

**APPENDIX A – STANDARD  
SPECIFICATIONS – 2019  
WASTEWATER UPDATES**



**GARDEN CITY**  
— KANSAS —

2019



# **STANDARD SPECIFICATIONS SANITARY SEWER CONSTRUCTION SECTION SS-1**

## **1.1 DESCRIPTION**

- A. This section of the specifications covers construction of wastewater collection systems consisting of sanitary sewer gravity and pressure mains, service fittings, and other appurtenances. This work shall consist of furnishing and installing pipe, service fittings, construction of manholes, testing, cleaning and other related work.

## **1.2 REFERENCES**

- A. American National Standards Institute (ANSI), Latest Edition.
- B. American Society of Mechanical Engineers (ASME), Latest Edition.
- C. American Society of Testing Materials (ASTM), Latest Edition.
- D. American Water Works Association (AWWA) Standards, Latest Edition.
- E. Building Officials and Code Administrators (BOCA) International, Inc., Latest Edition.
- F. Factory Mutual (FM), Latest Edition.
- G. International Association of Plumbing and Mechanical Officials (IAPMO), Latest Edition.
- H. Kansas Department of Health and Environment (KDHE), Minimum Standards of Design for Water Pollution Control Facilities, Latest Edition.
- I. UL, LLC, Latest Edition.

## **1.3 DEFINITIONS**

- A. ANSI: American National Standards Institute
- B. ASTM: American Society for Testing and Materials
- C. AWWA: American Water Works Association
- D. CCS: Copper Clad Steel
- E. CI: Cast Iron
- F. CICL: Cast Iron Cement Lined
- G. DI: Ductile Iron
- H. DICL: Ductile Iron Cement Lined
- I. DIPS: Ductile Iron Pipe Size
- J. DR: Dimension Ration
- K. IPS: Iron Pipe Size
- L. MJ: Mechanical Joint
- M. NSF: National Sanitation Foundation
- N. PVC: Polyvinyl Chloride
- O. RJ: Restrained Joint
- P. SJ: Slip Joint

## **1.4 SUBMITTALS**

- A. Product Data including the following:
  - 1. Catalog cut and general bulletins.
  - 2. Materials of construction.
  - 3. Manufacturer's certification or affidavit of compliance in accordance with applicable ANSI/AWWA or ASTM standard.
  - 4. Certification of NSF 61 and/or NSF 14.
  - 5. Compliance with RLDWA in accordance with NSF/ANSI 372.
  - 6. Operation, Maintenance, and Installation Manual.
- B. Manufacturer's Instructions: Instructions for installation for all pipe, fittings, and accessories utilized.
- C. Testing Reports as required.

## **1.5 PROJECT RECORD DOCUMENTS**

- A. Submit record documents to the City.
- B. Accurately record exact location of all buried piping and fittings.
- C. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

## **1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver, store and protect products per manufacturer's recommendations.
- B. Upon delivery, contractor shall inspect pipe and appurtenances for cracking, gouging, chipping, denting, and all other damage and immediately remove from the site. Replacement shall be provided with an acceptable material.
- C. The interior of all products shall be thoroughly cleaned of all foreign matter, and kept clean during construction operations. Protection of interior linings and exterior coatings shall be the contractor's responsibility.

## **1.7 COORDINATION**

- A. Coordinate any connections to the existing system with the City.
- B. Review installation procedures and coordinate the installation of items that must be installed with or before main pipeline construction
- C. Determine if any authorization to use water from the public fire hydrants for construction, testing and flushing is needed. Contractor shall apply for a permit at the appropriate City office to authorize usage of water.
- D. Operation of existing system valves shall be performed by the owner. Contractor may only operate valves if a utility company's representative is on site coordinating the operations.

## **1.8 PIPE & FITTINGS**

- A. Pipe and fittings used in sanitary sewer construction shall be in accordance with the following specifications or as called out in the Special Provisions. Any other pipe acceptable for use on the projects shall be outlined in the Special Provisions.

1. POLYVINYL CHLORIDE (PVC) GRAVITY PIPE:

- a. Integral bell and spigot-type rubber gasket “water-tight” joints with compounds conforming to ASTM D1784, SDR 35.
- b. Conforming to material requirements of ASTM D3034 and ASTM F679 in accordance with ASTM D1784.
- c. Joints shall meet the dimensional, chemical, and physical requirements as outlined in ASTM D3212.
- d. Gasket: Conform to ASTM F477.
- e. Minimum pipe stiffness at 5% deflections shall be 46 psi for SDR 35 pipe (all sizes) when tested in accordance with ASTM D2412.
- f. There should be no evidence of cracking or splitting when pipe is flattened in a circumferential orientation between two flat plates by sixty percent of the original inside diameter or as required by ASTM F1803.

2. DUCTILE IRON PIPE (DIP)

- a. Push-on joint type pipe conforming to ANSI/AWWA A21.51/C151 and ASTM A746, Pressure Class 250.
- b. Minimum wall thickness as specified in ASTM A746 Table 2 for Nominal Thicknesses for Standard Pressure Classes of Ductile Iron Pipe.
- c. Interior lining: AWWA C104, cement-mortar lined.
- d. Exterior coating: AWWA C151 and AWWA C110 asphaltic coating for buried piping approximately one (1) mil thick.
- e. Joints shall be push-on type joints conforming to ANSI A21.11 (AWWA C111).
- f. Flange Bolts: Stainless steel in structures and below grade.

3. POLYVINYL CHLORIDE (PVC) PRESSURE PIPE:

- a. Conform to ANSI/ASTM D2241, SDR 21. C900, SDR 18, C905.
- b. Pipe Compound: ASTM D1784
- c. Integral bell: Conform to ASTM D3139.
- d. Gasket: Conform to ASTM F477.
- e. Fittings: Ductile iron
- f. Provide mechanical joint restraints or concrete thrust blocking as shown on Drawings.

4. POLYETHYLENE (PE) PRESSURE PIPE:

- a. PE pipe for the pressure sewer mains shall meet the requirements of ANSI/AWWA Specification C906, DR 11, Polyethylene Pressure Pipe.
- b. Tubing that is bored under structures shall be supplied in lengths such that no splicing is necessary.

5. SPECIAL PIPE:

- a. Pipe used to encase sanitary sewer mains shall be steel pipe as specified in Section TT-1-1, Trenchless Technology. Pipe and fittings used in directional boring installations shall be as specified in the Trenchless Technology section.

## 6. AIR RELEASE/VACUUM VALVES

- a. Shall be a combination air valve for sewer and conforming to ANSI/AWWA C512.
- b. Shall operate under pressure to automatically allow entrapped air to escape from pipeline.
- c. Shall be of the type that releases large amounts of air, gases, and vapor during the filling of the system and allows large amounts of air into the system when the system drains to prevent vacuum damage to pipeline and accessories.
- d. Working pressure: coordinate with local pressures.
- e. Body: Composite (reinforced nylon)
- f. Thermal Protection:
  - 1) To be installed on all air release/vacuum valves inside buried structures.
  - 2) Exterior cover: Black PVC fabric 13 oz – water proof.
  - 3) Insulation: Closed cell foam – 0.58” thick.
  - 4) Interior cover: Black PVC fabric 13 oz – water proof.
  - 5) Fastening system: Fastened strap system with Velcro.
  - 6) Closure system: Teflon coated draw string.
  - 7) Manufacturer: A.R.I.
- g. Connection: Threaded or Flanged
- h. Manufacturer: A.R.I. – Substitutions with approval of City/Engineer.

## 1.9 PIPELINE ACCESSORIES – Subsidiary to Forcemain Construction

### 1. Tracer Wire

- a. Utilize on all open trenched non-ferrous pressure pipelines.
- b. Material: Blue No. 10 CCS wire, minimum; coated, plastic insulated as manufactured by Copperhead or approved equal. The insulation shall be heat, oil, and gasoline resistant.
- c. Shall run along the centerline of the pipe and taped to the pipe.
- d. Electrical tape shall cover splice locations so that no bare wire is exposed.
- e. Splices in the tracer wire shall be connected with snake bite locking wire connectors as manufactured by Copperhead or approved equal.

### 2. Tracer Wire Test Station

- a. Shall be installed adjacent to all air release/vacuum valve assemblies along the forcemain, road crossings, valves, pig launching/receiving stations, lift station(s), and both ends of the forcemain. Any exceptions to locations of test stations shall be approved by the ENGINEER.
- b. At each test station, the tracer wire shall be connected to a one pound zinc or magnesium anode. Anodes shall also be attached to the tracer wire at both the beginning and end of the proposed forcemain. Anodes shall be buried at the same elevation as the pipeline at each location. The anodes shall be connected to the CCS wire which shall be extended to the test station.
- c. Test station shall be galvanized or polypropylene material “condulet” style with removable solid cover having two leads extending from the face.

- d. The test shall be attached to a 1-inch conduit (36" length minimum).
  - e. In concrete environments, such as sidewalks in downtown areas, the contractor shall use the flush style test station.
  - f. Manufacturer: AGRA Industries, Farwest Corrosion Control Company, or approved equal.
  - g. Model / Manufacturer:
    - 8) Copperhead Industries, LLC; Monticello, MN.
    - 9) Farwest Corrosion Control Company; Downey, CA.
    - 10) Substitutions: Under provisions of Section 01600.
3. Underground Warning Tape
- a. Tracer tape shall be aluminum foil encased in an impervious mylar plastic coating on both sides and be at least 5 mils thick and three inches wide.
  - b. The tape shall be green in color and contain the message "Caution-Buried Sewer Line Below" printed in black.

## 1.10 MANHOLES

### 1. PRE-CAST MANHOLES:

- a. Manhole Frame and Cover – Cast Iron:
  - i. Gray Iron, ASTM A 48 Class 35B or Ductile Iron, ASTM 536 Grade 65-45-12.
  - ii. Model: Deeter 1315, Neenah NF-15360009/B (frame) and Neenah NF-15360010/B (cover).
  - iii. Substitutions with approval of City/Engineer
  - iv. All manhole frames to be placed in pavement or in areas to be subsequently paved shall have "machined horizontal bearing surfaces: and shall comply with Class #25 as established in ASTM A-48.
- b. Shaft Construction and Top Section:
  - i. Precast reinforced concrete manhole sections in accordance with ANSI/ASTM C478 except for the following modifications:
    - 1. Cement used in the construction of pre-cast reinforced concrete manholes shall conform to the requirements of the Standard Specifications for Portland Cement ASTM Designations C-150. The compressive strength of the concrete shall be not less than 4,000 psi.
    - 2. The minimum wall thickness for pre-cast concrete reinforced manholes shall be a minimum of 4" or 1/12 of the I.D. whichever is greater for manholes 16' or less in height; the minimum wall thickness for pre-cast concrete reinforced manholes shall be a minimum of 5" or 1/12 of the I.D. plus 1", whichever is greater, for manholes 16' or greater in height.
    - 3. Joints between precast reinforced concrete sections shall be of such design that leakage and infiltration can satisfactorily be reduced to a minimum. The use of mastics or rubber gaskets (natural or synthetic) at joints between pre-cast manhole sections is required.
    - 4. Pre-cast manhole bases are acceptable. The bottom sections of

all precast reinforced concrete manholes shall extend into the manhole base a minimum depth of 4". The base shall have a minimum diameter of 12" greater than the outside diameter of the manholes. Steel reinforcement of the manhole base is required. If the base is cast-in-place, use materials per Section 1.04, Manhole Materials.

5. Any precast manhole section that has been damaged, in transit or on site, such that the integrity of the section has been adversely affected, in the opinion of the Engineer, shall not be used.
- c. Manhole steps are not required.
    - i. Utilize a "Flat Top Manhole when total depth is less than 6 feet or if noted on the Drawings.
  - d. Adjustment Rings:
    - i. Precast reinforced concrete, tongue and groove.
    - ii. Cement shall conform to Portland Cement (ASTM C150).
  - e. Base Pad:
    - i. Pre-cast manhole bases are acceptable. The bottom sections of all pre-cast reinforced concrete manholes shall extend into the manhole base a minimum depth of 4-inches.
    - ii. The base shall have a minimum diameter of 12-inches greater than the outside diameter of the manholes.
    - iii. Steel reinforcement of the manhole base is required.
  - f. Butyl Sealant:
    - i. Butyl Rubber meeting AASHTO M-198B.
    - ii. Manufacturer: Bidco Sealants, Inc., Park Hills, Missouri.
    - iii. Model: Bidco C-56.
    - iv. Substitutions: Under provisions of Section 01600.
  - g. Exterior Joint Sealant
    - i. Rubber meets ASTM C923 / Mastic meets ASTM C990.
    - ii. Minimum 6 inches in width, centered on joint.
    - iii. Sealing Systems, Inc.; Loretto, MN
    - iv. Model: Infi-Shield Gator Wrap.
    - v. Substitutions with approval of City/Engineer
  - h. Manhole Chimney Seal
    - i. Rubber sleeve and extension meets ASTM C923, with a minimum 1500 psi tensile strength.
    - ii. Minimum 9 inches unexpanded vertical height and minimum thickness of 3-16 inches.
    - iii. Minimum of 1 inch stainless steel compression bands formed from 16 gauge stainless steel conforming to the applicable material requirement so ASTM C923.
    - iv. Shall be designed to prevent leak of water. Capable of repeated vertical movement of the frame of not less than 2 inches and/or repeated horizontal movement of not less than ½ inch.
    - v. Manufacturer: Cretex Specialty Products; Waukesha, WI.
    - vi. Model: External Chimney Seal.
    - vii. Substitutions: Under provisions of Section 01600.

- i. Pipe to Manhole Connection:
  - i. New Pipe to New Manhole
  - ii. Flexible pipe to manhole connector, watertight seal between pipe and concrete structure.

2. CAST-IN-PLACE MANHOLES:

- a. The use of cast-in-place manholes requires advance approval of the Engineer.
- b. Cast-in-place manholes shall have a minimum wall thickness of 8”.
- c. Concrete shall be placed in the forms in 2-foot layers and consolidated in a manner, which will prevent segregation of aggregates.
- d. Forms shall be made of metal, free from damage, and fabricated in sections permitting removal without damage to the concrete. The form used for the upper section of the manhole shall be tapered, resulting in a top diameter and height meeting the provisions of the standard drawings.
- e. Backfilling will not be permitted until 12 hours removal of the forms.

3. DROP MANHOLES.

- a. Drop manholes shall be constructed at locations where two or more lines connect or intersect at elevations differing 2’ or more. They shall be constructed in accordance with the standard drawings.

1.3 **MANHOLE MATERIALS.**

1. CONCRETE.

- a. Cement used in the construction of cast-in-place concrete manholes, or installation of pre-cast manholes, shall conform to the requirements of the Standard Specifications for Portland Cement ASTM Designations C-150. The compressive strength of the concrete shall be not less than 4,000 psi.

2. MORTAR.

- a. Mortar for jointing and plastering shall consist of one part Portland cement and two parts fine sand. The joints shall be completely filled and shall be smooth from surplus mortar on the inside of the manhole. Aggregate for mortar shall conform to ASTM Designation C-144.

3. NON-SHRINK GROUT.

- a. Master Builders "Embco, Sonneborn "Ferrolith CDS" or approved equal.

4. GASKETS.

a. MASTIC.

- i. Federal Specification SS-S-210; K.T Snyder "RamNek" or Kent Seal No. 2.

b. RUBBER.

- ii. Neoprene or other synthetic, 40 plus or minus 5 hardness when measured by ASTM D2240, Type A durometer.

c. MASTIC SEALING.

- iii. Koppers "Bitumastic SuperService Black", Tnemec "450 Heavy Tnemecol", or USS "Tarmastic 103".

## 5. CASTINGS.

- a. Manhole rings and covers shall be made of good quality gray iron, free from cracks, holes, swells and cold shuts and, shall be as shown on the standard drawings. Manhole rings and covers shall weigh not less than 270 pounds rated for traffic loading and the covers shall not be perforated unless otherwise specified. Cleanout frames and covers shall be made of the above material and shall weigh not less than 90 pounds.

## 6. FLOWABLE FILL.

- a. Flowable fill shall meet the specifications set forth in the City of Garden City, Kansas, Standard Specifications Section Str-6.

### 1.4 **CONCRETE CRADLES & ENCASEMENT**

1. Where unstable trench conditions are encountered which, in the opinion of the Engineer cannot be remedied by the addition of gravel or other select material, concrete cradle extending to the spring line of the pipe and 6" thick at the bottom shall be poured under the pipe and the full width of the trench.
2. A 6" thick concrete encasement shall be poured around the pipe when the cover over the top of the pipe is 30" or less.

### 1.5 **SERVICE CONNECTIONS & LINES**

1. Service connections shall be made with manufactured wye branch fittings.
2. Use of tapping tees or saddles is not allowed on new construction.
3. The minimum size of service line shall be 4",
4. Sch.40 PVC, using a minimum slope of 1/4" per foot.
5. All wye branches shall have a proper socket on the outer end.
6. Service lines shall be installed in accordance with the standard drawings.

### 1.6 **TRENCH AND BACKFILL**

1. Trench excavation and backfill shall include all excavation, backfilling, disposal of surplus and unsuitable material, and all other work incidental to the construction of trenches, including any excavation, which may be required for pipe installation and structures forming a part of the pipeline.
2. Work performed under this section shall also be in conformance with the City of Garden City *General Improvements Handbook*.
3. Water settlement (jetting) is not allowed.
4. The Contractor is responsible for conformance with current OSHA requirements and for the safety of his personnel and the public within or near excavations.
  - a. All shoring, bracing, and blocking shall be furnished and installed as required to preserve and maintain exposed excavation faces, to protect existing structures and facilities, and to provide for the safety of workmen and the general public.
5. The Contractor shall, in accordance with the *Manual of Uniform Traffic Control Devices, latest edition*, or as otherwise directed by the Engineer, provide and

maintain barricades, warning signs and lights and other safety devices required to protect the work, divert pedestrian and vehicular traffic and warn the general public of open excavations, unfilled trenches and other areas or conditions which might be hazardous.

6. All vegetation and other objectionable material shall be stripped from all areas of original ground or fill. Strippings shall not be used for backfilling structures, trenches or for fill of any kind. Unless otherwise directed, the contractor shall remove all unsuitable or surplus material, not required for fill or backfill, from the site.
7. Trenches shall be not less than 12" or more than 18" wider than the outside diameter of the pipe to be laid therein, unless otherwise required for proper bedding. Excess excavation below required level shall be backfilled with suitable material and compacted as directed by the Engineer. Bell holes shall be carefully excavated to insure pipe resting for its entire length upon the bottom of the trench. Trench bottoms shall be kept dry and stable during the trench preparation and until the pipe installation is completed to the extent that no damage from hydrostatic pressure, floatation, or other causes will result.

## 1.7 **INSTALLATION**

### 1. GENERAL:

- a. The pipe shall be installed to the line grade and pipe shown on the drawings. The Contractor shall provide all tools and equipment including any special tools designed for installing each particular type of pipe used. Proper implements, tools and facilities satisfactory to the Engineer shall be provided and used by the Contractor for the safe and convenient prosecution of the work.

### 2. DEWATERING OF TRENCH:

- a. Where water is encountered in the trench, it shall be removed during pipe laying operations and the trench so maintained until the ends of the pipe are sealed and provisions are made to prevent floating of the pipe.

### 3. RESPONSIBILITY FOR MATERIAL:

- a. The Contractor shall be responsible for all material furnished by him and shall replace at his own expense all such material found defective in manufacture or damaged in handling after delivery by the manufacturer. This shall include furnishing of all materials and labor required for the replacement of installed material discovered damaged or defective prior to the final acceptance of the work, or during the guarantee period.
- b. All rejected pipe shall be plainly marked by the Engineer and shall be replaced by the Contractor at his expense. After the pipe not rejected has been laid, all rejected pipe shall be accounted for.
- c. Pipe furnished by the Contractor shall be delivered and distributed at the site by the Contractor.
- d. Pipe, fittings and accessories shall be loaded and unloaded so as to avoid shock or damage. Under no circumstances shall such materials be dropped.
- e. The Contractor shall be responsible for the safe and proper storage of materials intended for the work.
- f. The interior of all pipe and other accessories shall be kept free from dirt

and foreign matter at all times. Precautions shall be taken to protect pipe and fittings against contamination.

- g. Pipe shall be so handled that coatings or linings will not be damaged. If, however, any part of the coating or lining is damaged, the repair shall be made by the Contractor, at his expense, in a manner satisfactory to the Engineer.

#### 4. LAYING OF PIPE:

- a. Pipe shall be laid and maintained to the required lines and grades with service fittings at the required locations.
- b. Pipe and fittings shall be carefully lowered into the trench piece by piece by suitable tools or equipment, in such a manner as to prevent damage to pipe materials and protective coatings and linings.
- c. Under no circumstances shall materials be dropped or dumped into the trench.
- d. All joints shall be made with the pipe in place in the trench.
- e. Ends of the pipe shall be clean and dry when the joints are made.
- f. Pipe bedding shall conform to ASCE Manual No. 60/WPCF Manual FD-5 or to the standards required for the type of pipe being installed.
- g. During laying operations, no debris, tools, clothing or other materials shall be placed in the pipe. At times when pipe laying is not in progress, the open ends of the pipe shall be closed by a watertight plug or other means approved by the Engineer.

### 1.8 **STRUCTURE EXCAVATION.**

- a. The topsoil is to be excavated and stockpiled. The excavation shall be carried to a line 2' beyond the exterior lines of the concrete foundation.
- b. If suitable soil is not encountered and it is necessary to excavate below the elevation shown on the plans, a good pit run gravel shall be placed thereon to the required grades to provide for the placement of the concrete.
- c. The material shall be compacted to the satisfaction of the Engineer. Provisions shall be made to allow for installation of piping and other connections to the respective structures.
- d. After completion of construction below original ground surface all forms, shoring, and bracing shall be removed and the excavation cleared of trash and debris.
- e. Material for backfilling shall consist of approved material from the excavation or from borrow source, placed in lifts, and compacted to a 95% standard density or as otherwise directed by the Engineer.
- f. Water settlement (jetting) is not allowed.
- g. All pipes under concrete floors/slabs shall be tested before the trenches are backfilled. After testing the pipelines, the trenches shall be backfilled with earth or sand and compacted to a density equal to that of the adjacent earth.

### 1.9 **CLEAN UP.**

- a. During the course of the work, and before final acceptance by the City, the

entire area shall be cleaned of all debris resulting from construction and shall be left in a clean and slightly condition.

- b. Rough grading shall be completed immediately after installation of construction.
- c. Landscape grading shall be completed within 10 working days of installation of construction.

#### 1.10 **SEPARATION FROM WATERMAINS.**

- a. A minimum horizontal distance of ten (10) feet shall be maintained between water and sewer lines. At points where sewers cross water mains, the sewer shall be constructed of cast or ductile iron, or encased in concrete for a distance of ten (10) feet in each direction of the crossing unless the water main is at least two (2) feet above the sewer.
- b. When using PVC (SDR-35) pipe and with advance approval by the Engineer, the crossing may be constructed using a section of pipe centered on the pipe to be crossed, resulting in joints located the maximum distance from the pipe to be crossed.

#### 1.11 **CERTIFICATIONS & TESTING.**

##### 1. REPORTS.

- a. Certified records of the tests made by the manufacturer or by a reliable commercial laboratory shall be submitted to the Engineer with each shipment of pipe.

##### 2. VIDEO.

- a. Prior to final acceptance, a video (CCTV) inspection shall be conducted by the City to check for alignment, deflection and other defects.

##### 3. LEAKAGE.

- a. Before acceptance, hydrostatic or air pressure tests shall be conducted, by the contractor in the presence of the Engineer. Testing method(s) to be used will properly consider groundwater elevation in relation to the sewer.
- b. Infiltration-exfiltration rates exceeding 25 gallons per day per inch of pipe diameter per mile for any section of the system shall be considered excessive and the section of pipe has failed.
- c. Infiltration-exfiltration tests must be conducted with a minimum of 4' of static water head above the invert of the sewer at the upstream manhole. Infiltration-exfiltration shall be less than 1.14 gallons per day per vertical foot of manhole height.

##### 4. LOW PRESSURE AIR TEST:

- a. Two procedures are included to find the rate of air leakage -- the constant-pressure method and the time-pressure drop method. This test may be used as a preliminary test to show the condition of a buried line prior to final backfill, paving, and other construction activities.
- b. This test is per Uni-Bell PVC Pipe Association, UNI-B-6-98. The section of the line to be tested is plugged. Air, at low pressure, is introduced into the plugged line. The line passes the test if the rate of air loss, as measured by pressure drop, does not exceed a specified amount in a specified time.
- c. APPARATUS.

- i. *Plugs*--Mechanical or pneumatic type.
  - ii. *Air Compressor*--A properly calibrated portable, oil-free air source with a singular control panel containing a main shut-off valve, pressure-regulating valve, 9 psig pressure-relief valve, input pressure gage, and a continuous monitoring pressure gage having a pressure range from 0 psi to at least 10 psi with minimum divisions of 0.10 psi and an accuracy of  $\pm 0.04$  psi.
  - iii. *Rotameter*, standard CFM reading with an accuracy of  $\pm 2\%$ .
- d. SAFETY PRECAUTIONS.
- i. It is extremely important that the various plugs be properly installed and braced to prevent the sudden expulsion of a poorly installed or partially inflated plug. Observe the following minimum safety precautions:
    - 1. No one shall be allowed in the manholes during testing.
    - 2. Install and restrain all caps and plugs securely.
    - 3. It is mandatory that all the caps and plugs be braced as an added safety factor.
    - 4. Do not over pressurize the lines. Do not exceed 9.0 psig. A regulator or relief valve set no higher than 9 psi shall be included on all pressurizing equipment.
- e. PROCEDURE.
- i. Clean the section of sewer line to be tested by flushing or other means.
  - ii. Isolate the section of sewer line to be tested by inflatable stoppers or other suitable test plugs.
  - iii. Plug or cap the ends of all branches, laterals, tees, wyes, and stubs to be included in the test to prevent air leakage. All plugs and caps shall be securely braced to prevent blow-out. One of the plugs or caps should have an inlet tap, or other provision for connecting a hose to a portable air control source.
  - iv. Connect the air hose to the inlet tap and portable air control source. The air equipment shall consist of necessary valves and pressure gages to control an oil-free air source and the rate at which air flows into the test section to enable monitoring of the air pressure within the test section.
  - v. Add air slowly to the test section until the pressure inside the pipe reaches 4.0 psig.
  - vi. After the pressure of 4.0 psig is obtained, regulate the air supply so that the pressure is maintained between 3.5 to 4.0 psig for at least 2 min. The pressure will normally drop slightly until equilibrium is obtained; however, a minimum of 3.5 psig is required.
  - vii. Determine the rate of air loss by either the constant pressure method or the time-pressure drop method.
    - 1. *Constant Pressure Method*--Add air until the internal air pressure of the sewer line is raised to 4.0 psig and the test pipe section is stabilized. Release the pressure to 3.5 psig to run the constant pressure test. The air-flow rate in

standard cubic feet per minute is read directly by a rotameter. Convert this air-flow rate to actual cubic feet per minute of air leaking from the test section by using the absolute pressure and temperature in the test section. The requirements for air loss under the constant pressure method shall be considered satisfied if the air loss does not exceed the specified leakage rate in cubic feet per minute per square foot of internal pipe surface area.

2. *Time-Pressure Drop Method*--Air is slowly introduced into the section of pipe to be tested, until the air pressure is raised to approximately 4.0 psi and the test pipe section is stabilized. Disconnect the air supply and decrease the pressure to 3.5 psi before starting the test. Determine the time required for the pressure to drop from 3.5 psi to 2.5 (or 3.0) psi, and compare this interval to the required time shown in Tables 1 or 2 to decide if the rate of air loss is within the allowable.
- viii. Upon completion of the test, open the bleeder valve and allow all air to escape. Plugs should not be removed until all air pressure in the test section has been reduced to atmospheric pressure.

f. TEST TIME CALCULATIONS.

- i. Calculate all test times by the following formula:

$$T = 0.085 DK/Q$$

where:

T = shortest time allowed for the air pressure to drop 1.0 psig, seconds  
K = 0.000419 DL  
but not less than 1.0

Q = leak rate in cubic feet/minute/square feet of internal surface = 0.0015 CFM/SF  
D = nominal diameter of sewer pipe, inches

L = length of test section, feet

- ii. Table 1 contains the specified minimum times required for a 1.0 psig pressure drop from a starting pressure of 3.5 psig using a leakage rate of 0.0015 ft<sup>3</sup>/min/ft<sup>2</sup> of internal surface.
- iii. Table 2 contains the specified minimum times required for a 0.5 psig pressure drop from a starting pressure of 3.5 psig using a leakage rate of 0.0015 ft<sup>3</sup>/min/ft<sup>2</sup> of internal surface. This test method is used for testing of long sections or sections of larger diameter pipes.
- iv. The total leakage from any test section shall not exceed 625Q.
- v. If the pressure drops 1.0 psig, or 0.5 psig, before the appropriate time shown in Table 1, or Table 2, has elapsed, the air loss rate shall be considered excessive and the section of pipe has failed the

test.

- vi. If lateral or service lines are included in the test, their length may be ignored for computing required test time if the test time requirements are met. If the test section fails, time shall be recomputed to include all the lateral lengths using the following formula:

$$T = 0.085(D1^2L1 + D2L2 + \dots)/(D1^2L1 + D2L2 + \dots)(K/Q)$$

where:

T = shortest time allowed for the air pressure to drop 1.0 psig, seconds,

K = 0.000419 (D1L1, + D2L2 + ...), but not less than 1.0,

Q = 0.0015 CFM/SF,

D1,D2,etc. = nominal diameters pipe being tested

L1,L2,etc. = respective lengths of the pipes being tested.

- vii. If the recomputed test time is short enough to allow the section tested to pass, then the test section meets the requirements of this test method.

**TABLE 1**  
**LOW PRESSURE AIR**  
**TEST PRESSURE**  
**DROP = 1.0 psi**

Minimum Specified Time Required for a 1.0 psig Pressure Drop for Size and Length of Pipe indicated for Q=0.0015

| Pipe Diameter in. | Minimum Time, min:s | Length for Minimum Time, ft. | Time for Longer Length,s | Specification Time for Length (L) Shown, min:s |        |        |        |        |        |        |        |        |
|-------------------|---------------------|------------------------------|--------------------------|--|--------|--------|--------|--------|--------|--------|--------|--------|
|                   |                     |                              |                          | 100 ft   | 150 ft | 200 ft | 250 ft | 300 ft | 350 ft | 400 ft | 450 ft |        |
| 4                 | 3:46                | 597                          | 0.380 L                  | 3:46   | 3:46   | 3:46   | 3:46   | 3:46   | 3:46   | 3:46   | 3:46   | 3:46   |
| 6                 | 5:40                | 398                          | 0.854 L                  | 5:40   | 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  | 17:48  |
| 10                | 9:25                | 239                          | 2.374 L                  | 9:26   | 9:26   | 9:26   | 9:53   | 11:52  | 13:51  | 15:49  | 17:48  | 25:38  |
| 12                | 11:20               | 199                          | 3.418 L                  | 11:20  | 11:20  | 11:24  | 14:15  | 17:05  | 19:56  | 22:47  | 25:38  | 30:04  |
| 15                | 14:10               | 159                          | 5.342 L                  | 14:10  | 14:10  | 17:48  | 22:15  | 26:42  | 31:09  | 35:36  | 40:04  | 45:31  |
| 18                | 17:00               | 133                          | 7.692 L                  | 17:00  | 19:13  | 25:38  | 32:03  | 38:27  | 44:52  | 51:16  | 57:41  | 64:06  |
| 21                | 19:50               | 114                          | 10.470 L                 | 19:50  | 26:10  | 34:54  | 43:37  | 52:21  | 61:00  | 69:48  | 78:31  | 87:14  |
| 24                | 22:40               | 99                           | 13.674 L                 | 22:47  | 34:11  | 45:34  | 56:58  | 68:22  | 79:46  | 91:10  | 102:33 | 113:57 |
| 27                | 25:30               | 88                           | 17.306 L                 | 28:51  | 43:16  | 57:41  | 72:07  | 86:32  | 100:57 | 115:22 | 129:48 | 144:23 |
| 30                | 28:20               | 80                           | 21.366 L                 | 35:37  | 53:25  | 71:13  | 89:02  | 106:50 | 124:38 | 142:26 | 160:15 | 178:03 |
| 33                | 31:10               | 72                           | 25.852 L                 | 43:05  | 64:38  | 86:10  | 107:43 | 129:16 | 150:43 | 172:21 | 193:53 | 215:25 |
| 36                | 34:00               | 66                           | 30.768 L                 | 51:17  | 76:55  | 102:34 | 128:12 | 153:50 | 179:29 | 205:07 | 230:46 | 256:24 |

**TABLE 2**  
**LOW PRESSURE AIR**  
**TEST PRESSURE**  
**DROP = 0.5 psi**

Minimum Specified Time Required for a 0.5 psig Pressure Drop for Size and Length of Pipe indicated for Q=0.0015

| Pipe Diameter in. | Minimum Time, min:s | Length for Minimum Time, ft. | Time for Longer Length,s | Specification Time for Length (L) Shown, min:s |        |        |        |        |        |        |        |      |
|-------------------|---------------------|------------------------------|--------------------------|--|--------|--------|--------|--------|--------|--------|--------|------|
|                   |                     |                              |                          | 100 ft   | 150 ft | 200 ft | 250 ft | 300 ft | 350 ft | 400 ft | 450 ft |      |
| 4                 | 1:53                | 597                          | 0.190 L                  | 1:53   | 1:53   | 1:53   | 1:53   | 1:53   | 1:53   | 1:53   | 1:53   | 1:53 |
| 6                 | 2:50                | 398                          | 0.427 L                  | 2:50   | 2:50   | 2:50   | 2:50   | 2:50   | 2:50   | 2:51   | 3:12   |      |
| 8                 | 3:47                | 298                          | 0.760 L                  | 3:47   | 3:47   | 3:47   | 3:47   | 3:48   | 4:26   | 5:04   | 5:42   |      |
| 10                | 4:43                | 239                          | 1.187 L                  | 4:43   | 4:43   | 4:43   | 4:57   | 5:56   | 6:55   | 7:54   | 8:54   |      |
| 12                | 5:40                | 199                          | 1.709 L                  | 5:40   | 5:40   | 5:42   | 7:08   | 8:33   | 9:58   | 11:24  | 12:50  |      |
| 15                | 7:05                | 159                          | 2.671 L                  | 7:05   | 7:05   | 8:54   | 11:08  | 13:21  | 15:35  | 17:48  | 20:02  |      |
| 18                | 8:30                | 133                          | 3.846 L                  | 8:30   | 9:37   | 12:49  | 16:01  | 19:14  | 22:26  | 25:38  | 28:51  |      |
| 21                | 9:55                | 114                          | 5.235 L                  | 9:55   | 13:05  | 17:27  | 21:49  | 26:11  | 30:32  | 34:54  | 39:16  |      |
| 24                | 11:20               | 99                           | 6.837 L                  | 11:24  | 17:57  | 22:48  | 28:30  | 34:11  | 39:53  | 45:35  | 51:17  |      |
| 27                | 12:45               | 88                           | 8.653 L                  | 14:25  | 21:38  | 28:51  | 36:04  | 43:16  | 50:30  | 57:42  | 64:54  |      |
| 30                | 14:10               | 80                           | 10.683 L                 | 17:48  | 26:43  | 35:37  | 44:31  | 53:25  | 62:19  | 71:13  | 80:07  |      |
| 33                | 15:35               | 72                           | 12.926 L                 | 21:33  | 32:19  | 43:56  | 53:12  | 64:38  | 75:24  | 86:10  | 96:57  |      |
| 36                | 17:00               | 66                           | 15.384 L                 | 25:39  | 38:28  | 51:17  | 64:06  | 76:55  | 89:44  | 102:34 | 115:23 |      |

1. *Note – Consult with pipe and appurtenance manufacturer for maximum test pressure for pipe size greater than 30 in. in diameter.*
  
2. *Note – It is not necessary to hold the test for the entire period of time in Table 1 or Table 2 when it is evident that the rate of air loss is zero or less than the allowable, and authorized by the Engineer.*

5. Manhole Vacuum Test:

- a. This test is used as an acceptance test for manholes. However, it may be a preliminary test to enable the Contractor to demonstrate the condition of the manholes prior to backfill.
  - i. Preparation of the manhole
    - 1. All lift holes shall be plugged. All pipes entering the manhole shall be temporarily plugged and securely braced to prevent them from being drawn into the manhole.
  - ii. Procedure
    - 1. The test head shall be placed at the top of the manhole in accordance with the manufacturer's recommendations. A vacuum of 10" of mercury shall be drawn on the manhole, the valve on the vacuum line of the test head closed, and the vacuum pump shut off. The time shall be measured for the vacuum to drop to 9" of mercury.
    - 2. The manhole shall pass if the time for the vacuum reading to drop from 10" of mercury to 9" of mercury meets or exceeds the values indicated in Table 3. If the manhole fails the initial test, necessary repairs shall be made by an approved method. The manhole shall then be retested until a satisfactory test is obtained.

**TABLE 3  
MANHOLE VACUUM TEST  
Minimum Test Times**

| Depth<br>(ft.) | Diameter, in. |    |    |    |    |    |    |     |     |
|----------------|---------------|----|----|----|----|----|----|-----|-----|
|                | 30            | 33 | 36 | 42 | 48 | 54 | 60 | 66  | 72  |
|                | Times         |    |    |    |    |    |    |     |     |
| 8              | 11            | 12 | 14 | 17 | 20 | 23 | 26 | 29  | 33  |
| 10             | 14            | 15 | 18 | 21 | 25 | 29 | 33 | 36  | 41  |
| 12             | 17            | 18 | 21 | 25 | 30 | 35 | 39 | 43  | 49  |
| 14             | 20            | 21 | 25 | 30 | 35 | 41 | 46 | 51  | 57  |
| 16             | 22            | 24 | 30 | 34 | 40 | 48 | 52 | 58  | 67  |
| 18             | 25            | 27 | 32 | 38 | 45 | 52 | 59 | 65  | 73  |
| 20             | 28            | 30 | 35 | 42 | 50 | 53 | 65 | 72  | 81  |
| 22             | 31            | 33 | 39 | 46 | 55 | 64 | 72 | 79  | 89  |
| 24             | 33            | 36 | 42 | 51 | 59 | 64 | 78 | 87  | 97  |
| 26             | 36            | 39 | 46 | 55 | 64 | 75 | 85 | 94  | 105 |
| 28             | 39            | 42 | 49 | 59 | 69 | 81 | 91 | 101 | 113 |
| 30             | 42            | 45 | 53 | 63 | 74 | 87 | 98 | 108 | 121 |

## 6. DEFLECTION TESTING.

- a. PVC gravity pipe sewer mains shall be tested for deflection.
- b. To insure accurate testing, the lines must be thoroughly cleaned.
- c. The maximum allowable deflection is 5.0%. Measurement will be made with a properly sized "go, no-go" mandrel or sewer ball, or other method approved by the engineer, not less than 30 calendar days following the installation.
- d. Deflections greater than 5.0% may require the pipe to be removed and reinstalled, or replaced if permanently damaged in any way.

## 1.12 **MEASUREMENT AND PAYMENT**

### 1. GENERAL:

- a. The following items shall constitute pay items for the work covered under this section of the Specifications. Payment for these items shall be full compensation for providing all materials, tools, labor and equipment necessary to complete the item and all incidental work related thereto, whether specifically mentioned herein or not. Payment shall include all testing and disinfecting.

### 2. GRAVITY SEWER MAIN – OPEN CUT:

- a. Open cut gravity sewer main will be paid for at the contract unit price per linear foot installed and measured on the centerline of the pipeline installed (horizontal to existing grade—no additional length will be paid for required curvature of pipe) for the respective pipe size indicated on the Drawings. This item shall include all costs in connection with furnishing and installing all pipe, fittings, caps or plugs, couplings, joint materials; restrained joints and special use fittings; seals; open trenching and over excavation of trench; stockpiling of topsoil; trench stabilization; dewatering as necessary; standard excavation; tunneling under or removing and replacing surface obstructions; discovery and protection of subsurface obstructions; shoring and bracing as required; fine grading and shaping trench bottoms; pipeline bedding; flowable fill where indicated; concrete encasement; backfilling and compaction; coordinating with Owner on salvage or disposal of surplus and waste materials; providing fill dirt as necessary; testing; grading; notification and coordination with adjacent landowners; borrow and disposal of soil as necessary; and all other incidental and appurtenant work required to complete this item.

### 3. FORCEMAIN PIPING – OPEN CUT:

- a. Open cut forcemain piping will be paid for at the contract unit price per linear foot installed and measured on the centerline of the pipeline installed (horizontal to existing grade—no additional length will be paid for required curvature of pipe) for the respective pipe size indicated on the Drawings. This item shall include all costs in connection with furnishing and installing all pipe, fittings, caps or plugs, couplings, joint materials; restrained joints and special use fittings; seals; open trenching and over excavation of trench; stockpiling of topsoil; trench stabilization; dewatering as necessary; standard excavation; tunneling under or removing and replacing surface obstructions; discovery and protection of subsurface obstructions; shoring and bracing as required; fine grading and shaping trench bottoms; pipeline bedding; flowable

fill where indicated; concrete encasement; backfilling and compaction; coordinating with Owner on salvage or disposal of surplus and waste materials; providing fill dirt as necessary; testing; grading; notification and coordination with adjacent landowners; borrow and disposal of soil as necessary; and all other incidental and appurtenant work required to complete this item.

4. MANHOLES:

- a. Measurement of manholes shall be on a per each basis, by numerical count of the sizes listed in the Proposal. A standard manhole shall be less than or equal to 8.0' in height. Extra manhole depth shall be measured on a vertical foot basis for each manhole over 8.01' in height. Payment for standard manholes and extra manhole depth, will be made at the Contract Unit Prices listed in the Proposal; which price shall include furnishing and installing the manholes, rock base, manhole testing, grout, adjustment rings (as necessary), cover, all additional excavation, backfill, and special compaction required for the installation, and all other work necessary or incidental for completion of the item.

5. CONNECTION TO EXISTING SYSTEMS

- a. Connection to Existing System will be paid for at the contract price per connection to the existing system. This item shall include all costs in connection with coordinating shutdown/by-pass pumping of existing system with Owner as necessary; removal and replacement of pavement or sidewalks disturbed by excavation activities; removal and replacement of existing ring and covers with joint seals; open trenching and over-excavation of trench; stockpiling of topsoil; trench stabilization; dewatering as necessary; standard excavation and over-excavation; tunneling under or removing and replacing surface obstructions; discovery and protection of subsurface obstructions; shoring and bracing as required; fine grading and shaping trench bottoms; pipeline bedding; furnishing and installing all pipe, special use fittings; connection to the existing gravity sewer manholes including water-stops; re-shaping of manhole inverts; grout as required; crushed rock fill; concrete; backfilling and compaction; grading; disposal of surplus and waste materials; manhole testing (if required); marking posts and appurtenant work required to complete this item.

6. SEWER SERVICE LINE CONNECTION

- a. Sewer Service Connection" will be paid for at the contract unit price for each connection actually installed and counted in place. This item shall include all costs in connection with additional excavation; rock excavation; standard and compacted backfill required; locating existing service line; connection to existing service line; furnishing and installing service connection wye; and all incidental and appurtenant work required to complete this item.

7. AIR RELEASE ASSEMBLY

- a. Air release assembly will be paid for at the contract unit price for each air release assembly installed. This item shall include all costs in connection with excavation, over excavation and backfill; compaction testing; dewatering as necessary; discovery and protection of subsurface obstructions; protection of surface obstructions; shoring and bracing as required; concrete;

concrete reinforcement; concrete testing; manhole steps; manhole ring and cover; tap; corporation stop as required; piping and fittings; valves; air/vacuum valve insulation and jacket; bracing, marker post, and crushed rock fill; disposal of surplus and waste materials; and all incidental and appurtenant work required to complete this item. Subsidiary items include clearing and grubbing.

### 1.13 **ACCEPTANCE OF WORK**

1. For all projects involving the City's wastewater facilities, work shall not be formally accepted by the City until the Contractor provides the City with two (2) copies of as-built drawings in accordance with Section 10 (k) of the City's General Conditions. Actual field dimensions between fittings, valves, hydrants, and other appurtenances shall be documented on these drawings, to the satisfaction of the City of Garden City Wastewater Department. In addition, dimensional ties will also be noted to physical aboveground features, which will locate the buried work.

Division of Environment  
Curtis State Office Building  
1000 SW Jackson St., Suite 400  
Topeka, KS 66612-1367



Phone: 785-296-1535  
Fax: 785-559-4264  
www.kdheks.gov

Lee A. Norman, M.D., Secretary

Laura Kelly, Governor

February 24, 2020

Mr. Doug Goetz, PE  
Wilson & Company  
1700 East Iron  
Salina, Kansas 67401

Re: Document titled:  
Garden City - Appendix A Technical - Standard Specifications-2019 Wastewater Updates  
Garden City - Appendix A Technical - Standard Specifications-2019 Trenchless Technologies

Dear Mr. Goetz:

The Kansas Department of Health and Environment has completed review of the above referenced Garden City documents.

The City of Garden City documents titled; Appendix A Technical - Standard Specifications-2019 Wastewater Updates and Appendix A Technical - Standard Specifications-2019 Trenchless Technologies as submitted, has been approved by KDHE for reference on current and future sanitary sewer extension projects. When revisions are made to the Sanitary portion of the said documents, please forward KDHE a copy. The KDHE shall maintain this copy on file for reference purposes with a file number of **19307**. Please refer to this number when submitting sanitary sewer extension project documents to the KDHE for review and permitting. The approval date for this document is February 24, 2020.

If you should have any questions regarding this approval, please contact our office.

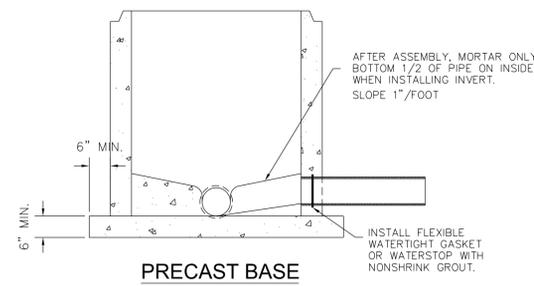
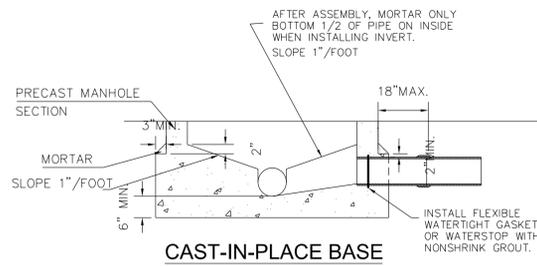
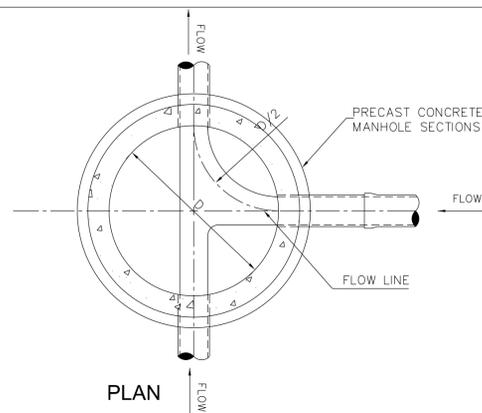
Sincerely yours,

A handwritten signature in blue ink that reads "Frank R. Weinhold".

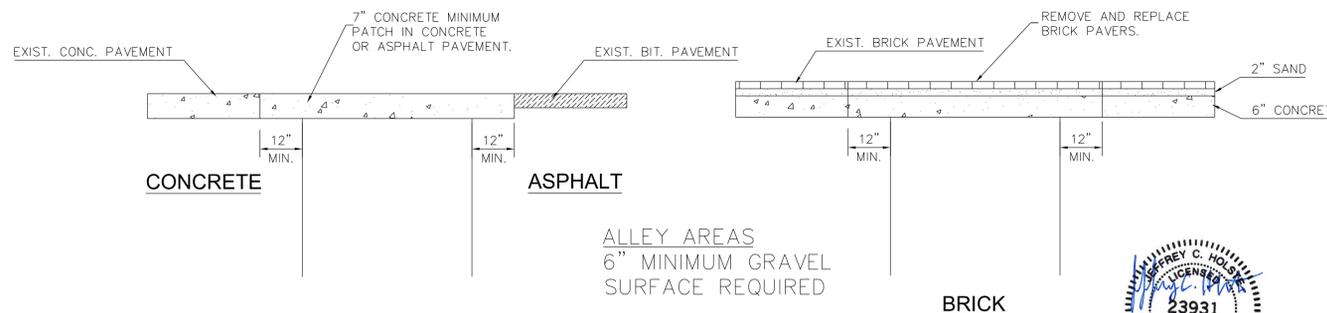
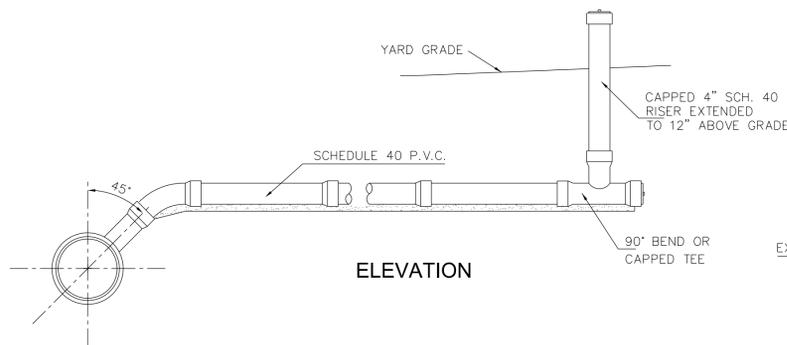
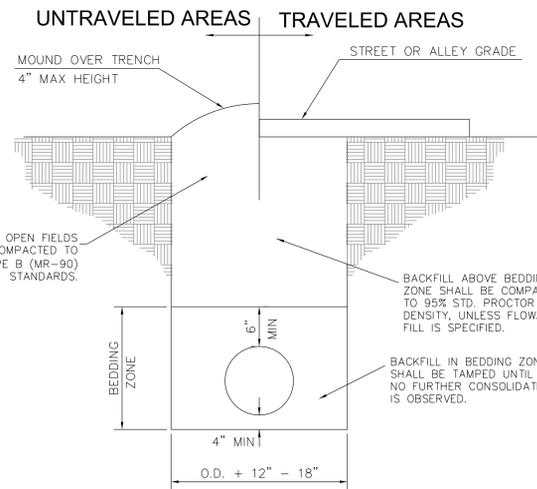
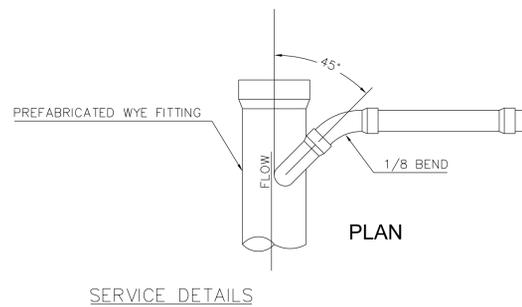
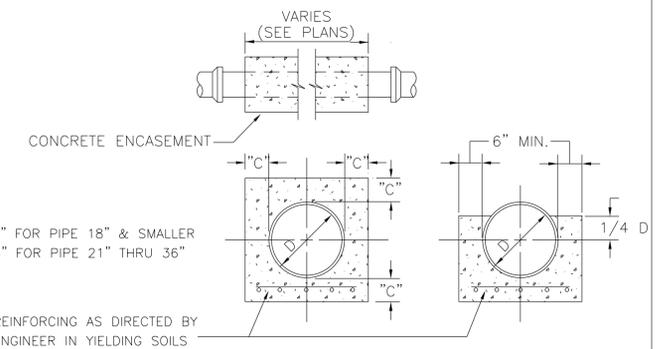
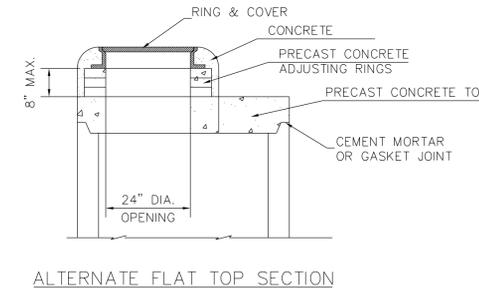
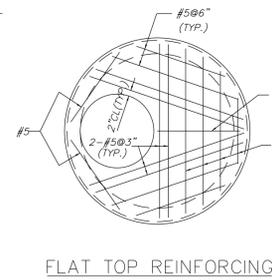
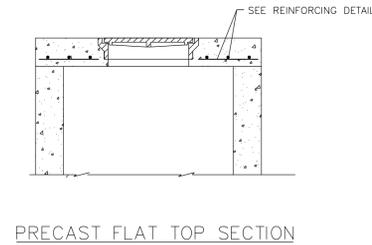
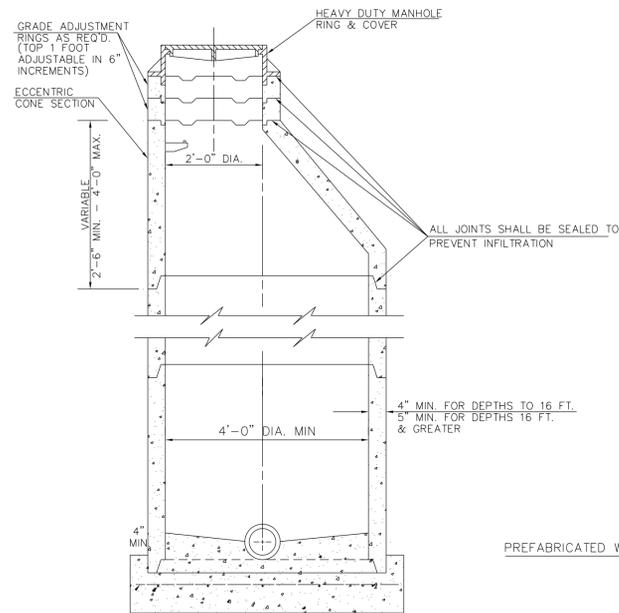
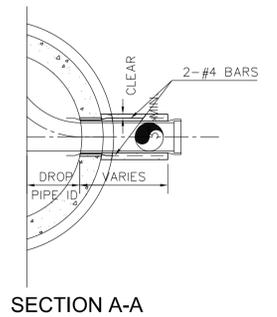
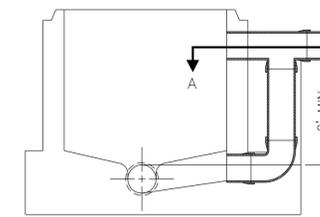
Frank R. Weinhold, P.E.  
Municipal Programs Section  
Bureau of Water

Enclosure: Wilson & Co. Letter dated 11/25/19

pc: Garden City – (Fred Jones Water Resources Manager) w/encl  
Rance Walker  
Jordan Beck  
2.0 File w/encl



**MANHOLE BASE DETAIL**



**SERVICE NOTES:**  
 IN NO CASE SHALL A SERVICE LINE CONNECT TO THE MAIN DIRECTLY AT TOP OF MAIN.  
 THE BID ITEM FOR SERVICE WYES SHALL INCLUDE THE STANDARD WYE, 45° BEND, AND RISER PIPE. SERVICE LINE & ALL TRENCHING AND BACKFILLING OF SEWER PIPE WILL BE PAID FOR PER LINEAR FOOT. SERVICE LINES SHALL BE INSTALLED AT A MINIMUM SLOPE OF 1R AS DIRECTED BY THE ENGINEER. THE SERVICE LINE SHALL BE SEALED WITH A SOLVENT WELDED CAP AND INCLUDED IN THE LINE TESTING.

**GENERAL NOTES:**

ALL STANDARD MANHOLE RINGS AND COVERS TO BE DEETER 1315, NEENAH NF-1536009/B (FRAME) AND NF-15360010/B (COVER), OR APPROVED EQUAL.

ALL MANHOLE RINGS TO BE PLACED IN PAVEMENT OR IN AREAS TO BE SUBSEQUENTLY PAVED SHALL HAVE "MACHINED HORIZONTAL BEARING SURFACES" AND SHALL COMPLY WITH CLASS #25 AS ESTABLISHED IN ASTM A-48.

STEPS ARE NOT REQUIRED.

**GENERAL NOTES FOR PRE-CAST MANHOLES**

1. REINFORCEMENT IN ALL SECTIONS SHALL EQUAL OR EXCEED A.S.T.M. C-478 SPECIFICATIONS.
2. MASTIC MATERIAL TO BE USED AT ALL SECTION JOINTS. O-RINGS MAY BE USED FOR JOINTS BELOW THE CONE SECTION, BUT THE CONE SECTION ITSELF SHALL NOT HAVE O-RING JOINTS.
3. APPROVED GASKET OR CONCRETE MORTAR TO BE USED AROUND PIPE IN KNOCK-OUTS.
4. USE FLAT TOP WHEN TOTAL DEPTH IS LESS THAN 6'.



City of Garden City, Kansas  
 Public Utilities Department  
 Wastewater Division  
 Wastewater Treatment Plant  
 345 S. Jennie Barker Rd., Garden City KS 67846

**Standard Details ~ Sanitary Sewer**

|                                 |           |             |
|---------------------------------|-----------|-------------|
| City Engineer: Wilson & Company | Revisions | Dr. By: JTA |
| Date: 10/02/2019                |           | Ck. By: DAG |
| Scale: NONE                     |           | Dr. No.: of |