

July 21, 2014

Missouri Department of Natural Resources  
Water Protection Program  
PO Box 176  
Jefferson City, MO 65102-0176  
Attn: Mrs. Emily Carpenter

Dear Mrs. Carpenter:

Per the letter of June 18, 2014 Byron F. Shaw, Jr., PE letter of please find one (1) copy of pertinent revised sections to the City of Carthage Standard Specifications for Sewer Main Construction.

Requirement items are addressed as follows:

- |                               |                      |
|-------------------------------|----------------------|
| Items 1, 2, and 11 through 17 | Specification 02722. |
| Item 3                        | Specification 02221. |
| Item 4                        | Specification 02222  |
| Items 5 and 6                 | Specification 02749  |
| Item 7                        | Removed              |
| Items 8, 9 and 10             | Specification 02601  |

Recommended items are addressed as follows:

- |                   |                            |
|-------------------|----------------------------|
| Item 1            | removed from Spec. 00110   |
| Items 2, 3, and 4 | Specification 02749        |
| Item 5            | Specification 02722        |
| Item 6            | not addressed at this time |

While we agree that in some instances detail drawings can provide a better explanation than the specifications, the ones noted occur so very rarely that we feel each should be reviewed on a case by case basis.

Please note the Engineer of Record is Mr. Jason Eckhart, P.E. with Anderson Engineering, Inc. I, Rick West, am an Associate Designer with the same firm however I am not a professional engineer. Please address all future correspondence to Mr. Eckhart.

Sincerely,  
  
Rick West, Designer

Enc.: 1 copy of revised Standard Specifications

Cc: Carthage Water and Electric Plant

1. GENERAL

- 1.1 Standard specifications for the work shall consist of the “Standard Specifications for Sewer Main Construction” of the Carthage Water and Electric Plant, City of Carthage, and specific sections from the “Standard Specifications for Highway Construction” of the Missouri Highway and Transportation Commission.
- 1.2 A Performance and Maintenance Bond shall be on file with the Public Work’s Department prior to the start of the public improvement construction.
  - 1.2.1 The Performance and Maintenance Bond shall be for the cost of the public improvement construction.
  - 1.2.2 The Performance Bond shall be in effect until project completion. The Maintenance Bond shall be effective for a 12-month period following project completion and acceptance by the City of Carthage.
- 1.3 No public improvement project construction shall begin until a set of engineering drawings of the proposed construction; sealed by a licensed professional engineer registered in the State of Missouri, is received by the City of Carthage and approved by signature of the Public Works Director or his designee.
- 1.4 Any public improvement which will be located in a State of Missouri right-of-way shall be permitted first by the Missouri Department of Transportation (MoDOT) before being considered by the City of Carthage. A copy of the MoDOT permit shall be supplied to the City of Carthage.
- 1.5 All public improvement construction shall be performed in accordance with specifications listed herein and shall be inspected and documented by the City of Carthage Public Works Department.
- 1.6 If the public improvement construction is required to be done after normal working hours, or on weekends or holidays, all overtime pay for Public Works inspector shall be paid for by the contractor. Failure to pay overtime fees shall result in a claim against the project Performance Bond.
- 1.7 The contractor or owner will be responsible for the repair/replacement of any City facilities damaged during construction. Failure to repair/replace damaged City facilities will result in a claim against the contractor/owner’s liability insurance policy.
- 1.8 For new construction projects, an emergency contact with a 24 hour telephone numbers must be on file in case of emergency.

2. SEWER MAIN IMPROVEMENTS

- 2.1 Sewer lines shall be completed to comply with the standards contained herein, with the requirements of the Missouri Department of Natural Resources, and all design standards and specifications now or hereafter promulgated by the Public Works Director or adopted by the Council, in accordance with the final construction plans required to be approved prior to final plat approval.
- 2.2 Responsibility for improvements costs: All costs for sewer line construction including testing and certification shall be the responsibility of the owner/developer.

3. TRAFFIC CONTROL

- 3.1 General. Materials, placement, maintenance, and removal of Traffic Control Devices shall be governed by Part 6 of the "Manual of Uniform Traffic Control Devices," published by the U.S. Department of Transportation of the Federal Highway Administration.
- 3.2 Maintenance of Access – Construction Sequence. The Contractor shall strictly adhere to the construction sequence outlined on the Construction Phasing Plans.
- 3.3 Placement of Devices – Approximate Quantities. In order to maintain safe work and travel in the construction zone, the Contractor shall provide and install signs, barriers, and lane channelization for vehicles as shown on the Traffic Control Plan.

4. QUALITY ASSURANCE

- 4.1 Developer/Contractor shall provide to City Engineer test reports from independent testing laboratory confirming lines, manholes, sub-grade, granular stone base, granular stone bedding, and pavement have been constructed in conformance with the appropriate City Specifications. The City Engineer or City Inspector shall be notified at least 24 hours prior to a scheduled inspection or test. Costs for independent testing of all components shall be the responsibility of the developer. Trench backfill and pipe bedding under streets shall be tested and inspected prior to construction of streets. Following construction, the project engineer shall provide signed approval stating to City that sewer lines and appurtenances have been constructed in accordance with approved plans and specifications.

1. GENERAL

- 1.1 Description: The work of this section consists of excavation for trenches relating to the construction of underground piping. There will be no distinction made in any definition or classification of excavation covered by this section between wet or dry materials below the surface of the earth. Trench excavation shall consist of all materials of whatever character encountered in the work, including soil, solid rock, fragmented rock, water, or other. Work under this section shall also include:
  - 1.1.1 All sheeting, shoring, bracing, protection of adjacent property, preparation of all sub-grades, storage of excavated materials, backfilling, tamping, grading, and surfacing.
  - 1.1.2 Diversion of surface water, and all pumping, draining, or other means of dewatering excavations.
  - 1.1.3 All subsequent handling and disposal of excavated material, together with the preparation of all trench sub-grades.
- 1.2 Protection of Adjacent Property: The Contractor shall protect all excavations and trenches from settlement or displacement by approved means of bracing and shoring. All existing underground utilities and structures as well as all surface improvements and structures shall be protected and their functional purpose preserved.

2. CLASSIFICATION OF EXCAVATION

- 2.1 All excavation shall be considered as unclassified unless solid rock excavation is specifically denoted on the drawings and in the bid schedule.
- 2.2 Solid rock excavation shall denote all materials which cannot be removed by conventional excavating equipment and must be removed by jack hammering or blasting. Solid rock excavation shall only be measured and paid for when denoted on the plans and in the bid schedule.

3. TRENCHING

- 3.1 Lines and Grades: The Contractor shall furnish and set all stakes to establish and maintain the lines and grades as shown on the drawings including all grade boards, uprights, and accessory materials required. Line and grade shall be maintained either by grade boards with string or laser beam.
  - 3.1.1 Grade boards shall be installed across the trench at intervals not to exceed 25 feet. The Contractor shall be held responsible for verification of lines and grades as established and shown on the drawings. The Owner may check the line and grade at any given point before backfilling has been started, and if there is a variation of more than two-hundredths (0.02) of a foot from the true grade, the same shall be raised or lowered as required.
  - 3.1.2 In the event a laser beam is used to set line and grade for the pipe laying operation, grade stakes shall be set at each structure (i.e. catch basin, drop inlet, manhole, etc.) and at 25 feet, 50 feet, 100 feet, and then 100-foot increments thereafter, upgrade of the structure. The laser must be checked at the beginning of each day and at each grade stake to insure the proper line and grade of the pipe.
- 3.2 Excavation: All excavation for trenches shall be made with a sufficient working space to permit the placement, inspection, and completion of all work contemplated in the contract. Excavated material that is unsuitable for backfill, and all boulders exposed by grading shall be removed from the work area. Trenches shall be excavated in accordance with the drawings for trench width relative to trench depths.

- 3.2.1 Trenches shall be excavated to six inches below the bottom of the pipe when set to established flow lines. Should the trench be excavated more than six inches below the bottom of the pipe, the Contractor shall use only granular stone bedding material to establish flow line grade. All ledge rock, boulders, and large stones shall be removed to provide a minimum clearance of four inches (4") below and on each side of all pipe(s).
- 3.2.2 Trench excavation shall, in all cases, be made continuous from the ground surface to the established trench depth. Materials excavated shall be stockpiled at the sides of the trench and within established area limits so as to minimize inconvenience to the public, and damage to vegetation and structures in the area.
- 3.2.3 Trenching, shoring, bracing, and shields shall be placed by the Contractor whenever necessary for the proper preservation of any excavation, embankment, or structure. Where the ground is of such a character or other conditions are such as to render it necessary, the sheeting shall be closely driven and to such depth below the lowest point of the final excavation as may be directed. The Contractor shall be held responsible for the sufficiency of all sheeting and bracing used, and for any and all persons injured, or property damaged as the result of improper quality, strength, placement, maintenance, or removal of the same. No extra compensation will be made for sheeting and bracing, whether left in place or not. The Contractor shall, at his own expense, shore up, protect, and insure from injury all building, retaining walls, piers, and footing, storm sewers, sanitary sewers, gas lines, water lines, fences, curbs, trees, or other property liable to be injured during the process of the work, and he will be held responsible for all damage which may occur by reason of prosecution of the work. Sheeting, shoring, and bracing shall be provided, installed, and maintained to protect the excavation, insure the safety of workmen, and as required by applicable federal, state, and local laws, rules, and regulations.
- 3.2.4 Trench width from six inches below the bottom of the pipe to six inches above the pipe bell shall be held to 1.4 times the outside diameter of the pipe plus twelve inches. Trench width above these levels may be wider to accommodate shoring, bracing, and shields, but shall be kept within practical limits. Contractor shall not receive additional payment for extra trench width.
- 3.3 Removal of Water: The Contractor shall furnish and operate sufficient pumps and appliances, and shall provide all material, labor, etc. required to prevent interference with any work by water, ice, or snow. Damage of any kind resulting from insufficient pumping facilities or similar lack of proper conduct of the work shall be made good by the Contractor at his own expense. No structure or pipe shall be placed in water and water shall not be allowed to run into or cover any concrete work or pipe, or into or through any pipe, unless by special permission given by the Owner in writing.
- 3.4 Record Drawings: Whether all excavations are considered unclassified or rock excavation is classified, the Contractor shall clearly indicate on the Record Drawings (which he shall submit to the Owner) the elevations and extent of all solid rock encountered during construction of the project.

#### 4. BACKFILLING AND COMPACTING

- 4.1 Material used for backfilling of trenches shall be free from perishable matter and from other material liable to become unstable when saturated with water after having been compacted. No frozen material shall be used in backfill. No large stones or organic matter shall be placed within two feet of the top of the sewer pipe. Care shall be taken to prevent damage to the pipe and structures. Special precautions shall be taken in backfilling over pipes. No backfill shall be placed over any portion of pipes and/or joints not inspected by the Owner. The granular stone bedding material shall be brought to a depth of at least six inches over the top of the pipe bell, with this material carefully deposited in uniform layers not exceeding six inches in depth, and each layer carefully and solidly tamped with mechanical tampers in such a manner as to avoid damage to pipe or disturbing completed work. Unless noted otherwise on the drawings, backfilling for the remainder of the trench shall be previously excavated gravel, sand, or earth, and shall contain no stone over three inches in its largest dimensions. Stones smaller than that size may be used in proportion not exceeding one part of stone and three parts of earth in any place. This

backfilling shall be deposited and spread in layers and solidly tamped. As the trenches are backfilled, the Contractor shall remove all surplus material and re-grade the surface leaving it in good order. The trenches shall be filled to the ground surface elevation which previously existed, unless shown otherwise on the drawings.

- 4.1.1 The Contractor may be required to settle certain backfill material with water, in addition to other backfilling procedures. The water will be furnished by the Contractor without cost to the Owner. Methods and procedures in using the water shall be approved by the Owner prior to carrying out the operation.
- 4.1.2 Whenever, in the opinion of the Owner, the excavated material is not suitable for backfilling the trench, or there is a deficiency of material, the Contractor shall, as his own expense, provide suitable material.
- 4.1.3 All excess excavation materials shall be cleaned up by the Contractor as directed. All backfilled trenches shall be maintained by the Contractor for a period of one year after Final Acceptance of the work by the Owner.
- 4.1.4 Roadway Crossings: At all open-cut roadway crossings, and as noted elsewhere, the trench shall be backfilled to grade with granular stone meeting the requirements of Section 02222 - GRANULAR STONE BEDDING AND BACKFILL. For roadway surface replacement, see Section 02575 - ROADWAY SURFACE AND SIDEWALK REPLACEMENT.
- 4.1.5 Private Drives, Field Entrances, etc.: At all open-cut crossings of private drives, field entrances, and the like, the trench backfill shall be deposited and spread in layers and solidly tamped to Range "B" compaction requirements set forth in Section 02250 - COMPACTION CONTROL AND TESTING. Private drives, etc. shall be backfilled "immediately" upon completion of the pipe laying across the drive. The driving surface shall be restored to its original condition immediately following proper compaction of the backfill.

1. GENERAL

1.1 Description: The work in this section shall consist of furnishing, hauling, placing, and compacting granular stone for bedding underground utility piping, and for granular stone backfill at street crossings and other locations shown on the drawings.

2. MATERIALS

2.1 Pipe Bedding: Embedment for PVC gravity sewer pipe in ordinary trench conditions with or without high groundwater and with or without a hydraulic gradient shall be ASTM D2321 Class IB dense graded, clean, manufactured, and processed aggregates described as angular crushed stone, crushed rock, or crushed gravel and crushed stone/sand mixtures containing little or no fines with gradations selected to minimize migration of adjacent soils. Class IB aggregates must be compacted to 85% standard proctor density and tested to ensure proper compaction. Sieve requirements for Class IB aggregates for various PVC gravity sewer pipe nominal diameters are shown below.

2.2 Embedment for PVC gravity sewer pipe in ordinary trench conditions without high groundwater and without a hydraulic gradient when ASTM D2321 Class IB aggregate is not used, shall be ASTM D2321 Class IA open graded, clean, manufactured aggregates described as angular crushed stone, crushed rock or crushed gravel with large void content containing little or no fines. Class IA aggregates must be compacted. Sieve requirements for Class IA aggregates for various PVC gravity sewer pipe nominal diameters are shown below.

Nominal pipe diameter (inch)	Bedding material ASTM D2321 Class	Amounts Finer Than Each Laboratory Sieve (Square Openings) Mass Percent					
		Sieve Size					
		1 ½ inch (37.5 mm)	¾ inch (19mm)	½ inch (12.5mm)	3/8 inch (9.75mm)	No. 4 (4.75mm)	No. 200 (0.075 mm)
4	IA				100%	≤10%	≤5%
4	IB				100%	≤50%	≤5%
6	IA			100%		≤10%	≤5%
6	IB			100%		≤50%	≤5%
8 to 15	IA		100%			≤10%	≤5%
8 to 15	IB		100%			≤50%	≤5%
≥16	IA	100%				≤10%	≤5%
≥16	IB	100%				≤50%	≤5%

2.3 High strength embedment (steel reinforced concrete low cradle, steel reinforced concrete high cradle, steel reinforced concrete encasement, or steel reinforced concrete arch constructed to ASTM C12 (standards for Class A embedment) shall be used for problem soil conditions, near Karst features including caves and sink holes, for road crossings, for stream crossings, for water main/sewer main crossings, and for sewer main/stormwater conduit crossings.

2.4 PVC gravity sewer pipe laid at slopes equal to or greater than 20% and PVC gravity sewer pipe for which the combination of average inside diameter and slope result in a velocity greater than 15 feet per second (fps) when calculated using Kutter’s Formula with an “n” value of 0.013 shall have mechanical restraints or poured concrete slope anchors with steel tie-down bars bearing against undisturbed earth at pipe bells

at a maximum spacing (center to center) of 36 feet (36') for slopes up to 35%, 24 feet (24') for slopes greater than 35% up to 50%, and 16 feet (16') for slopes greater than 50%. Slope anchors shall be constructed to ASTM F1668 Standard Guide for Construction Procedures for Buried Plastic Pipe. Slopes at which slope anchors (or mechanical restraints) are required for commonly used PVC gravity sewer pipes are shown below.

	Slope at which Slope Anchors are Required	Pipe Description & Nominal Diameter	Slope at which Slope Anchors are Required
ASTM D3034 SDR-35 6"	20.00%	ASTM F679 T-2 18"	>6.709%
ASTM D3034 SDR-35 8"	20.00%	ASTM F679 T-2 21"	>5.276%
ASTM D3034 SDR-35 10"	>16.12%	ASTM F679 T-2 24"	>4.451%
ASTM D3034 SDR-35 12"	>12.35%	ASTM F679 T-2 27"	>3.751%
ASTM D3034 SDR-35 15"	>9.098%	ASTM F679 T-2 30"	>3.169%
ASTM D2241 SDR-21 16"	>9.084%	ASTM F679 T-2 36"	>2.322%

2.5 Pipe Backfill: When granular stone backfill is required, the aggregate shall be identical to the pipe bedding material specified in paragraph 2.1.

### 3. EXECUTION

- 3.1 Pipe Bedding: Granular stone shall be placed in the trench and shaped so as to provide uniform support for the bottom quadrant of the pipe barrel. The bedding shall be not less than six (6) inches in thickness. Following the placement of the pipe, the trench shall be filled with granular stone bedding material to a minimum compacted depth of six (6) inches above the pipe bell. Bedding installation in trench shall be to the widths and depths as shown on the drawings.
- 3.2 Pipe Backfill: When granular stone backfill is required, it shall be of the specified gradation and shall be placed in the trench in maximum 24-inch thick layers and compacted to 80% of maximum density.

1. GENERAL

- 1.1 Description: The work of this section shall consist of furnishing, hauling, and placing all precast concrete manholes shown on the drawings and as required for sewer line construction.
- 1.2 Precast concrete manholes shall be of the type, size, and configuration shown on the drawings, and all manholes shall be provided by one sole manufacturer.

2. MATERIALS

- 2.1 Portland Cement: Shall conform to ASTM C150, latest revision, Type I, II, or V.
- 2.2 Concrete Reinforcement: Shall be as specified in Section 03200 - CONCRETE REINFORCEMENT.
- 2.3 Aggregate: Shall conform to ASTM C33, latest revision, for coarse and fine aggregate.
- 2.4 Mortar: Shall conform to ASTM C270, latest revision, Type M.
- 2.5 Water: Mixing water shall be clean and potable.
- 2.6 Dampproofing: Shall conform to Koppers Specifications for Coal Tar Bitumastic Super Service Black or an approved alternate.
- 2.7 Joint Sealant: Shall meet AASHTO Specification M-198, and shall be suitable for application in vertical and horizontal joints. Sealant shall be as manufactured by Hamilton-Kent, Ram-Nek, or approved equal.
- 2.8 Joint Wrap: Shall be a stretchable, self-shrinking, intra-curing halogenated based rubber meeting the requirements of ASTM C923 and shall have a minimum thickness of 30 mils.
  - 2.8.1 Adhesive: The joint wrap shall be secured with a cross-linked reinforced butyl adhesive. The adhesive shall be a non-hardening sealant with a minimum thickness of 30 mils.
- 2.9 Grout: Grout shall be a pre-mixed, packaged, non-ferrous, aggregate non-shrink grout.
- 2.10 Manhole Frame and Cover: Frame and cover shall be made of clean, even grain, tough gray cast iron. The casting shall be smooth, true to pattern, and free from projections, sand holes, warp and other defects which would interfere with the use of, or impair the serviceability of the casting. The iron used for these castings shall conform to ASTM A48, latest revision, for Class 35B gray iron.
  - 2.10.1 Frame and cover shall have machined horizontal bearing surfaces and shall be Neenah Foundry R-1769-A or approved equal. Minimum clear opening of the access shall be 22 inches.

3. EXECUTION

- 3.1 Fabrication and Manufacturing: Precast reinforced concrete manholes shall be manufactured to requirements of ASTM C478, latest revision and shall be of the type, size, and configuration shown on the drawings. Manhole tops shall be of the eccentric type. The minimum allowable wall thickness shall be determined by the manhole depth as below:

<u>Depth</u>	<u>Wall Thickness</u>
0 to 16 feet	1/12 of internal diameter
16 feet or greater	1/12 of internal diameter + 1"

- 3.1.1 Minimum internal diameter of any manhole section shall be 4 feet.
- 3.2 Dampproofing shall be factory applied on all interior and exterior surfaces except to the interior surface of the bottom section. Dampproofing shall be field applied to the interior surface of the bottom section after base and fillet have been placed. Dampproofing system shall be Koppers Coal Tar Bitumastic Super Service Black or an approved alternate, applied per the manufacturer's specifications. Two coats, each of minimum 14 mils, dry thickness shall be applied. A 75-volt maximum wet sponge detector shall be employed to check for holidays in the dried finish film.
- 3.3 Construction:
- 3.3.1 Manhole Base: The manhole base shall be of either cast-in-place reinforced concrete or a precast concrete unit with the precast unit being the preferred method on all new installations.
- a. Precast manhole bases shall consist of either a precast unit with integral invert or a precast base with field constructed invert. Either type of precast unit shall be set on a minimum of 6" of compacted crushed stone. The unit shall be set plumb and to the elevation as shown on the plans.
  - b. Cast-in-place concrete base shall be constructed of 3,500 min. psi concrete, 4-inch max. slump concrete with #4 steel reinforcing bars at 12-inch on center each way. The bottom section of the precast unit shall be set into the base a minimum of 12 inches. The base shall extend not less than 6 inches beyond the outside manhole wall.
  - c. Bench: A bench shall be provided on each side of any manhole channel when the pipe diameter(s) are less than the manhole diameter. The bench should be sloped no less than a one-half inch per foot (0.5 in/ft). No pipe shall discharge onto the surface of the bench.
- 3.3.2 Precast riser sections shall be set plumb and oriented with manhole steps and access opening to match the detailed drawings designations. Each section of the precast concrete manhole shall be set in a pre-molded mastic material or a rubber gasket. Joint wrap shall also be applied to the exterior of manhole at each joint so as to produce an absolutely watertight joint under full hydrostatic head conditions. The joint wrap shall be installed per the manufacturer's requirements and recommendations.
- 3.3.3 Openings for sewer pipe in manhole sections shall be formed at the factory, either cast-in-place gasket or cut out opening. The minimum opening for cutouts shall be equal to outside diameter of pipe plus four inches and maximum opening shall be equal to outside diameter of pipe plus six inches.
- 3.3.4 Flexible watertight cast-in-place gaskets shall be used, and shall be A-LOK or approved equal.
- 3.3.5 Invert channels shall be smooth and semi-circular in shape conforming to the inside of the adjacent pipe line sections with change in flow direction made by a smooth curve of as large a radius as the manhole size will permit, and changes in the size and grade of the channels being made gradually and evenly. Manhole floor shall rise a minimum of 1 inch per foot from side of channel to wall.
- 3.3.6 All frames and covers shall be set true to line and to correct elevation upon a mastic gasket. Frames and covers shall have true common bearing surfaces, such that the covers will seat firmly without rocking or shifting. In areas prone to flooding or surcharging manhole frames shall be attached to manholes with anchor bolts.
- 3.3.7 Manhole Drop: In manholes where the difference in the inverts of the inlet and outlet pipes is 2 feet or more an outside drop shall be constructed as shown on the standard construction details. If precast manholes are utilized, the drop connections shall not enter the manhole at a joint.

- 3.3.8 Inlet and outlet pipes shall extend through the walls of the structures a sufficient distance beyond the outside surface to allow for connections, and shall extend two inches beyond the inside surface of the wall. The new manhole shall be cleaned of silt, debris, or other foreign matter prior to acceptance.
- 3.3.9 All lifting holes shall be thoroughly wetted and completely filled with non-shrinking grout to form a watertight seal.
- 3.4 New Manhole Over an Existing Line: Manholes to be located over an existing sewer line shall be built so that all of the manhole inverts will be smooth and continuous after the sewer tile is broken open.
- 3.5 Connections to Existing Manholes: Existing manholes used for connecting new sewer lines to the existing sewerage system shall have the new sewer line connected by core boring a hole in the side of the existing manhole at the new plan flowline elevation. The bore hole shall be of sufficient diameter to allow for the insertion of an A-lok gasket or equal such to provide a flexible watertight connection. The new sewer pipe shall then be inserted into the gasket and invert grouted to provide a continuous, uninterrupted flow of existing and new sewage.

1. GENERAL

1.1 Description: The work of this section shall consist of installing the gravity sewers to the lines and grades shown on the drawings and as specified herein.

2. MATERIALS

2.1 Gravity Sewers: Gravity sewer lines shall be solid wall polyvinyl chloride (PVC) pipe meeting the requirements of Section 02622 - PLASTIC PIPE or ductile iron pipe (D.I.P.) meeting the requirements of Section 02615 - DUCTILE IRON PIPE AND FITTINGS. Where noted, gravity sewers shall be constructed of ductile iron pipe

2.2 Pressure Sewers: Pressure sewer lines shall be solid wall polyvinyl chloride (PVC) pipe meeting the requirements of Section 02622 - PLASTIC PIPE or ductile iron pipe (D.I.P.) meeting the requirements of Section 02615 - DUCTILE IRON PIPE AND FITTINGS. Where noted, pressure sewers shall be constructed of ductile iron pipe

2.3 Manholes shall be as specified in Section 02601 - PRECAST MANHOLES.

3. EXECUTION

3.1 Handling, Receiving and Delivery of Materials: All materials shipped by rail shall be carefully inspected for damage in transit in the cars. If damaged material is found, it shall not be unloaded except upon instructions from the official freight agent. In the event of damaged pipe, it may be lifted out of the cars and placed along the switch site, but no material shall be removed from the railroad company property. If materials are delivered by truck, they shall be inspected as they are unloaded. Damaged pipe shall not be left at the job site, but shall be removed promptly so that rejected material will not mistakenly be used in construction. All pipe, pipe fittings, and other accessories and materials shall be unloaded in such a way as to avoid damage due to shock. Under no circumstances shall pipe be dropped to the ground from cars or trucks. Special precautions shall be taken to prevent one pipe from striking another forcefully.

3.2 Storage: All materials shall be placed for storage in suitable places. As pipe is placed along the intended alignment of the trench, it shall be placed with bell ends facing the direction in which work will proceed (upstream), unless otherwise directed.

3.3 Pipe Inspection: Before pipe is lowered into the trench, the pipe shall be inspected for defects. Ductile iron pipe shall be rung with a light hammer to detect cracks. Any defective, damaged, or unsound pipe shall be rejected.

3.4 Pipe Cleaning: A thorough cleaning of each pipe section shall be done just before the section is lowered into the trench. A suitable swab shall be pushed through the pipe to insure that all foreign matter and dirt is removed from the inside of the pipe. The pipe shall be kept clean by approved means during and after laying.

3.5 Cutting Pipe: All cutting of pipe shall be done in a neat manner with the least amount of waste of pipe involved and without damage to existing or new pipe lines.

3.6 Pipe Alignment:

3.6.1 Sewers twenty-four inches (24") and less shall be laid with straight alignment between manholes. Alignment shall be checked by either using a laser beam or by lamping.

3.6.2 Curvilinear alignment of sewers larger than twenty-four inches (24") may be considered on a case-by-case basis provided compression joints are specified and ASTM or specific pipe

manufacturers' maximum allowable pipe joint deflection limits are not exceeded. Curvilinear sewers shall be limited to simple curves which start and end at manholes. Curvilinear sewers shall be designed so as to provide a minimum velocity of two feet (2') per second when flowing full.

- 3.7 Pipe Installation: All pipes, pipe fittings, etc. shall be lowered into the trench piece by piece by means of derricks, ropes, or other suitable equipment. Under no circumstances shall pipe or other materials be dropped into the trench. The pipe shall be laid with bell holes upstream, i.e., in the direction of laying operations. Pipe shall be laid in a bed of granular stone as shown on the drawings and as specified in Section 02222 - GRANULAR STONE BEDDING AND BACKFILL. In all cases, full length joints of pipe shall be used except in making closures. Grade lines shown on the profile drawings are the internal invert lines of the sewer pipe. The pipe shall be laid on grade with a grade rod that has an iron heel for the invert and notches for the line stretched over the pipe between the grade boards. Pipe laying machines, laser beams, or other devices may be used in lieu of a grade rod so long as comparable results are achieved. Bedding and backfilling of the pipe shall be in accordance with Section 02221 - TRENCHING, BACKFILLING, AND COMPACTING. At the close of each day's work, or when pipe is not being laid, the end of the pipe shall be stopped to overcome possible uplift and prohibit contamination. Any pipe which settles before acceptance, or which is not in true alignment, shall be taken up and replaced by the Contractor at his expense.
- 3.8 Joints: At all pipe joints, the granular stone bedding shall be excavated sufficiently so that the pipe bell will not rest on the bedding materials, but all the weight of the pipe shall be evenly distributed along the entire length of the barrel of the pipe. Care shall be taken to insure that the joints of the pipe are clean and free of any foreign material, and constructed watertight at all points. Any leaks or other defects discovered at any time before the final acceptance of the work shall be immediately repaired, or that portion of the sewer rebuilt, if necessary.
- 3.9 Removal of Buildings, Structures, and Improvements: Where buildings, structures, improvements, or materials of value are encountered in the area where sewer line is to be installed, the Contractor shall provide for the removal, protection, and disposition of these elements. The Contractor shall consult with the Owner relative to the proposed means of removal. All fences disturbed during construction shall be restored to a condition at least equal to that which existed prior to construction, unless specifically directed otherwise by the drawings. Certain repaired fence sections shall require installation of a fence gate. Locations of these gates shall be as called out on the drawings. Gates shall conform to the details shown on the drawings.
- 3.10 Stream Crossing: Stream crossings shall be constructed with mechanical joint, ductile iron pipe unless shown otherwise on the drawings. The length of the crossing being determined by the Plan and Profile drawings.
- 3.10.1 Depth: Sewers shall be installed to the depths shown on the Plan & Profile drawings and shall be compliant with 10 CSR 20-8.120(8)(A).
- 3.10.2 Structures: All structures related to the sewer system shall be installed such that they are located so as not to interfere with the free discharge of flood flows of the stream.
- 3.10.3 Silt and Erosion Control: The City of Carthage Model Best Management Practices (BMP's) for Land Disturbance shall be utilized to control silt laden runoff from the project area. The contractor shall provide to the owner an erosion control plan with BMP's denoted. The owner shall determine if the proposal is acceptable. If the proposal is found to be unacceptable, the contractor shall re-work the proposal to address all areas of concern. The owner shall have ultimate authority to approve or disapprove any erosion control plan.
- 3.11 Aerial Crossing: Sewers that must cross ditches, streams, gullies, etc., above ground shall be constructed of mechanical joint, ductile iron pipe. Each exposed joint of pipe shall have a minimum of two (2)

supports. Footings or foundations for each support shall be founded on undisturbed earth and the bottom of the footing/foundation shall be a minimum of 24" below grade.

3.11.1 Couplings shall be installed at each end of the transition from above-ground to below-ground sewers.

### 3.12 Separation of Sewer and Water Lines

3.12.1 Horizontal Distance: Sanitary sewers laid parallel to existing potable water lines, shall be installed to maintain at least ten feet horizontal separation between the sewer and water lines.

a. Deviation from the above requirement will be allowed in areas where horizontal separation cannot be maintained. In these cases the sewer may be installed closer to the water main, provided the water main is in a separate trench or on an undisturbed shelf located on one (1) side of the sewer and at an elevation so the bottom of the water main is at least eighteen inches (18") above the top of the sewer.

3.12.2 Vertical Distance: Sewers crossing water mains shall be laid to provide a minimum vertical distance of eighteen inches (18") between outside of the water main and the outside of the sewer. This shall be required whether the water main is above or below the sewer line. The crossing shall be arranged so the sewer joints will be equidistant and as far as possible from the water main joints.

a. Deviation from the above requirement will be allowed in areas where vertical separation cannot be maintained. In these cases sewers shall be constructed of ductile iron or pressure class 200 PVC (DR14) for ten feet each direction from the crossing point.

3.12.3 Where deviation from the proper clearance is required, the sewer shall be constructed of slip-on or mechanical joint pipe or be continuously encased and be pressure tested to one hundred fifty pounds per square inch (150 psi).

### 3.13 Separation of Manholes and Water Lines

3.13.1 Manholes shall be located at least ten feet (10') horizontally from any existing or proposed water main.

3.14 Lateral Sewers: The exact location of all tee or wye branches and other special pieces shall be carefully ascertained by the Owner before concealment by backfilling, by accurate measure from the center of the manhole next below in the same line of pipe; that a true and exact record may be preserved for future use.

a. No tee or wye branch or special piece shall be covered before its exact location has been noted and recorded. If the sewer is being laid within the street right-of-way, all laterals shall extend to the right-of-way line.

b. Tracer Wire: A #12 AWG solid copper tracer wire shall be installed with the lateral line from the building to the sewer main. The wire shall have an exposed pigtail near the building and shall be connected to a ½" x 4'-0" ground rod set near the tee or wye in the main.

c. Temporary Marker: A temporary wood 2" x 2" or equivalent will be required at the end of each lateral or tee extending from the lateral or tee to within two (2) to six (6) inches below the ground surface.

## 4. TESTING

4.1 General: Completed gravity and pressure sewer shall require pneumatic or hydrostatic testing for the purpose of locating potential infiltration and/or exfiltration within the system. Testing shall be as specified in Section 02749 - SEWER AND MANHOLE TESTING.

1. GENERAL

1.1 Description: The work of this section consists of pneumatic and hydrostatic testing of completed sewers, manholes and appurtenances for the purposes of measuring the amounts of infiltration and/or exfiltration prevailing or possible within any section of sewer line, any manhole or appurtenances. All acceptance tests for both sewer lines and manholes shall be conducted in the presence of the certifying engineer, his representative, or the city representatives.

2. MATERIALS AND EQUIPMENT

2.1 Pneumatic Testing Equipment: Equipment used shall meet the following minimum requirements:

2.1.1 Pneumatic plugs shall have a sealing length equal to or greater than the diameter of the pipe to be inspected.

2.1.2 Pneumatic plugs shall resist internal test pressures without requiring external bracing or blocking.

2.1.3 All air used shall pass through a single control panel.

2.1.4 Three individual hoses shall be used for the following connections:

2.1.5 From control panel to pneumatic plugs for inflation.

2.1.6 From control panel to sealed line for introducing the low pressure air.

a. From sealed line to control panel for continually monitoring the air pressure rise in the sealed line.

2.1.7 Equipment shall be equal to Cherne Air-Loc Equipment or approved equal.

2.2 Sewer Pipe Plugs: Shall be as manufactured by Cherne, Halliburton or approved equal.

2.3 Hydrostatic Testing Liquid: Shall be potable water or non-potable clean water. Raw sewage shall not be used.

2.4 Deflection Testing Equipment: Shall be rigid ball or mandrel with an outside diameter equal to 95 percent of the inside diameter of the line to be tested and shall have nine (9) or more odd number of flutes or points.

3. EXECUTION

3.1 Pneumatic Testing: The Contractor shall perform low pressure air testing on all sections of completed sewer, 6-inch through and including 24-inch diameters, in the presence of the Owner. It will be the responsibility of the Contractor to furnish and operate equipment capable of making the required tests. Testing methods and air leakage rates shall conform to ASTM C828-80T, Practice for Low-Pressure Test of Vitrified Clay Pipe or F1417-92 entitled Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines using Low-Pressure Air, or latest revision thereof, as a minimum. A copy of ASTM F1417-92 is included herewith for review.

3.1.1 Procedures, Above Groundwater Table: All pneumatic plugs shall be seal-tested before being used in the actual test installation. One length of pipe shall be laid on the ground and sealed at both ends with the pneumatic plugs to be checked. Air shall be introduced into the plugs to 25

psig. The sealed pipe shall be pressurized to 5 psig. The plugs shall hold against this pressure without bracing and without movement of the plugs out of the pipe.

- a. After a manhole to manhole reach of pipe has been backfilled and cleaned and pneumatic plugs are checked by the above procedure, the plugs shall be placed in the line at each manhole and inflated to 25 psig. Low pressure air shall be introduced into this sealed line until the internal air pressure reaches 4 psig greater than the average back pressure of any groundwater that may be over the pipe. At least two (2) minutes shall be allowed for the air pressure to stabilize.
- b. After the stabilization period (3.5 psig minimum pressure in the pipe), the air hose from the control panel to the air supply shall be disconnected. The portion of line being tested shall be termed "Acceptable" if the time required in minutes for the pressure to decrease from 3.5 to 2.5 psig (greater than the average back pressure of any groundwater that may be over the pipe) shall not be less than the time shown for the given diameters as found in ASTM F1417-92.

3.1.2 Procedures, Below Groundwater Table: In areas where groundwater is known to exist, the Contractor shall install a one-half diameter capped pipe nipple, approximately 10" long, through the manhole wall on top of one of the sewer lines entering the manhole. This shall be done at the time the sewer line is installed. Immediately prior to the performance of the test, the groundwater shall be determined by removing the pipe cap, blowing air through the pipe nipple into the ground so as to clear it, and then connecting a clear plastic tube to the nipple. The hose shall be held vertically and measurement of the height in feet of water over the invert of the pipe shall be taken after the water has stopped rising in this plastic tube. The height in feet shall be divided by 2.3 to establish the pounds of pressure that will be added to all readings. (For example, if the height of water is 11 ½ feet, then the added pressure will be 5 psig. This increases the 3.5 psig to 8.5 psig and the 2.5 psig to 7.5 psig. The allowable drop of one pound and the timing remain the same.)

3.2 Test Failures: If the sewer installation fails to meet these requirements, the Contractor shall, at his own expense, determine the source of leakage. He shall then repair or replace, at his own expense, all defective materials and/or workmanship.

3.3 Testing of Manholes: The Contractor will be required to make either hydrostatic or vacuum infiltration/exfiltration tests of all manholes in the presence of the City, to demonstrate that the manholes are free of leaks. Hydrostatic testing shall conform to ASTM C969. Vacuum testing shall conform to ASTM 1244.

3.3.1 Hydrostatic Testing: Where the top of the sewer is below water level, a non-half inch (1/2") galvanized pipe nipple is to be cast into each manhole wall and capped on the inside. The pipe nipple is to be located at the top of the inside bore of sewer pipe. All tests are to be conducted in the following manner:

- a. Test plugs are to be placed in the end of each sewer pipe on the downstream and upstream side of each manhole and inflated to a maximum pressure of 16 psig. Plugs are to be thoroughly blocked to prevent them from blowing out. The manhole is to be filled with water to a level four and one-half feet (4 ½') above the groundwater level or seven (7') feet above the pipe invert, or 2 feet (2') minimum above top of manhole rim elevation, whichever is higher. Ten minutes shall then be allowed for absorption, after which the water level shall be brought back to the test elevation.
- b. The specified head shall be maintained on the manhole for a period of eight (8) hours. Sufficient water shall be added to maintain this level. All water added shall be metered to within one-tenth of a gallon and recorded. The maximum allowable leakage shall be as specified herein.

- c. The Contractor shall provide all water, pumping facilities, and metering facilities necessary to perform the tests. After each test, all test water is to be pumped out.

3.3.2 Vacuum Testing: An approved vacuum type manhole tester shall be used to test manhole. The manhole ring shall be installed and tested as part of the manhole.

- a. The procedure for testing manholes shall be as follows:

Each manhole shall pass two tests; the first test shall be after assembly but prior to backfilling and the second test shall be after backfilling.

Place the vacuum "test head" assembly inside the manhole cover cast iron frame. The vacuum test shall include testing of the seal between the cast iron frame and concrete cone, slab or grade rings.

Plug all pipes entering the manhole at least eight inches into the sewer pipe. The plug must be inflated at a location past the manhole/pipe gasket.

Brace all plugs to prevent the plug or pipe from being dislodged and drawn into the manhole.

A vacuum of at least ten and one-half inches of mercury shall be drawn on the manhole. Shut valve on vacuum line to manhole and disconnect vacuum line. Open the vacuum line valve and adjust vacuum to ten inches of mercury.

The pressure gage shall be liquid filled and have a 3 ½ inch diameter face with a reading from zero to thirty inches of mercury. The test equipment shall be capable of having two gages connected. The gage supplied with the test equipment shall match the reading of a gage furnished by the Utilities Department. The gage reading is to be verified on each project.

The time for the vacuum reading to drop from ten inches of mercury to nine inches of mercury must be equal to or greater than the following values for the manhole to be considered as passing the vacuum test:

<u>MANHOLE DEPTH</u>	<u>TIME (minutes)</u>
10 feet or less	2
10.1 to 15 feet	2.5
15.1 to 25 feet	3

If vacuum drops less than one-inch mercury within the test time, the manhole is considered acceptable and passes the test. If manhole fails and leaks, the contractor shall make the needed repairs and test again until satisfactory results are obtained. Test may be done before backfilling, but shall be repeated after backfill.

All safety procedures, placing of plugs, and bracing, labor, and other work required for testing will be the responsibility of the contractor.

The contractor shall supply all required test plugs, vacuum plate, and vacuum pump.

3.4 Infiltration/Exfiltration Allowance:

3.4.1 Sewers 6" through 24" Diameter: Exfiltration of infiltration shall not be permitted to exceed 100 gallons per inch of pipe diameter per mile per day for any section of sewer and 1.14 gallon per day per foot of vertical depth per manhole.

- a. After the air test is carried out, a measurement of any flow in the sewers shall be made by the Contractor, in the presence of the Owner, to determine if the flow is below 100 gallons per inch diameter per mile per day limitation. Hydrostatic testing of manholes may then be conducted.
- b. Infiltration/exfiltration for manholes shall not exceed 1.14 gallons per day per vertical foot of manhole, determined by hydrostatic testing as specified by paragraph 3.2.

3.5 Infiltration/Exfiltration Elimination: The Contractor shall locate all sources of infiltration and exfiltration in the sewer lines, manholes, and appurtenances and shall correct deficiencies and eliminate infiltration/exfiltration sources. All sections of sewer line, manholes and appurtenances shall be re-tested after corrections are finalized. The Contractor shall carry the sole responsibility for providing a sewer system having infiltration or exfiltration below the specified limits.

#### 4. DEFLECTION TEST ON FLEXIBLE PIPE

- 4.1 Deflection tests shall be performed on all flexible pipes. The test shall be conducted after the final backfill has been in place at least thirty (30) days.
- 4.2 No pipe shall extend a deflection of five percent (5%). If the deflection exceeds the five percent (5%) limit, the pipe shall be excavated. Replacement or correction shall be accomplished in accordance per the owner's direction.
- 4.3 Performance: The deflection test shall be performed by hand pulling a rigid ball or mandrel through the installed pipe in the presence of the Owner. The mandrel shall be pulled through the pipe without the aid of a mechanical pulling device. If the rigid ball or mandrel fails to pull through the pipe, the section being tested fails the test and will be replaced by the Contractor at no expense to the Owner.