewer line shall be at least 18 inches below the bottom of the water line.
2. If this condition is also unobtainable, the sewer line is to be constructed of materials and have a joint design equivalent to water main standards as approved by the Utility Department and the approved Standard Water Specifications and Details, and shall be pressure tested in accordance with the requirements for water mains approved by the Utility Department and the approved Standard Water Specifications and Details to assure water tightness.

Crossing Installations

1. Where the water line crosses house sewers, storm sewers, or sanitary sewers, a separation of at least 18 inches shall be provided between the bottom of the water line and the top of the sewer.

2. Sewers lines passing over or under water lines without the vertical separation shall be shall be constructed of materials, and have a joint design equivalent to water main standards as approved by the Utility Department and the approved Standard Water Specifications and Details, and shall be pressure tested in accordance with the requirements for water mains approved by the Utility Department and the approved Standard Water Specifications and Details to assure water tightness.
3. Water mains passing under sewers shall be protected (in addition to the above sewer line construction) by providing:
 - a. at least 18 inches between the bottom of the sewer and the top of the water line;
 - b. adequate structural support to prevent excessive joint deflection or damage to the water line when crossing a gravity or storm sewer; Install the water line in a steel casing to prevent excessive joint deflection or damage to the water line if crossing a gravity sewer or storm sewer. Center up the steel casing on the crossing and extend in both direction a minimum of five feet or as shown on the approved plans.
 - c. adequate structural support to prevent excessive joint deflection or damage to the water line when crossing a force main or low pressure sewer; Install the force main or low pressure sewer line in a PVC casing pipe to prevent excessive joint deflection or damage to the water line if crossing a gravity sewer or storm sewer. Center up the PVC casing on the crossing and extend in both direction a minimum of five feet or as shown on approved plans. The PVC casing pipe shall be equivalent to water main standards as approved by the Utility Department.
 - d. centering of the water line section to result in the water line joints being removed from the sewer line to the maximum possible extent.

No water line shall pass through or come into contact with any part of a sewer or sewer manhole.

- X. The Contractor shall be responsible for determination of active services. No payment shall be made for reconnection of inactive services unless approved by the Owner. Damages or fines resulting from failure to reconnect any active service(s) shall be the Contractor's responsibility. If the Contractor renews an inactive service that is not approved, the Contractor shall make a point repair by excavation or shall apply an approved internal patch to repair the cut-in hole. The Contractor shall make the necessary repairs at no cost to the Owner.
- Y. Make sewer service connections to all existing sewer lines as shown on the drawings or as required by the Engineer. Make connections either by removing a section of the sewer from the existing line and inserting a wye -

tee branch of the proper size or by constructing a manhole as shown on the drawings.

- Z. Make sewer service connections to new sewer lines by installing sewer connection tee-wyes concurrent with the construction of the sewer lines. The location of the service tee-wye shall be as per the plans or determined in the field by the Engineer or Owner.
- AA. Make connections to existing manholes or inlets by core drilling a hole in the wall of the existing structure, installing a Kor-N-Seal or approved equal connector, inserting a length of sewer pipe into the hole. Shape or reshape bottom of the manholes as necessary to fit the invert of the sewer pipe.
- BB. Joint dissimilar pipe by using suitable compression couplings. If compression couplings are not available, make jointing with a special fabricated coupling approved by the Engineer.
- CC. Provide concrete protection or concrete cap as shown on the drawings for sewers that, when completed, have less than 2.5 feet of covering in non-traffic areas and 4 feet of cover in traffic areas. If such protection is not shown on the drawings, place it in accordance with the typical section shown on the plans. Concrete protection or concrete cap shall be a minimum 6 inches thick for non-traffic areas and a minimum 12 inches thick for traffic areas.
- DD. Carefully protect from damage all existing sewers, water lines, gas lines, sidewalks, curbs, gutters, pavements, electrical lines, and other utilities or structures in the vicinity of the work at all times. If it is necessary to repair, remove, and/or replace any such utility or structure in order to complete the work properly, do so in compliance with the provisions set forth in other section of these specifications or as required by the owner of the appropriate utility. Any such work shall be considered incidental to the construction of sewer lines, and no additional payment will be allowed therefor.
 - 1. Water service connections shall be repaired or replaced by the Contractor at his expense as an incidental part of the work.
 - 2. Service or house connections to existing sewers that are damaged or removed shall be repaired or replaced by the Contractor at his own expense as an incidental part of the work.

2.16 BACKFILLING

- A. The trench cross section shown on the Drawings and ASTM D 2321 describing the bedding, haunching and initial backfill shall be filled with TDOT No. No. 57 OR No. 7 crushed stone from 6-inches below the pipe to 12-inches above the pipe. The crushed stone shall conform to the quality requirements in ASTM D 692 and the gradation of TDOT Specification Subsection 903.22. Thoroughly and completely tamp each layer into place

before placing additional layers. The requirements are the same for all pipe materials installed.

- B. Unpaved Areas: Backfilling the area of the trench described as final backfill on the Drawings and ASTM D 2321 shall be filled with material excavated from the trench unless the material is not approved for backfill by the Engineer. Use special care to prevent backfilling operations or equipment from causing any damage to the pipe.
- C. Paved Areas: Backfilling the area of the trench described as backfill on the Drawings and ASTM 2321 shall be filled with TDOT No. No. 57 or No. 7 crushed stone conforming to the quality requirements in ASTM D 692 and the gradation of TDOT Specification Subsection 903.22 to within 12 inches above the top of proposed pipe. The remaining backfill under paved areas or aggregate surface shall be flowable fill. The final portion of backfill shall be binder and asphalt as described in the drawing details.
- D. If earth material for backfill is, in the opinion of the Engineer, too dry to allow thorough compaction, add enough water so that the backfill can be properly compacted. Do not place earth material that the Engineer considers too wet or otherwise unsuitable.
- E. Wherever excavation has been made within easements across private property, refer to the detail sheet on the construction drawings for backfill requirements.
- F. Conduct backfilling around manholes, inlets, outfalls, and/or structures in the same manner as specified above for pipelines except that even greater care is necessary to prevent damage to the utility structure.
- G. Wherever pipes have diameters of 15 inches or less, do not use power operated tampers to tamp that portion of the backfill around the pipe within one foot above the pipe.
- H. Perform backfilling so as not to disturb or damage any pipe and/or structure against which the backfill is being placed. If any pipe or structure is damaged and/or displaced during backfilling, open up the backfill and make whatever repairs are necessary.
- I. Backfilling and clean-up operations shall closely follow pipe laying; failure to comply with this provision will result in the Engineer's requiring that the Contractor's other activities be suspended until backfilling and clean-up operations catch up with pipe installation.
- J. Check dams shall be installed in the bedding and backfill of all new or replaced sewer lines to limit the drainage area subject to the french drain effect of gravel bedding. Dams shall consist of compacted clay bedding and backfill at least three (3) feet thick to the top of the trench and cut into the

walls of the trench two (2) feet. The preferred location is upstream of each manhole. The clay bedding material to be approved by Engineer. All stream crossings will include check dams on both sides of the crossing. Check dams are not a separate pay item.

2.17 STANDARD PRE-CAST CONCRETE MANHOLES

- A. Precast concrete manholes shall conform to Designation C478, latest revision and the Standard Detail Drawings. Standard manholes shall be circular in shape and shall be constructed of precast concrete manhole sections in general conformity with the Standard Detail Drawings. Any manhole materials that have been damaged or are otherwise unsuitable for use in the work shall be rejected and removed from the site, and shall be replaced at the Contractor's own expense.
- B. Precast Manhole Bases: The Contractor shall install the precast concrete manhole base upon a gravel (No. 57, or approved equal) base that is a minimum of twelve (12) inches thick. This gravel base shall be carefully brought to the required grade. Care shall be taken that the gravel bed is level and even, so that when the precast unit is set in place the manhole sidewall will be installed plumb, and the concrete manhole base is in full contact upon the gravel base. The precast manhole base shall be a minimum of six (6") inches in thickness. Backfilling operations, as specified herein, may begin after the installation of the precast manhole sidewall with base has been completed and initial vacuum test completed. Upon completion of the backfilling operations, traffic may be allowed on the structure. The base of the manhole shall be a precast section with openings or flexible connections sized to accept the sewer pipe.
- C. Shape manhole inverts from concrete to be smooth, accurately shaped, and in accordance with the Plans.
- D. Inlets and outlets from each manhole shall be finished smooth and flush with the sides of the manhole walls so as not to obstruct the flow of liquid through the manhole.
- E. Provide a subbase with a minimum of 12" of Class I granular material (No. 57 stone, or approved equal), well compacted with mechanical tamping equipment.
- F. When completed, the manhole shall be free from channel obstructions and leakage.
- G. Seal joints between sections with sealant described in Section 2.8.A.3.

2.18 MANHOLE RINGS AND COVERS

- A. Manhole castings shall conform to ASTM Designation A48, latest revision, Class 30B, and shall be free from scale, lumps, blisters, sand holes, and defects of every nature which would impair their use. Castings shall be well cleaned. Bearing surfaces of frames and covers shall be machined to provide a solid bearing and prevent rocking.
- B. The standard frame and cover shall be traffic type of gray cast iron ASTM Designation A48, latest revision, with a 24-inch minimum diameter opening, traffic rated. JBS 1150, JBS 1150D, and Vulcan V-1380 are acceptable. Submittal required.
- C. The covers shall be the solid self-sealing types with no holes except watertight pick notes, except end of line manholes. End of line manholes shall have four holes (minimum 1/2" diameter) for ventilation. The surface between the cover and frame shall fit smoothly without rocking and shall be thoroughly cleaned.
- D. The frame shall be attached to the manhole barrel by means of four 5/8-inch anchor bolts and shall be set in a bed of mastic so as to constitute a watertight seal between the barrel and the frame.

2.19 RUBBER ADJUSTMENT RISERS FOR INCLINES

- A. Contractor shall furnish and install a rubber adjustment riser as needed or directed by the engineer in streets to make casting flush with existing pavement surface. Adjustment risers shall be Flex-O Ring Series BE 864 (inclined), InfraRISER 32800 Series, or as approved by engineer.
- B. Manhole, riser, and casting surfaces shall be clean, dry, and free of grease, oil, or other substances before adding sealing compound as directed by manufacturer.
- C. Adjustment risers shall be bonded to adjacent surfaces by laying a continuous bead (5/16" thick cold applied joint sealant compound conforming to ASTM D1850, latest revision) on the top surface of the concrete on a diameter 1" smaller than the outside diameter of the rubber adjustment riser.
- D. If more than one adjustment riser is required, a continuous bead of sealant shall be applied between each unit in the same manner as in Part (C) above.

2.20 DROP MANHOLE ASSEMBLIES

- A. Drop manhole assemblies shall be constructed as outlined on the Plans.
- B. The material used in the drop pipe construction shall be ductile iron and Class "B" concrete.
- C. Drop connections shall be built in manholes at the locations and in conformance with the details shown on the Standard Detail Drawing. The minimum size drop pipe shall be eight (8") inches. Generally, drop pipes shall be one size smaller than the sewer which they serve.
- D. All straps and anchor bolts used to secure drop assemblies to stainless steel.

2.21 STUBOUTS FOR FUTURE USE

- A. Stubouts for future extensions of the gravity sewer shall be built at the locations and grades shown on the Plans or as directed by the Engineer. Stubouts shall include a resilient pipe connector (see 2.8.C.1 above) and a two-foot (2') section of plugged pipe installed in accordance with the specifications for bedding and backfilling for the type of pipe being. Proper bracing of plug is necessary prior to vacuum testing.

2.22 CONNECTIONS TO EXISTING LINES

- A. Taps on Existing Mains:

Service connections to existing sewer collector lines shall be made using a Romac Industries, Inc CB-6.66 Universal Sewer Saddle, 48 Strap (Romac Part Number 218-6664U). This shall be used on sewer mains from 8 to 12 inches in diameter. For larger mains the Romac Industries Universal Sewer Saddle for that size pipe shall be used. An Inserta Tee sized and installed per the manufacturer's recommendations is also allowed.

- B. Straight Line Connection

Where indicated on the plans, new lines may be connected to existing lines other than PVC SDR-26 by means of a flexible coupling. Coupling materials shall be of an elastomeric PVC secured by bolts and stainless steel bands as manufactured by Fernco or equal. SDR-26 PVC lines shall be connected using bell and spigot with rubber gasket.

- C. Connection to Existing Manholes

All connections of pipe to manholes shall be made with resilient connectors.

Openings in the manhole sidewall for the pipe shall be precast or cored to provide required size and location. The hole shall be manufactured to allow for lateral and vertical movement, as well as angular adjustments through twenty (20°) degrees. A resilient connector between the manhole and pipes such as ALOK- X-Cel, Kor-N-Seal or an approved equal shall be installed in the precast or cored opening. The resilient connector shall be molded from an EDPM or polyisoprene compound meeting requirements set forth in ASTM C923. An external band made entirely of corrosion resistant stainless steel shall be used to effect the seal around the pipe. The invert shall be built in the manhole as determined to be necessary by the Engineer or Owner using Class "C" concrete.

D. Manhole Over Existing Lines

On existing lines smaller than 18" in diameter, the contractor shall cut the existing line and install a new precast manhole connecting to the existing line with rubber boots. On lines 18" in diameter or larger, the contractor may install a "mouse hole" type manhole. Class C concrete and hydrotite shall be used to form the seal around the pipe and base. Concrete shall be vibrated to minimize honeycombing. Exterior of concrete and manhole shall be coated with two layers of bitumastic coating applied at right angles.

2.23 SETTLEMENT OF TRENCHES

The contractor shall be responsible for any trench settlement which occurs in the project within one year from the time of final acceptance of the work. If paving shall require replacement because of trench settlement within this time, it shall be replaced by the contractor at NO extra cost to the Owner. Repair of settlement damage shall meet the approval of the Engineer, the City of Crossville, Cumberland County, and/or the State of Tennessee as applicable.

2.24 BITUMINOUS CONCRETE HIGHWAY, STREET & DRIVEWAY

The contractor shall replace those sections of existing roads, streets, and driveways required to be removed to install the pipelines under this contract. He shall construct same to the original lines and grades and in such manner as to leave all such surfaces in as good (or better) condition than that which existed prior to the operations.

Prior to trenching, the pavement shall be scored or cut to straight edges at least

12 inches outside each edge of the proposed trench to avoid unnecessary damage to the remainder of the paving. Edges of the existing pavement shall be recut and trimmed to square straight edges after the pipeline has been installed and prior to placing the new base and pavement.

2.25 PORTLAND CEMENT CONCRETE HIGHWAY, STREET & DRIVEWAY REPLACEMENT

Wherever Portland cement concrete streets and driveways are removed, they shall be reconstructed to the original lines and grades and in such manner as to leave all such surfaces in fully as good or better condition than existed prior to the operation.

The existing concrete paving shall be sawed or cut to straight edges 12 inches outside edges of the trench or broken out to an existing joint, as directed by the Engineer. The concrete pavement shall be equal to the existing pavement thickness but not less than 6 inches and 4 inches in thickness for street and driveways, respectively.

Pavement replacement shall be accomplished with 2500 psi concrete in accordance with the details shown on the drawings.

2.26 UNPAVED DRIVEWAYS

Where unpaved streets, driveways, and parking areas are disturbed during the construction work, they shall be replaced to as good (or better) condition than that which existed prior to the contractor's operations.

Backfilling of the pipeline trench shall be in accordance with Method "B."

2.27 EXISTING FACILITIES

Existing mail boxes, drainage culverts, clothes line posts, fences, and the like shall NOT be molested or disturbed unless necessary, in which case they shall be replaced in as good condition as found as quickly as possible. Existing materials shall be reused in replacing such facilities when materials have not been damaged by the contractor's operation. Existing facilities damaged by the contractor's operation shall be replaced with new materials of the same type at the contractor's expense. Work in this category is NOT a pay item.

2.28 SEEDING

Lawns and other grassed areas shall be seeded after force main installation and grading to the original ground surface has been completed.

2.29 TESTING OF GRAVITY SEWERS

A. Visual Tests:

1. Upon completion of the construction or earlier if the Engineer deems advisable, the Engineer will make a visual inspection of the sewer and construction site. Immediately repair all leaks and defects found by such inspection.
2. In addition to general cleanup and leakage, the following standards shall be used to determine failure or defects of this project.
 - a. Sewers shall be built so as to remain true to line and grade. The inclining grade of the bottom of the sewer after completion shall be such that, after flooding, the flood water drains off so that no remaining puddle of water is deeper than 1/2 inch on pipe 36 inch internal diameter or smaller and 3/4 inch on pipe larger than 36 inch internal diameter. Any section of pipe that does not comply with the specifications at any time previous to final acceptance of the work shall be replaced or re-installed at the Contractor's expense.
 - b. The Contractor will be held strictly responsible that all parts of the work bear the load of the backfill. If cracks 1/100 inch develop in the pipe within one year from the date of final acceptance of the work, the Contractor will be required to replace, at his expense, all such cracked pipe. To this end, the Contractor is advised to purchase pipe under a guarantee from the manufacturer, guaranteeing proper service of sewer pipe under conditions established by the drawings, specifications, and local conditions at the site of the work.

B. Air Testing for Sewers 21 Inches and Smaller: Perform low pressure air testing as follows:

1. Furnish all equipment, facilities, and personnel necessary to conduct the test. The test shall be observed by a representative of the Engineer.
2. Make the air test after all services have been installed and backfilling has been completed and compacted.
3. Perform the first series of air tests after 2,000 LF but before 4,000 LF of sewer has been installed. The purpose of this first series of tests is to assure both the Contractor and the Engineer that the materials and method of installation meet the intent of these specifications. Conduct the remainder of the tests after approximately each 10,000 LF has been installed.
4. Plug all tees and ends of sewer services with flexible joint plugs or caps securely fastened to withstand the internal test pressures. Such plugs or caps shall be readily removable, and their removal shall provide a socket

- suitable for making a flexible jointed lateral connection or extension.
5. Prior to testing, check the pipe to see that it is clean. If not, clean it by passing a full-gage squeegee through the pipe. It shall be the Contractor's responsibility to have the pipe cleaned.
 6. Immediately following this check or cleaning, test the pipe installation with low pressure air. Supply the air slowly to the plugged pipe installation until the internal air pressure reaches 4.0 PSI more than the average back pressure of any ground water that may submerge the pipe. Allow at least three minutes for temperature stabilization.
 7. The pipeline shall be considered acceptable when tested at an average pressure of 3.0 PSI more than the average back pressure of any ground water that may submerge the pipe, if the section under test does not lose air at a rate greater than that specified. Calculate the pressure drop as the number of seconds for the air pressure to drop from a stabilized pressure of 3.5 to 2.5 PSI more than the average back pressure of any ground water that may submerge the pipe. Calculate time as described in ASTM C828.
 8. The requirements of this specification shall be considered satisfied if the time required in seconds for the pressure to decrease from 3.5 to 2.5 PSI more than the average back pressure of any ground water that may submerge the pipe is not less than that shown in the following table:

MINIMUM TEST TIME AND ALLOWABLE AIR LOSS VALUES

Pipe Size	Minimum Test Time in Seconds Per 100 LF	Allowable Air Loss in CFM
4 inch	25	2.0
6 inch	42	2.0
8 inch	72	2.0
10 inch	90	2.5
12 inch	108	3.0
15 inch	126	4.0
18 inch	144	5.0
21 inch	180	5.5

9. If the pipe installation fails to meet these requirements, the Contractor shall determine at his own expense the source or sources of leakage and repair or replace all defective materials or workmanship. The completed pipe installation shall meet the requirements of this test before being

considered acceptable.

10. The recommended procedures for conducting acceptance tests are as follows:
 - a. Clean pipe that is to be tested.
 - b. Plug all pipe outlets with suitable test plugs, and brace each plug securely.
 - c. Increase gage pressure in the test by the amount of ground water pressure at the crown of the pipe.
 - d. Add air slowly to the portion of the pipe installation being tested until the internal air pressure is raised to 4.0 PSI more than the average back pressure above the crown of the pipe.
 - e. After the above internal pressure is obtained, allow at least two minutes for air temperature to stabilize, adding only the amount of air required to maintain pressure.
 - f. After two minutes, disconnect the air supply.
 - g. When pressure decreases to 3.5 psig either by leaking down or by bleeding down with a release valve, start the stopwatch, and determine the time in seconds that is required for the internal air pressure to reach 2.5 psig. Compare this time interval as calculated above. If the time is more than that calculated, the test shall be assumed to be acceptable.
 11. Plugs used to close the sewer pipe for the air test must be securely braced to prevent the unintentional release of a plug, which can become a high velocity projectile. Locate gages, air piping manifolds, and valves at the top of the ground. No one shall be permitted to enter a manhole where a plugged pipe is under pressure. Four pounds air pressure (gage) develops a force against the plug in a 12 inch pipe of approximately 450 pounds. Provide a safety release device set to release at 10 PSI between the air supply and the sewer under test.
- C. Air Testing for Sewers Larger than 21 Inches:
1. Test each full segment of pipe for air tightness at 3.5 psig for the minimum dwell period specified. Seal pipe ends with suitable restrained closure. Pressurize the pipe with air at 3.5 psig and cut off the air source. Commence timing the dwell period specified. If the pressure falls below 3.0 psig within the test period the segment shall be rejected. Contractor shall make corrections at his own expense.
 2. All other recommended procedures for conducting pressure testing as described in 3.04.B shall be followed.

MINIMUM TEST TIMES AND ALLOWABLE AIR LOSS VALUES
(0.5 psig Pressure Drop)

Pipe size	Minimum Test Time in Seconds (Minutes)	Allowable Air Loss <u>in CFM</u>
	per 100 LF	
24 inch	216 (3.6)	6.0
27 inch	252 (4.2)	6.5
30 inch	288 (4.8)	7.0
36 inch	360 (6.0)	8.0
42 inch	438 (7.3)	9.0
48 inch	510 (8.5)	10.0

3. Air testing of pipes more than 30 inch in diameter shall not be performed unless necessary because of the difficulty of adequately blocking the plugs. Provide a safety release device set to release at 10 PSI between the air supply and the sewer under test.

D. Infiltration Testing:

1. Ground water above the pipe will reduce air loss. If the section of line under test shows significant infiltration, the Contractor, at no added compensation over the Contract price for the sewers, shall furnish, install and maintain a V-notch sharp crested weir in a wood frame tightly secured at the low end of each sewer lateral and at locations on the main sewers required by the Engineer. Maximum allowable infiltration shall be 25 gallons per mile per inch of diameter of sewer per 24-hour day at any time. The joints shall be tight, and visible leakage in the joints or leakage in excess of that specified above shall be repaired at the Contractor's expense by any means found to be necessary.
2. When infiltration is demonstrated to be within the allowable limits, the Contractor shall remove such weirs.
3. Infiltration tests may be required for the complete line or any portion thereof. Failure of any part of the line to pass an infiltration test shall be sufficient reason to require additional work by the Contractor to reduce the amount of infiltration in such portion of the line tested.
4. The passing of an infiltration test shall in no way relieve the Contractor of any responsibility to repair visible leaks found during the visual inspection.

5. Infiltration testing shall be performed on sewers larger than 30 inches in diameter when the hydrostatic head outside the pipe exceeds the upstream manhole depth above the top of the pipe.
- E. Exfiltration Testing:
1. For sewers larger than 30 inches in diameter the sewer shall be tested by exfiltration when infiltration testing cannot be performed.
 2. The groundwater table must be maintained below the section of pipe being tested at all times.
 3. When exfiltration testing is employed, the sewer shall be subjected to a minimum of four feet of head, or up to the top of the previously tested manhole, whichever is lesser, above the crown of the pipe at the upstream manhole of the section being tested.
 4. Hold the water level constant for at least 30 minutes, adding water as necessary. Measure and record duration and quantity of water added.
 5. The maximum allowable exfiltration shall be 25 gallons per mile per inch of diameter of sewer per 24-hour day.
 6. If the pipe installation fails to meet the test requirements, the Contractor shall determine at his own expense the source or sources of leakage and repair or replace all defective materials or workmanship. The completed pipe installation shall meet the requirements of the test before being considered acceptable.
- F. Repairs: Regardless of the outcome of any tests, repair any noticeable leak.
- G. No additional payment will be made for testing gravity sewers and shall be merged into the cost of pipe.
- H. Submit written testing records to the Engineer documenting the results of the tests for each section of sewer between manholes. The record shall show, at a minimum, sewer size, manhole numbers, sewer length, duration of test, quantity of water added (exfiltration test), measured infiltration/exfiltration rate, and pressure loss (low pressure air test).
- I.

2.30 VISUAL INSPECTION OF MISCELLANEOUS MATERIALS

- A. All material used on this project will be visually inspected by the Engineer at the site for conformance to the required specifications. When reasonable doubt exists that said material meets the specifications, the Engineer may require certified mill tests, samples, and/or tests by an independent laboratory or other suitable form of verification that the material meets the required specifications.

2.31 DEFLECTION TESTING FOR PVC AND HDPE PIPE

- A. Test deflection of all PVC pipe by passing a 9-arm pin go/no-go mandrel sized to 95 percent of the pipe diameter of the actual pipe used with the pipe in place and covered. Make this acceptance test after backfill consolidation has occurred. The Contractor shall provide the mandrel and conduct test in presence of the Engineer.
- B. No additional payment will be made for mandrel testing and shall be merged into the cost of pipe.

2.32 CLEANUP

- A. After completing each section of the sewer line, remove all debris, construction materials, and equipment from the site of the work, grade and smooth over the surface on both sides of the line, and leave the entire right-of-way in a clean, neat, and serviceable condition.

END OF SECTION

3. BASIS OF MEASUREMENT & PAYMENT

(for Projects Bid out by the city only)

3.1 GENERAL

The Contractor shall furnish all labor, tools, and materials to construct the proposed improvements complete as shown on the Drawings and described in these Specifications. The work shall be measured for payment in accordance with the applicable provisions to these Specifications and payment shall be made on the basis of the unit prices or lump sum prices bid. The sum of the payments for eligible pay items contained in the proposal form shall be the compensation to be paid for the completed project, provided however, that changes in the work covered by written change orders, properly executed, may result in additions or deductions from the Contract price.

The Contractor's attention is called to the fact that although the pay items shown shall be the basis for establishing the Contract price, the description of the pay items does not necessarily reflect the extent of the work to be performed. The cost of incidental work such as clearing and grubbing, trenching, backfilling, testing, etc., which is necessary but which is not specifically listed as one of the pay items, shall be included in the prices bid for the pay items to which the incidental work is most closely related.

3.2 GRAVITY SEWER

Payment for furnishing and installing gravity sewer lines of the various sizes and types of pipe will be made at the contract unit price per linear foot, complete in place, which shall include compensation for furnishing, hauling, trenching (including rock excavation), bedding, fittings, laying, jointing, installing marking tape, testing, backfilling, ground restoration (except pavement replacement), and clean up. The quantity of gravity sewer line to be paid for shall be the length of the completed gravity sewer line measured.

3.3 SEWER MANHOLES

Payment for furnishing and installing gravity sewer manholes of the various sizes and heights will be made at the contract unit price for different heights, complete in place, including manhole ring and covers. Payment for gravity sewer manholes will be made at the contract unit price per each, complete and in place.

3.4 CASING PIPE (BORE & JACK)

Payment for casing pipe (jack and bore) will be made at the contract unit price per foot. This item includes installing the casing at grade per the drawings and includes end seals. This item does not include the carrier pipe which will be paid additionally.

3.5 CASING PIPE (OPEN CUT)

Payment for casing pipe (open cut) will be made at the contract unit price per foot. This item includes installing the casing at grade per the drawings and includes end seals. This item does not include the carrier pipe which will be paid additionally.

3.6 CONNECT TO EXISTING LINE

Payment for connection to existing line will be made at the contract unit price per each, complete and in place.

3.7 ASPHALT RESTORATION

Payment for asphalt restoration will be made at the contract unit price per square yard or ton.

3.8 GRAVEL RESTORATION

Payment for gravel restoration will be made at the contract unit price per square yard or ton.

END OF SECTION

4. DETAIL SHEETS

See attached sheets.

