

DIVISION 14**SEWERS**14.01 Description:

The work shall consist of installing lines of sewer pipe or of monolithic sewer of the specified size or sizes, for the conveyance of storm water, sanitary sewage, or industrial waste, laid in a trench, and shall include excavating and backfilling. The work also shall include the construction of manholes, catch basins, and inlets with connections to the sewer, service laterals to abutting property when specified in the case of a sanitary sewer, and the restoration of pavement or other structures which are removed or damaged.

14.02 Materials:

- 14.02.01 (a) Sewer Mainline Pipe – Sewer pipe shall conform to one or all of the following current ASTM or other specification as designated on the plans or in the proposal items.
- (1) Concrete Pipe conforming to the current specifications ASTM C-14 or ASTM C-76, Class I through V as specified.
 - (2) Vitrified Clay Pipe conforming to either standard or extra strength ASTM C-700 or to the National Clay Pipe Institute's ER 4-67, as specified by the Engineer.
 - (3) Internally Braced Double Wall Truss Pipe and ES Solid Wall Pipe composed of virgin ABS compound conforming to ASTM D-2680, Type I or IV, excepting that the minimum heat deflection temperature (ASTM D-648) shall be 180 degrees Fahrenheit.
 - (4) Internally Braced Double Wall Truss Pipe composed of virgin PVC compound conforming to ASTM D-1784, with solvent cement joints.
 - (5) Ductile Iron Pipe shall conform to the current ANSI Standard A 21.50 thickness Class 52. Ductile Iron Pipe shall be cement or mortar lined in accordance with the current ANSI Standard A 21.51 or as shown on the Drawings or specified in the Bid Form. (Sanitary sewers, storm sewers, or basin connections)
- (b) House Sewer Lateral Pipe or Riser Pipe shall be six (6") inch truss pipe, six (6") inch ES solid wall pipe, six (6") inch vitrified clay pipe, or six (6") inch concrete pipe unless other wise specified.

- (1) Vitrified Clay Pipe for depth up to ten feet shall be standard strength pipe conforming to standard strength ASTM C-700 or National Clay Pipe Institute's ER 4-67. Depths over ten feet shall be extra strength ASTM C-700 or as specified by the Engineer.
- (2) Concrete Pipe shall conform to the requirements of the current specifications ASTM C-14 for depths up to ten (10') feet. For depths over ten (10') feet, the pipe shall be as specified by the Engineer.
- (3) Truss Pipe shall be as specified in Section 14.02.01 (a) 3 above.
- (4) SDR 35 PVC Pipe conforming to ASTM D 3034, with solvent cement joints.
- (5) Ductile Iron Pipe shall conform to the current ANSI Standard A 21.50 thickness Class 52. Ductile Iron Pipe shall be cement or mortar lined in accordance with the current ANSI Standard A 21.51.

14.02.02 Joints for Storm Sewer, Sanitary Sewer, Lateral or Riser Pipe shall conform to the following specifications.

- (1) Concrete Pipe – Joints for concrete sewer pipe shall be of Tylox type CR rubber gasket or equal using bell and spigot design. To form the seat for this rubber gasket, the spigot end of the pipe shall have a step in it formed by a machined steel ring. Joints and gaskets shall conform to current specification ASTM C-443 except the taper on the conic surfaces of the inside of the bell and the outer surface of the spigot shall not be more than four degrees with respect to the longitudinal axis of the pipe.

Joints for concrete sewer pipe of twelve (12") inch diameter and larger shall be of the round rubber gasket type using a modified bell and spigot design. The spigot shall have an external groove accurately sized to receive the gasket, so that when the pipe is laid and the joint completed, the gasket shall be enclosed on all four surfaces. Joints and gaskets shall conform to the current ASTM Specifications C-443 except the taper on the conic surfaces of the inside of the bell and outer surface of the spigot shall not be more than two degrees with respect to the longitudinal axis of the pipe. The durometer hardness of rubber gaskets shall be forty five (45) plus or minus five (5) and the gaskets shall have a circular cross-section. The Contractor shall furnish to the City a detailed drawing showing the pipe and joint proposed to be furnished under these specifications.

- (2) Vitrified Clay Pipe joints shall conform to the current ASTM Specifications C-425 Types I, II, or III. Clay pipe with PVC bells may be used with prior approval of the Engineer.

- (3) Truss Pipe joints shall be solvent weld type on eight (8”) inch (or less) sewer pipe with couplings manufactured of materials with chemical and physical properties equal to that of the pipe. Joints on sewers greater than eight (8”) inch in diameter shall be rubber gasket joints installed per the manufacturers recommendations.

14.02.03 Cement

- (a) Portland Cement shall conform to the requirements for Type I of the current specifications for Portland Cement, ASTM Designation C-150.
- (b) Air Entraining Portland Cement shall conform to the requirements for Type IA of the current specifications for Air Entraining Portland Cement, ASTM, Designation C-175.

14.02.04 Masonry Sand shall conform to the requirements of “Masonry Sand, 2MS” of the current MDOT Standard Specification.

14.02.05 Fine Aggregate shall conform to the requirements for “Sand 2NS” of the current MDOT Standard Specifications.

14.02.06 Coarse Aggregate shall conform to the requirements for “ Coarse Aggregate, 6A” of the current MDOT Standard Specifications.

14.02.07 Water for mixing and curing the mortar and concrete shall be obtained from a potable water supply, unless otherwise specified.

14.02.08 Steel Reinforcement shall conform to the requirements for Steel Reinforcement of the current MDOT Standard Specifications.

14.02.09 Cast Iron Units – Castings for manhole rings and covers, cast iron manhole steps, catch basin frames and grates, and for catch basin hoods, shall conform to the requirements of Division 16.

14.02.10 Block Masonry units and precast concrete section for use in manholes, catch basins, and inlets, shall conform to the requirements of Division 16.

14.02.11 Manhole Steps shall be cast iron or galvanized iron, or plastic as specified in Division 16.

14.02.12 Pipe Test Certification – All materials, except steel, used in the manufacture of concrete pipe, fittings, and specials shall be inspected for conformity with the specified requirements; all samples shall be taken; all concrete mixes shall be designed; and all specified tests shall be conducted or observed by an independent testing laboratory acceptable to the City. The entire cost of inspection, sampling, and testing, and all fees and other charges of the testing laboratory shall be paid by the Contractor. Contractor

shall supply pipe test certifications, additional tests may be required by the Engineer at the Contractor's cost.

A minimum of four pieces of each size and class of pipe, and up to one percent of the total laying length, shall be tested to ultimate failure by the testing laboratory at the expense of the Contractor. The number and type of tests will be determined by the Engineer. At least two pieces of each size and class shall be tested to ultimate failure by differential loading across the joint. The remainder shall be subjected to three-edge bearing tests.

The independent testing laboratory shall provide all necessary inspectors at the pipe manufacturing plant. Each inspector shall be fully qualified for the work entrusted to him. The testing laboratory shall certify to the City full compliance with the specified requirements for all accepted materials; shall submit reports covering all tests, acceptances, and rejections; and shall mark each acceptable pipe, fitting, or special with a permanent identifying symbol.

The Contractor shall furnish mill test reports on steel.

14.02.13 Pipe Marking – In addition to the markings which are required by the governing standard specification, each pipe, fitting and special section shall have plainly and permanently marked thereon:

- (a) Pipe Class.
- (b) Date of manufacture.
- (c) Manufacturer's name or trademark.
- (d) On bends, the angle turned thereby.

Markings shall be indented in the pipe or painted thereon with waterproof paint.

14.02.14 Pre-cast Storm Tee – Only precast storm tee from supplier will be allowed. No storm tee shall be constructed on the job site. The storm tee shall meet all requirements for precast storm sewer pipe of type and class specified.

The storm tee will be paid for at the contract unit price of each as measured at placement.

14.03 Construction Method:

14.03.01 Concrete Masonry – For a reinforced monolithic concrete sewer, the handling and storing of aggregates, the mixing, consistency, proportioning and strength of the concrete shall be as specified for Class A Concrete in Division 7. The concrete mixing and placing equipment and their use, the materials and workmanship for falsework and forms, placing

steel reinforcement, construction and expansion joints, curing, and protection from freezing, shall be done as specified for “Concrete Structure” in Division 8, or in Special Specifications.

- 14.03.02 Mortar – For block masonry and where permitted for sewer pipe joints, shall consist of one part of Portland Cement or Air-Entraining Portland Cement, and two parts of masonry sand. These proportions shall be measured by volume.

The sand and cement shall be mixed dry in a clean tight box or in a regular concrete mixer until a mixture of uniform color is produced, after which potable water shall be added until the required consistency is obtained. Mortar shall be mixed only in such quantities as needed for immediate use. The re-tempering of mortar will not be permitted.

- 14.03.03 Laying Sewer Pipe

- (a) General – The construction shall begin at the outlet end and proceed toward the upper end. The pipe shall be carefully laid in the prepared trench to the line and grade as given by the Engineer, with the spigot end downstream. The bottom of the trench shall be so shaped to permit a firm and even bearing along the barrel of the pipe. A sufficient sand cushion shall be provided in clay soil as specified in Section 13.03.01. The pipe shall be fitted close and tight and with smooth inverts.

Unless otherwise shown on the plans, all pipe shall be laid straight and at a uniform grade between manholes. Except where bends are installed adjacent to manholes, all lines shall be laid so that each section between manholes is true to line and grade and can be checked by laser.

Pipe shall be protected from lateral displacement by means of pipe embedment material installed as provided in the trench backfill specification. Under no circumstances shall pipe be laid in water and no pipe shall be laid under unsuitable weather or trench conditions.

When jointed in the trench, the pipe shall form a true and smooth line. Pipe shall not be trimmed except for closures, and pipe not making a good fit shall be removed.

While pipe laying is in progress, not less than three unfilled joints shall be in place ahead of any joint filling or sealing work, so that the sealed joints will not be disturbed by pipe laying operations.

Whenever a force of pressure main is to be constructed in which sewage will be pumped under pressure, it shall be installed according to the construction methods as specified in Division 17 or these specifications.

- (b) Pipe Handling – Pipe, fittings, and accessories shall be handled in a manner that will insure their installation in the work in sound, undamaged condition. Equipment, tools and methods used in unloading, reloading, hauling, and laying pipe and fitting shall be such that they are not damaged.

Hooks inserted in ends of vitrified clay pipe shall have broad, well padded contact surfaces. Vitrified clay pipe having premolded joint rings shall be handled in such a manner that no weight, including the weight of the pipe itself, will bear on or be supported by the spigot rings at any time. Care shall be taken to avoid dragging the spigot ring on the ground or allowing it to come in contact with gravel, chat, crushed stone, rocks, or other hard objects. Joint rings, which have been damaged in any way, will not be accepted and shall not be incorporated in the work.

Concrete pipe and fittings shall be handled with suitable slings and lifting hooks. No hooks shall be permitted to come in contact with joint surfaces. Pipe units shall be kept from contact with adjacent units during handling and storage.

- (c) Pipe Cleaning – The interior of all pipe and fittings shall be thoroughly cleaned of all foreign matter before being installed and shall be kept clean until the work has been accepted. All joint contact surfaces shall be kept clean until the jointing is completed.

Every precaution shall be taken to prevent foreign material from entering the pipe while it is being installed. No debris, tools, clothing or other materials shall be placed in the pipe.

Whenever pipe laying is stopped, the end of the pipe shall be closed with a plug, cap or end board closely fitting the end of the pipe.

- (d) Pipe Inspection – Each piece of clay sewer pipe shall be tested for soundness, after its delivery alongside the trench near the point of installation, by standing the pipe on one end (with a minimum of ground contact) and tapping the other end with a light hammer. Each end of each pipe shall be thus tested.

All pipe shall be subject to rejection on account of failure to conform to any requirement of the governing ASTM Standard Specification or these Specifications.

All accepted pipe and fittings shall be plainly marked in such a manner, and with such material, that the acceptance marks or symbols will be plainly visible after installation in the trench and that they will not become effaced by weather or handling.

Rejected pipe and fittings shall be marked and shall be removed from the site of the work immediately and permanently.

- (e) Laser – The Contractor shall use the laser beam method of maintaining line and grade for sewer construction, unless otherwise approved by the Engineer. The Contractor shall submit evidence to the Engineer that a qualified operator will handle the laser beam equipment during the course of construction.

The survey party shall place the line and grade stakes at each manhole, at a maximum of fifty (50') feet from the manhole and a maximum of one hundred (100') feet spacing or more often, as required by the Engineer. The Contractor shall check the line and grade at any point at which a stake has been placed.

- (f) Laterals – In sanitary sewers, the wye openings for house connections shall be placed at the locations shown on the plans or as indicated by the Engineer, and the pipe shall be laid from the wye to the property line. These laterals shall be laid at right angles to the street line unless otherwise directed and shall be laid on a uniform line and grade from the sewer opening to the property line. The laterals shall be laid at a minimum slope of one (1.0%) percent and the maximum slope shall not exceed two (2') feet vertical to one foot horizontal. Each lateral shall be laid so that it is eight and one-half (8-1/2') feet deep from the proposed top of curb elevation or ground elevation to the invert of the lateral, whichever is lowest, at the property line, unless otherwise ordered by the Engineer. The upper end of the lateral shall be closed with an acceptable stopper sealed in place by the same joint and material as used for the lateral.

The location of the end of each lateral and of each opening in the sewer shall be marked by a two (2") inch by two (2") inch wooden stake which stake shall extend vertically from the sewer pipe to within one foot of the ground surface. Service connections shall not be covered until the location of each has been recorded by the Engineer. All wooden markers shall be securely anchored and maintained in a proper vertical position until backfilling is complete. At the top of each two (2") inch by two (2") inch wooden stake, a magnetic washer shall be securely fastened at the upper end.

In the event that the lateral being constructed is to be constructed all the way to the structure which it will serve, the final connection is to be made by a licensed plumber in possession of a valid connection permit. No lateral is to be constructed any closer than five (5') feet to the structure it is to serve without the above requirements being met.

Approved pre-manufactured pipe-to-pipe adapters shall be utilized on all laterals where more than one type of pipe is used.

- (g) Other Connections – All other connections shall be made in Tee or Wye openings at the locations shown on the plans or as directed by the Engineer.

- (h) Sewer Tap – When tapping into a larger sewer, the opening in the larger sewer shall be no larger than is necessary to admit the new sewer. When the larger sewer is of reinforced concrete construction, the reinforcing steel shall be carefully cut off to the proper distance to avoid spalling the concrete. All broken or surplus material shall be removed from both sewers. A T-saddle or other approved connection shall be installed where a branch opening in an existing sewer does not exist. The connection and encasement shall be as shown in the standard details. The cut-in pipe shall not extend into the inner wall of the pipe cut into. The joint shall be sealed with 1:2 mortar, and with a sufficient bead or fillet of such mortar to insure a solid connection. When so directed by the Engineer, the Contractor shall place such a bead of fillet on the inside as well as on the outside of the larger sewer.

- 14.03.04 Concrete Cradle – Where concrete cradle is required, it shall be built using five (5) sack concrete and to conform to the details and at the locations shown on the plans or as ordered by the Engineer.
- 14.03.05 Manholes – All manholes shall be constructed to conform to the requirements of Division 16.
- 14.03.06 Catch Basins – All catch basins, intake basins, inlet chambers, etc., shall be constructed to conform to the requirements of Division 16.
- 14.03.07 Acceptance Tests – Acceptance tests will be conducted by the Engineer to determine the acceptability of the sewers as constructed. The Contractor shall furnish suitable assistants to help the Engineer during the conduction of the tests.

All defects in the sewers shall be repaired to the satisfaction of the Engineer.

- (a) Line and Grade – Each section of sewer line between manholes is required to be straight and uniformly graded. Each section will be checked by laser, as directed by the Engineer.
- (b) Exfiltration – The Contractor shall conduct an exfiltration test on each reach of pipe between manholes if so directed by the Engineer.

Ex-filtration tests shall be conducted by blocking off the other openings in the manhole at each end of the reach to be tested, filling the line and the manholes with water two (2') feet above the top of the pipe at the upper manhole and measuring the water required to keep that level. The total ex-filtration shall not exceed one hundred (100) gallons per inch of inside diameter per mile of pipe per day. The ex-filtration test shall be maintained on each reach for at least two (2) hours and as much longer as necessary, in the opinion of the Engineer, to locate all leaks. An allowance of ten percent of gallonage shall be permitted for each additional two (2') feet head over a basic two (2') feet minimum internal head at the lower manhole.

Ex-filtration tests in areas with water tables expected to be two (2') feet or more above the top of the pipe as determined by the soil borings shall be done as follows:

- (1) Where the water table has returned to its expected elevation above the pipe, the test shall be conducted by filling the section under test with water to a level which is two (2') feet above the water table, but not less than two (2') feet above the crown of the pipe. Allowable leakage shall be in accordance with the requirements of the above paragraph.
- (2) Where the water table has not returned to its expected elevation above the pipe, the test shall be conducted by filling the section under test with water to a level which is four (4') feet above the water table at the time of testing by not less than four (4') feet above the crown of the pipe provided that the water level inside the test section need not be more than two (2') feet above the expected water table elevation. Allowable leakage shall be in accordance with the above paragraph.

The Contractor shall provide, at his own expense, all necessary piping between the reach to be tested and the source of water supply, together with equipment and materials required for the tests. The methods used in the conduction of the ex-filtration tests shall be subject to the approval of the Engineer.

If the leakage in any reach exceeds the allowable maximum, it shall be re-tested after the leaks are repaired

In the event the Engineer determines that the results of the ex-filtration test are inconclusive because of visible infiltration, improper application of testing methods or other similar reasons, he may require an infiltration test for the section or sections of sewer involved before final acceptance.

- (c) Air Testing – A low pressure air test may be performed in lieu of the ex-filtration test for completed sections of sewer, at the discretion of the Engineer. If the sewer is tested by an air test, manholes shall be tested separately by means of the ex-filtration test.

The low pressure air test shall be performed on each section of pipe between manholes. The section of pipe being tested shall be sealed at each manhole using inflatable plugs or other approved devices. All plugs shall be adequately braced when required. An air supply with the necessary valves or gauges shall be provided for the test. Gauges shall have minimum division of 0.10 psi and shall have an accuracy of plus or minus 0.40 psi.

Where the expected water table level, as determined by the soil borings, is above the sewer elevation, the pressure testing limits for a dry trench condition shall be as follows:

- (1) Where the expected water table level is zero (0') feet to seven (7') feet above the pipe, the test pressure limits will be 3.5 to 2.5 psig.
- (2) Where the expected water table level is over seven (7') feet above the pipe, the test pressure limits will be 4.5 to 3.5 psig.

In a wet trench condition where the water table has risen above the pipe prior to testing, the air testing limits shall be determined by adding to the original 3.5 psig an additional .433 psig for each foot the water table is above the crown of the pipe, or as determined in the dry trench condition, whichever is greater.

The air pressure in the section under test shall be raised to an initial pressure of 0.5 psig above the beginning test pressure and allowed to stabilize for a minimum of five (5) minutes. Air shall be added during this stabilization period as required to maintain the pressure at or above the beginning test pressure.

The rate of air loss shall be determined by measuring the time interval required for the internal pressure to decrease 1.0 psi within the limits previously specified.

Minimum time interval for satisfactory test shall be in accordance with the table following this specification.

In the event the Engineer determines that the results of the air test are inconclusive because of visible infiltration, unsatisfactory or incomplete records, or improper application of testing methods or equipment or other similar reasons, he may require either an exfiltration test or an infiltration test for the section or sections of sewer involved.

Refer to Table 14A at the end of the section for Minimum Holding Times required.

- (d) Infiltration – In sanitary sewers, weirs will be placed temporarily for testing purposes in such manholes as necessary to measure the amount of infiltration, in which work the Contractor shall give the Engineer all reasonable assistance together with the necessary materials. In the event the allowable limit of infiltration is exceeded in any item of the contract, the Engineer shall order the reconstruction of the defective portion of the sewer.

The allowable amount of infiltration for sanitary sewers and laterals is shown in the following tabulation, based upon one hundred (100) gallons per inch of diameter per mile of sewer per day:

ALLOWABLE INFILTRATION/EXFILTRATION

<u>Diameter of Sewer (in)</u>	<u>Infil./Exfil Gal/Day/Foot</u>	<u>Diameter of Sewer (in)</u>	<u>Infil./Exfil Gal/Day/Foot</u>
6"	.113	30"	.568
8"	.151	36"	.681
10"	.198	42"	.795
12"	.227	48"	.909
15"	.284	54"	1.022
18"	.341	60"	1.136
21"	.397	66"	1.250
24"	.454	72"	1.363
27"	.511		

- (e) Video Inspection Test – A video inspection of all new sewers shall be provided to the City upon completion of the sewer and prior to final approval. Video shall be in the form of a DVD, with chapters identifying sections from manhole to manhole. Any infiltration or other defects identified within the video shall be corrected by the Contractor at no charge prior to final acceptance of the sewer.
- (f) Deflection Test – All flexible pipe with less than two-hundred (200 psi) pounds per square inch stiffness and all flexible pipe with greater than twelve (12') feet of cover shall be tested for deflection. Deflection testing shall be conducted at least 30 days after compaction of utility trench using a rigid ball or mandrel. Any pipe segment with deflection greater than 5% shall be considered unacceptable and shall be relaid and retested by the Contractor. The cost of deflection testing is considered to be included in the price bid for the sewer.

14.03.08 Sewer Reconstruction

- (a) Removal of Existing Sewer – When so noted in the items or on the plans, the work under these items shall include the removal of all existing sewer, laterals, manholes etc. Which are to be replaced by the reconstructed sewer system. No extra compensation will be paid for said removal or for any necessary plugs, unless provided in the proposal.

- (b) Maintain Existing Services – The Contractor shall make every reasonable effort to maintain uninterrupted water and sewer service to all property owners adjoining the project. In the event that such interruption of service is unavoidable, it shall be done only with prior approval of the Engineer. Any necessary pumping of sewage for any reason whatever shall be the responsibility of the Contractor. This responsibility shall commence at the time the Contractor commences reconstruction operations, or forty eight (48) hours after the award of the contract, whichever occurs first unless otherwise required in the Special Specifications.
- (c) Reconnection of Laterals – The Contractor shall place wyes in the reconstructed sewer as close to the existing laterals as is possible. No wye shall be placed upstream from the lateral. All tees and wyes shall be premanufactured. No field connections into the reconstructed sewer line will be allowed unless approved by the Engineer. Any necessary additional lateral alignment may be accomplished by using premium jointed bends, provided that no bends shall be sharper than forty five (45°) degrees.

The Contractor shall clean and inspect the lateral to the property line, and advise the Engineer of the condition of the lateral prior to making the connection.

The necessary field connection between the new lateral pipe and the existing lateral pipe shall be made by cutting the new lateral pipe to the proper length, inserting a prefabricated pipe to pipe adapter, and pouring a concrete collar not less than six (6”) inches thick by twelve (12”) inches wide around the joints. In the event the lateral is constructed of truss pipe, no concrete collar is to be placed. No misalignment or angle point will be allowed at the field connection. Connections using stainless steel or no-hub bands may be used.

The Contractor will be compensated for the field connection under the item for furnishing wyes. The Contractor will be compensated for the new lateral pipe under the “Furnish and Lay Sewer Lateral” item. The basis of payment for said compensation will be the straight line measurement from the centerline of the proposed main sewer line to the field connection at the existing lateral. No extra compensation will be paid for any bends or any other specials in the lateral.

14.03.09

Right-of-Way – The necessary rights-of way for the pipe line will be provided by the Owner. The Contractor shall confine his construction operations to the immediate vicinity of the location shown on the plans, and shall use due care in placing construction tools, equipment, excavated materials, and pipe line materials and supplies, so as to cause the least possible damage to property and interference with traffic. The placing of such tools, equipment, and materials shall be subject to the approval of the Engineer.

- (a) On Private Property – The boundaries of right-of-way across private property will be marked by the Engineer with stakes set at intervals of approximately two hundred (200’) feet and at each property line. The Contractor shall replace these

stakes with substantial posts approximately eight (8') feet long, set three (3') feet in the ground. Such posts shall be maintained in position until backfilling and cleanup operations have been completed adjacent thereto.

The Contractor shall be responsible for all damages to crops and other property outside of the boundaries of the right-of-way as marked, and shall make satisfactory settlement for such damage directly with the property owner and tenant involved, as their interest in such damage may require.

If it is necessary or desirable that the Contractor use or occupy land outside of the Owner's right-of-way, the Contractor shall obtain written consent from, or execute a written agreement with, the owner and tenant of such land permitting such occupation; the Contractor shall not enter for pipe delivery or occupy for any other purposes with men, tools, equipment, construction materials, or with materials excavated from the pipe trench, any private property outside the designated right-of-way boundaries without such written permission from the owner and tenant of the entered or occupied property.

14.04 Method of Measurement:

- 14.04.01 Sewers shall be measured on a horizontal plane in linear feet along the centerline of the sewer after installation of the pipe, from center to center of manholes, including tees and wyes.

Sanitary sewer shall be measured and paid for according to the depth classification listed in the proposal. Pay depth shall be measured from the existing centerline or survey line to the invert of the sewer.

The removal of pavement, curb, gutter, sidewalk, trees, brush, or other structures will be measured and paid for as similar items in the proposal unless otherwise stated.

- 14.04.02 Sewer Laterals shall be measured on a horizontal plane in lineal feet along the centerline of the pipe from the center of the main line sewer to the other end of the pipe.

The removal of pavement, curb, gutter, sidewalk, trees, brush, or other structures will be measured and paid for as similar items in the proposal unless otherwise stated.

- 14.04.03 Riser – Payment for risers shall be included in the placement of the lateral. No payment will be made separately.

- 14.04.04 Wyes and Service Connections – The unit prices named in the proposal for wyes and service connections shall be the additional cost of the wye or service connection over and above the cost of sewer pipe. The unit price shall include furnishing and installing a suitable plug in the wye, service connection, or service connection piping and providing a location marker.

14.04.05 Plugs/Bulkheads – Payment for plugs or bulkheads for pipe sized less than fifteen (15”) inches shall be included in the payment for the pipe. No additional compensation will be made for said placement if used for future extensions of sewer. Payment for plugs and bulkheads for pipe fifteen (15”) inches or larger shall be paid under the item Plug/Bulkheads.

14.05 Basis of Payment:

14.05.01 Furnishing and Laying of Sewers, Laterals and Riser shall be paid for at the contract unit price for each of the items, which payment shall be payment in full for completing the sewer ready for use.

The unit prices named in the proposal shall include all trenching, pipe jointing, materials, pipe laying, pipe embedment, channeling manholes, all backfill, labor and equipment, and all other costs in connection with furnishing and installing of sewers, laterals, and risers.

14.05.02 Wyes and Service Connections shall be paid for at the contract unit price for each, which payment shall be payment in full for furnishing and laying the wyes ready for use.

TABLE 14A

LOW PRESSURE AIR TEST TABLES
TIME REQUIRED FOR 1.0 PSIG PRESSURE DROP
WHEN TESTING ONE PIPE DIAMETER ONLY FOR SIZE AND LENGTH OF PIPE INDICATED.

TABLE FOR PVC AND DI PIPE

1 Pipe Diameter (in.)	2 Minimum Time (min:sec)	3 Length for Minimum Time (ft.)	4 Time for Longer Length (sec.)	Test Time for Length (L) Shown (min:sec)							
				100 ft.	150 ft.	200 ft.	250 ft.	300 ft.	350 ft.	400 ft.	450 ft.
4	3:46	597	.380 L	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46
6	5:40	398	.854 L	5:40	5:40	5:40	5:40	5:40	5:40	5:42	6:24
8	7:34	298	1.520 L	7:34	7:34	7:34	7:34	7:36	8:52	10:08	11:24
10	9:26	239	2.374 L	9:26	9:26	9:26	9:53	11:52	13:51	15:49	17:48
12	11:20	199	3.418 L	11:20	11:20	11:24	14:15	17:05	19:56	22:47	25:38
15	14:10	159	5.342 L	14:10	14:10	17:48	22:15	26:42	31:09	35:36	40:04
18	17:00	133	7.692 L	17:00	19:13	25:38	32:03	38:27	44:52	51:16	57:41
21	19:50	114	10.470 L	19:50	26:10	34:54	43:37	52:21	61:00	69:48	78:31
24	22:40	99	13.674 L	22:47	34:11	45:34	56:58	68:22	79:46	91:10	102:33
27	25:30	88	17.306 L	28:51	43:16	57:41	72:07	86:32	100:57	115:22	129:48
30	28:20	80	21.366 L	35:37	53:25	71:13	89:02	106:50	124:38	142:26	160:15
36	34:00	66	30.768 L	51:17	76:55	102:34	128:12	153:50	179:29	205:07	230:46

TABLE FOR VCP AND CONCRETE PIPE

1 Pipe Diameter (in.)	2 Minimum Time (min:sec)	3 Length for Minimum Time (ft.)	4 Time for Longer Length (sec.)	Test Time for Length (L) Shown (min:sec)							
				100 ft.	150 ft.	200 ft.	250 ft.	300 ft.	350 ft.	400 ft.	450 ft.
4	1:53	597	.190L	1:53	1:53	1:53	1:53	1:53	1:53	1:53	1:53
6	2:50	398	.427L	2:50	2:50	2:50	2:50	2:50	2:50	2:51	3:12
8	3:47	298	.760L	3:47	3:47	3:47	3:47	3:48	4:26	5:04	5:42
10	4:43	239	1.187L	4:43	4:43	4:43	4:57	5:56	6:55	7:54	8:54
12	5:40	199	1.709L	5:40	5:40	5:42	7:08	8:33	9:48	11:24	12:50
15	7:05	159	2.671L	7:05	7:05	8:54	11:08	13:21	15:35	17:48	20:02
18	8:30	133	3.846L	8:30	9:37	12:49	16:01	19:14	22:26	25:38	28:51
21	9:55	114	5.235L	9:55	13:05	17:27	21:49	26:11	30:32	34:54	39:16
24	11:20	99	6.837L	11:24	17:57	22:48	28:30	34:11	39:53	45:35	51:17
27	12:45	88	8.653L	14:25	21:38	28:51	36:04	43:16	50:30	57:42	64:54
30	14:10	80	10.683L	17:48	26:43	35:37	44:31	53:25	62:19	71:13	80:07
36	17:00	66	15.384L	25:39	38:28	51:17	64:06	76:55	89:44	102:34	115:23
42	19:50	57	20.939L	34:54	52:21	69:48	87:15	104:42	122:09	139:36	157:03

Note: When testing two sizes of pipe simultaneously, time shall computed by ratio of lengths involved.

Example: 400 feet of 8-inch PVC pipe and 150 feet of 6-inch VCP pipe.

$$\begin{aligned}
 \text{Time} &= \frac{\text{Time} = \text{Length}_1 \times \text{Time}_1 + \text{Length}_2 \times \text{Time}_2}{\text{Length}_1 + \text{Length}_2} \\
 &= \frac{400 \times 10:08 + 150 \times 2:50}{400 + 150} = \frac{400 \times 608 + 150 \times 170}{400 + 150} \\
 &= 489 \text{ seconds} = 8:09 \text{ (min:sec)}.
 \end{aligned}$$