

SECTION 330500 - COMMON WORK RESULTS FOR UTILITIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Piping joining materials.
 - 2. Transition fittings.
 - 3. Sleeves.
 - 4. Grout.
 - 5. Flowable fill.
 - 6. Piped utility demolition.
 - 7. Piping system common requirements.
 - 8. Equipment installation common requirements.

1.3 DEFINITIONS

- A. Exposed Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions.
- B. Concealed Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- C. PVC: Polyvinyl chloride plastic.

1.4 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.6 COORDINATION

- A. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

PART 2 - PRODUCTS

2.1 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness, unless otherwise indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
 - 2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Solvent Cements for Joining Plastic Piping:
 - 1. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

2.2 TRANSITION FITTINGS

- A. Transition Fittings, General: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.
- B. AWWA Transition Couplings NPS 2 and Larger:
 - 1. Description: AWWA C219, metal sleeve-type coupling for underground pressure piping.
- C. Plastic-to-Metal Transition Fittings:
 - 1. Description: PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint or threaded end.
- D. Plastic-to-Metal Transition Unions:
 - 1. Description: MSS SP-107, PVC four-part union. Include brass threaded end, solvent-cement-joint or threaded plastic end, rubber O-ring, and union nut.
- E. Flexible Transition Couplings for Underground Non-pressure Drainage Piping:
 - 1. Description: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.

2.3 SLEEVES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized, plain ends.
- B. PVC Pipe Sleeves: ASTM D 1785, Schedule 40.

2.4 GROUT

- A. Description: ASTM C 1107, Grade B, non-shrink and nonmetallic, dry hydraulic-cement grout.
 - 1. Characteristics: Post hardening, volume adjusting, non-staining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

2.5 FLOWABLE FILL

- A. Description: Low-strength-concrete, flowable-slurry mix.
 - 1. Cement: ASTM C 150, Type I, Portland.
 - 2. Density: 115- to 145-lb/cu. ft.
 - 3. Aggregates: ASTM C 33, natural sand, fine and crushed gravel or stone, coarse.
 - 4. Aggregates: ASTM C 33, natural sand, fine.
 - 5. Admixture: ASTM C 618, fly-ash mineral.
 - 6. Water: Comply with ASTM C 94/C 94M.
 - 7. Strength: 100 to 200 psig at 28 days.

PART 3 - EXECUTION

3.1 PIPED UTILITY DEMOLITION

- A. Disconnect, demolish, and remove piped utility systems, equipment, and components indicated to be removed.
 - 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
- B. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 PIPING INSTALLATION

- A. Install piping according to the following requirements and utilities Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on the Coordination Drawings.

- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping to permit valve servicing.
- E. Install piping at indicated slopes.
- F. Install piping free of sags and bends.
- G. Install fittings for changes in direction and branch connections.
- H. Select system components with pressure rating equal to or greater than system operating pressure.
- I. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of equipment areas or other wet areas 2 inches above finished floor level.
 - 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
 - a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
 - b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
- J. Verify final equipment locations for roughing-in.
- K. Refer to equipment specifications in other Sections for roughing-in requirements.

3.3 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and utilities Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

- E. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- F. Soldered Joints: Apply ASTM B 813 water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy (0.20 percent maximum lead content) complying with ASTM B 32.
- G. Plastic Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
 - 3. PVC Non-pressure Piping: Join according to ASTM D 2855.

3.4 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
 - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.5 EQUIPMENT INSTALLATION

- A. Install equipment level and plumb, unless otherwise indicated.
- B. Install equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference with other installations. Extend grease fittings to an accessible location.
- C. Install equipment to allow right of way to piping systems installed at required slope.

3.6 GROUTING

- A. Mix and install grout for equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.

H. Cure placed grout.

END OF SECTION 330500

SECTION 333100 - SANITARY SEWER

PART 1 - GENERAL

1.1 SANITARY SEWER PIPE

A. DESCRIPTION

Sanitary sewer pipe shall consist of trench excavation, removal of existing sanitary sewer, bypass pumping as required, furnishing and installing new sanitary sewer as specified, bedding material, backfill and complete restoration of disturbed areas, construction layout of new sanitary sewer with service laterals and follow up internal television inspection.

B. MATERIALS

1. Pipes and Fittings

- a. Polyvinyl chloride pipe (PVC) and fittings shall conform to the specifications set forth in ASTM D 3034, heavy wall class SDR 35.

C. CONNECTIONS

1. Pipe connections to the manhole shall be made with flexible connectors capable of sealing the annular space between the pipe and the manhole opening and of centering the pipe in the opening.
2. Connections to existing pipe, if and where applicable, shall be the fernco flexible pipe coupling appropriate for the material for the existing pipe, fernco couplings, or approved equal.

D. CONSTRUCTION REQUIREMENTS

1. Sanitary Sewer Replacement

- a. Open cut excavations shall be made in accordance with the latest provisions of "Subpart P - Excavations, Trenching and Shoring" taken from the Department of Labor, Occupational Safety and Health Administration Construction Safety and Health Regulations as published in the Federal Register and also in accordance with the requirements of the DOT Standard Specifications, to protect life, property or the work.
- b. The existing sanitary sewer pipe shall be removed as indicated on the plans. Upon removal of the existing pipe, bypass pumping shall be provided except at the direction of the engineer. The contractor shall provide and maintain pumps, piping, hoses, labor, and supervision necessary for the bypass pumping during sanitary sewer replacements.
- c. Excavation shall be carried to a depth of six inches below the existing invert grades. Upon this subgrade foundation, a cushion of bedding material as per the construction detail shall be placed and compacted to the grade of the underside of the pipe barrel. The pipe shall then be set to the line and grade and additional bedding material placed to one foot above the pipe.

- d. Pipe shall not be laid until the exact locations of utility structures in the vicinity have been determined in the field and the line and grade of the pipes have been approved by the engineer.
- e. Supports for existing utilities shall be provided as directed by the engineer.
- f. Dewatering methods and equipment shall be adequate to properly dewater the work and shall be subject to the approval of the engineer. In no case will the laying of pipe or the placing of masonry be permitted with water in the excavation nor will completed portions of the work be used as a means of dewatering trenches. Water removed from the work shall be disposed of in an approved manner without damage to adjacent property or other work. All sewage wastes removed from the excavation shall be transported to the municipal sewage treatment plant for disposal.
- g. Pipe shall be installed according to the manufacturer's recommendations and the current best practice in the industry.
- h. When cutting the pipe is required, the work shall be done with a power saw using a blade appropriate for the material in order to leave a smooth end at a right angle to the axis of the pipe.
- i. Prior to the laying of pipe and trench drains, the method to control alignment and grade shall be submitted for approval. The method shall be a laser system or grade board set up to establish a reference grade and alignment control directly above or in the pipe and along the invert of the trench drain.
- j. Broken pipe or otherwise damaged pipe shall be replaced.
- k. Existing sanitary sewer service laterals must be confirmed by the contractor either during construction or through records obtained by the municipality. All sanitary sewer house connections shall be made flush with the outside edge of the new sanitary sewer pipe and shall be watertight.
- l. The contractor should exercise care during construction. If any damage occurs to the existing sanitary pipes, manholes, or service laterals because of the contractor's operations, all damaged material shall be replaced in kind and in a manner satisfactory to the municipality at the contractor's expense.
- m. All excavations shall be completely backfilled and as great a portion as possible of the excavated material shall be used for backfill. The excavated material to be used for backfill shall be free from stumps, brush, weeds, roots, sod, rubbish, garbage, and other matter that may decay. The excavated material to be used for backfill shall also be free from rock, boulders, frozen materials and clay. It shall be suitable granular material as approved by the engineer. Excavations and backfill shall meet the requirements of Section 2.1 - Earthwork and other applicable sections of this specification.

1.2 MANHOLES, SANITARY SEWERS

A. DESCRIPTION

- 1. The work of this item shall consist of the construction of sanitary sewer manholes in accordance with the drawings and specifications, at the required locations and to the prescribed lines, grade, and dimensions.

B. MATERIALS

1. Material shall conform to the requirements specified therefore in the DOT Standard Specifications.

C. CONSTRUCTION REQUIREMENTS

1. The manhole bottoms shall be Class C concrete. Concrete channels shall be formed in the bottom with a cross section of the depth of one half the sewer diameter, shall slope to the outlet, matching the exact shape of the sewer invert. Channels shall have a minimum slope and shall have a smooth surface.
2. Manhole walls shall be constructed of concrete block and all joints between blocks shall be completely filled with 1:2 cement-sand mortar. Joints shall be made to produce a smooth and uniform surface. The outside surface of each manhole shall be plastered 1/2 inch thick, and troweled smooth with cement-sand mortar of the same consistency as above. The outside plastered surface shall be allowed to dry, and then shall be painted with one seal coat of coal tar or asphalt. Manhole walls may be constructed of poured concrete, subject to approval by engineer.
3. Frames shall be well bedded in mortar, making a watertight joint, and shall be adjusted so that the rim is approximately 1/4 inch above finished grade. Cover and frame shall have a shop coat of asphaltic pitch and shall have a field coat of similar paint after the frame is set in final position. Steps shall be provided in the manhole as shown on the drawings.
4. Each manhole shall be constructed absolutely watertight. Manholes that are not watertight will not be accepted. Plastering on top of defective joints to correct leaky conditions will not be permitted.
5. All work shall be done in a workmanlike manner and shall be subject to inspection, requirements and approval of the Municipality.
6. Precast manholes shall be an acceptable alternative.

1.3 SANITARY SERVICE CONNECTIONS

A. DESCRIPTION

1. The work of this item shall consist of the replacement and construction sanitary sewer laterals from the proposed sanitary sewer pipe to behind the proposed or existing curb, risers, and branch connections. The new lateral shall be of equal or greater size than existing.
2. This item shall include the excavation, removal of existing, bypass pumping as required, furnishings and installing the new sanitary service lateral between the main and a new cleanout, bedding material, backfill and complete restoration of disturbed areas, and a construction layout showing the new service laterals and sanitary sewer main. Also to be included will be a new pipe cleanout, tee, hub, and all miscellaneous items and labor necessary for installation from the main to the new cleanout and to connect the new service lateral from the building to the new cleanout.

B. MATERIALS

1. Polyvinyl chloride (PVC) sewer pipe and fittings shall be of 4", 6" or 8" size and shall be manufactured in accordance with ASTM specification D-3034 (SDR-35).

2. Fittings shall be made from virgin PVC compound having a cell classification of 12454-B, 12454-C, or 13343-C, as defined in ASTM D-1784. Different cell classifications having one or more superior properties may be acceptable and shall be submitted to the engineer for approval.
3. Fittings shall be suitable for use with SDR-26 gravity sewer pipe and shall not deflect more than the pipe when loaded and bedded in the same manner.
4. Joints shall be push on type and shall be in accordance with ASTM D-3212. Joints shall be as manufactured by Johns-Manville "ring-tite", certain-teed "fluid-tite" or approved equal.
5. Rubber-ring gaskets shall be molded or extruded and suitable for use with sewage, resistant to oil or solvents, and "in conformance with ASTM D-1869". The compound consisting of either a synthetic or natural rubber basis polymer and shall meet the following physical specifications:

Durometer Hardness, Points	52-62 Min.
Ultimate Tensile PST	2000 Min.
Elongation-Percent	350 Max.
Tension Set At 250°F	10% Max.
Modulus At 300%	1200-2300 Psi

C. CONSTRUCTION REQUIREMENTS

1. The contractor shall also aid the engineer taking measurements as necessary to permanently locate branch conditions.
2. Building laterals shall be laid coincidental with, or shortly after, the main sewer is installed so that repairs and cleanup are rapidly completed.
3. The pipe shall be laid on continuous upgrade of not less than 1/4" per foot and located where ordered by the engineer.
4. The General Contractor (GC) shall be responsible for the service connection from the main to the building and the connection to the building sanitary waste line.

1.4 GENERAL

- A. The Contractor shall be responsible for all conditions, requirements, and inspections as stated in applicable permits and in accordance with the latest edition of the DOT Standard Specifications.

END OF SECTION 333100

SECTION 333900 - SANITARY SEWER STRUCTURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Expansion joints.
 - 2. Encasement for piping.
 - 3. Manholes.

1.2 ACTION SUBMITTALS

- A. Product Data: For expansion joints.
- B. Shop Drawings: For manholes. Include plans, elevations, sections, details, and frames and covers.

1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Show pipe sizes, locations, and elevations. Show other piping in same trench and clearances from sewer system piping. Indicate interface and spatial relationship between manholes, piping, and proximate structures.
- B. Field quality-control reports.

PART 2 - PRODUCTS

2.1 MANHOLES

- A. Standard Precast Concrete Manholes:
 - 1. Description: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.
 - 2. Diameter: 48 inches or 72 inches minimum – see drawings.
 - 3. Ballast: Increase thickness of precast concrete sections or add concrete to base section, as required to prevent flotation.
 - 4. Base Section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section; with separate base slab or base section with integral floor.
 - 5. Riser Sections: 4-inch minimum thickness, of length to provide depth indicated.
 - 6. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated; with top of cone of size that matches grade rings.
 - 7. Joint Sealant: ASTM C 990, bitumen or butyl rubber.
 - 8. Resilient Pipe Connectors: ASTM C 923, cast or fitted into manhole walls, for each pipe connection.
 - 9. Steps: Individual FRP steps, FRP ladder, or ASTM A 615, deformed, 1/2-inch steel reinforcing rods encased in ASTM D 4101, PP wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 15-inch intervals. Omit steps if total depth from floor of manhole to finished grade is less than 36 inches.

10. Adjusting Rings: Interlocking HDPE rings, with level or sloped edge in thickness and diameter matching manhole frame and cover, and with height as required to adjust manhole frame and cover to indicated elevation and slope. Include sealant recommended by ring manufacturer.
11. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, with diameter matching manhole frame and cover, and with height as required to adjust manhole frame and cover to indicated elevation and slope.

B. Manhole Frames and Covers:

1. Description: Ferrous; 24-inch ID by 7- to 9-inch riser, with 4-inch- minimum-width flange and 26-inch- diameter cover (or sizes as indicated on the site plans or construction detail sheets.) Include indented top design with lettering cast into cover, using wording equivalent to "SANITARY SEWER."
2. Material: ASTM A 536, Grade 60-40-18 ductile iron unless otherwise indicated.

2.2 CONCRETE

A. General: Cast-in-place concrete complying with ACI 318, ACI 350/350R, and the following:

1. Cement: ASTM C 150, Type II.
2. Fine Aggregate: ASTM C 33, sand.
3. Coarse Aggregate: ASTM C 33, crushed gravel.
4. Water: Potable.

B. Portland Cement Design Mix: 4,000 psi minimum, with 0.45 maximum water/cementitious materials ratio.

1. Reinforcing Fabric: ASTM A 185, steel, welded wire fabric, plain.
2. Reinforcing Bars: ASTM A 615, Grade 60 deformed steel.

C. Manhole Channels and Benches: Factory or field formed from concrete. Portland cement design mix, 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio. Include channels and benches in manholes. Benches to be swept in 72" diameter manhole.

1. Channels: Concrete invert, formed to same width as connected piping, with height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope.
 - a. Invert Slope: 2 percent through manhole.
2. Benches: Concrete, sloped to drain into channel.
 - a. Slope: 8 percent.

D. Ballast and Pipe Supports: Portland cement design mix, 3000 psi minimum, with 0.58 maximum water/cementitious materials ratio.

1. Reinforcing Fabric: ASTM A 185, steel, welded wire fabric, plain.
2. Reinforcing Bars: ASTM A 615, Grade 60 deformed steel.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Excavating, trenching, and backfilling are specified in Section "Earthwork."

3.2 MANHOLE INSTALLATION

- A. General: Install manholes complete with appurtenances and accessories indicated.
- B. Install precast concrete manhole sections with sealants according to ASTM C 891.
- C. Form continuous concrete channels and benches between inlets and outlet.
- D. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 3 inches above finished surface elsewhere unless otherwise indicated.
- E. Install manhole-cover inserts in frame and immediately below cover.

3.3 IDENTIFICATION

- A. Materials and their installation are specified in Section "Earthwork." Arrange for installation of green warning tapes directly over piping and at outside edges of underground manholes.
 - 1. Use detectable warning tape over nonferrous piping and over edges of underground manholes.

3.4 FIELD QUALITY CONTROL

- A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.
 - 1. Submit separate report for each system inspection.
 - 2. Defects requiring correction include the following:
 - a. Alignment: Less than full diameter of inside of pipe is visible between structures.
 - b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
 - c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
 - d. Infiltration: Water leakage into piping.
 - e. Exfiltration: Water leakage from or around piping.
 - 3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
 - 4. Re-inspect and repeat procedure until results are satisfactory.
- B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
 - 1. Do not enclose, cover, or put into service before inspection and approval.
 - 2. Test completed piping systems according to requirements of authorities having jurisdiction.
 - 3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
 - 4. Submit separate report for each test.

5. Hydrostatic Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction and the following:
 - a. Fill sewer piping with water. Test with pressure of at least 10-foot head of water, and maintain such pressure without leakage for at least 15 minutes.
 - b. Close openings in system and fill with water.
 - c. Purge air and refill with water.
 - d. Disconnect water supply.
 - e. Test and inspect joints for leaks.
 6. Air Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction, UNI-B-6, and the following:
 - a. Option: Test plastic gravity sewer piping according to ASTM F 1417.
 - b. Option: Test concrete gravity sewer piping according to ASTM C 924.
 7. Manholes: Perform hydraulic test according to ASTM C 969.
- C. Leaks and loss in test pressure constitute defects that must be repaired.
- D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.
- E. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- F. Re-inspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for re-inspection.
- 3.5 CLEANING
- A. Clean interior of piping. Remove dirt and debris as work progresses.
 - B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
 - C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION 333900

SECTION 334100 – STORM DRAINAGE

PART 1 - GENERAL

1.1 GENERAL

Furnish and install the storm drainage system as shown on the drawings.

The Contractor shall furnish and install manholes, outlet structures, trench drains, slot drains, catch basins, stormwater chambers, storm pipe, and fittings shown on the drawings.

Existing pipe and storm water structures to remain in place shall be cleaned and all debris removed shall be disposed of off site. The piping to remain in place shall be saw cut and prepared for connection with the new drainage structures and piping.

1.2 STORM PIPE

- A. Scope: The Contractor shall furnish, lay and joint storm drainage pipe as shown on the drawings.

The work shall include all labor, tools, materials, and equipment including bedding and joint materials.

- B. Type of Pipe:

1. N-12 Pipe double wall HDPE as manufactured by ADS or equivalent
 - a. HDPE pipe shall have a smooth interior and annular exterior corrugations and in accordance with ASTM F2648.
2. Schedule 40 PVC.
 - a. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.
 - b. Cellular-Core PVC Pipe: ASTM F 891, Schedule 40.
 - c. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
 - d. Adhesive Primer: ASTM F 656.
 1. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 2. Adhesive primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

e. Solvent Cement: ASTM D 2564.

1. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Solvent cement shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Pipe Requirements:

1. The pipe shall be accurate and of uniform dimensions. All pipe shall be straight and true to form without bulges, dents, cracks, tears, or defects which will affect strength and shall have no bulges or dents on interior surfaces which will result in a noticeable variation in diameter from that obtained on adjacent unaffected portions of the surface.
2. Only domestic materials shall be offered, provided as follows, notwithstanding any inconsistent provision of law and unless the owner shall determine it to be in consistent with public interest or the cost to be unreasonable. Only pipe manufactured in the United States shall be used on this project.
3. The contractor shall supply pipe in standard lengths.
4. Each length of pipe shall be furnished with the manufacturer's designation indicating class, size, and batch of pipe.
5. The Contractor shall supply standard manufactured fittings and adapters for all bends and differences in pipe diameters.

D. Pipe Installation:

1. All pipe shall be carefully examined for dents, cracks, and other defects, and no pipe known to be defective shall be laid. If any pipe is found to be broken or defective after being laid, it shall be removed and replaced with a sound pipe without any further payment.
2. Joint surfaces shall be protected from damage and shall be carefully examined before jointing. No damaged joints shall be used in the work.
3. Pipe shall be thoroughly cleaned and ample precautions shall be taken to prevent entrance of dirt and debris into the pipe after laying. Exposed ends of the sewer shall be provided with temporary plugs or covers.
4. All pipe shall be carefully laid to true alignment and grade. The trench bottom (6" below invert of pipe) shall be carefully graded to the proper elevation and the maximum practical solid bearing area shall be provided throughout its entire length, prior to swinging the pipe into place.
5. Care shall be taken not to excavate below grade (6" below invert). Material excavated below grade shall be replaced by material that meets with the approval of the Engineer.
6. All trenches shall be dewatered prior to laying pipe.

7. Pipe to be installed at indicated slopes free of sags and bends.
8. Install fittings for changes in direction, branch connections and changes in pipe diameter.
9. Immediately after the pipe is brought to final position, it shall be thoroughly secured and properly bedded, and ample support shall be provided to prevent settlement or disturbance.
10. Pipe shall be protected during construction against possible floatation in case the trench becomes flooded prior to placing the backfill.
11. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
12. Install sleeves for piping penetrations of walls.

E. Jointing:

1. PVC pipe jointing:
 - a. Plastic, Non-pressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - b. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - c. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 Appendixes.
2. HDPE pipe
 - a. Pipe shall be joined using a bell & spigot joint meeting ASTM F2648.
 - b. The joint shall be soil-tight and gaskets, when applicable, shall meet the requirements of ASTM F477. Gaskets shall be installed by the pipe manufacturer and covered with a removable wrap to ensure the gasket is free from debris. A joint lubricant supplied by the manufacturer shall be used on the gasket and bell during assembly.
3. Pipe shall be carefully jointed in conformity with the best practice and the detailed instructions of the manufacturer.
4. All pipe ends shall be thoroughly cleaned prior to and during the jointing operation.
5. At the manholes and inlet connections use flexible water stops, resilient connectors, or other flexible connections to the structures.

1.3 CLEANOUTS

A. Plastic Cleanouts:

1. Description: PVC body with PVC threaded plug. Include PVC storm sewer pipe fitting and riser to cleanout of same material as storm sewer piping.

1.4 CATCH BASINS

A. Standard Precast Concrete Catch Basins:

1. Description: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.
2. Base Section: 8-inch minimum thickness for floor slab and 6-inch minimum thickness for walls and base riser section, and separate base slab or base section with integral floor.
3. Riser Sections: 6-inch minimum thickness, 48-inch diameter, and lengths to provide depth indicated.
4. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.
5. Joint Sealant: ASTM C 990, bitumen or butyl rubber.
6. Retain one of first two subparagraphs below if required.
7. Adjusting Rings: Interlocking rings with level or sloped edge in thickness and shape matching catch basin frame and grate. Include sealant recommended by ring manufacturer.
8. Grade Rings: Include two or three reinforced-concrete rings, of 6- to 9-inch total thickness, that match 24-inch-diameter frame and grate.
9. Steps: ASTM A 615, deformed, 1/2-inch steel reinforcing rods encased in ASTM D 4101, PP, wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of catch basin to finished grade is less than 36 inches.
10. Pipe Connectors: ASTM C 923, resilient, of size required, for each pipe connecting to base section.

B. Frames and Grates: ASTM A 536, Grade 60-40-18, ductile iron designed for A-16, structural loading. Include flat grate with small square or short-slotted bicycle safe drainage openings.

1. Size: 24 by 24 inches minimum unless otherwise indicated.
2. Grate Free Area: Approximately 50 percent unless otherwise indicated.

1.5 CATCH BASIN INSTALLATION

- A. General: Install catch basins, complete with appurtenances and accessories indicated.
- B. Install precast concrete catch basin sections with sealants according to ASTM C 891.
- C. Set tops of frames and covers flush with finished surface of catch basins that occur in pavements.

1.6 UNDERGROUND STORMWATER CHAMBERS

- A. Underground stormwater chambers are designed for stormwater management through retention and infiltration of controlled stormwater runoff. Chambers are to be Cultec Recharger V8HD units or approved equal.
- B. The chambers will be arched in shape and open-bottomed. Chambers will be joined using an interlocking overlapping rib method. Connections must be fully shouldered overlapping ribs, having no separate couplings or separate end walls.
- C. The nominal chamber dimensions shall be 32 inches tall, 60 inches wide and 8 feet long. The installed length of a chamber shall be 7.5 feet. The nominal chamber dimension of a "starter" or "end" unit shall be 32 inches tall, 60 inches wide and 5.08 feet long, with an installed length of 4.58 feet.
- D. The "intermediate" chamber units will have two side portals to accept feed connectors to create an internal manifold. The nominal dimensions of each side portal will be 10.5 inches high by 12 inches wide. The nominal chamber dimensions of the feed connectors shall be 12 inches tall, 16 inches wide and 24.2 inches long.
- E. The chambers will have discharge holes bored into the sidewalls of the unit's core to promote lateral conveyance of water.
- F. The chambers will have a raised integral cap at the top of the arch in the center of each unit to be used as an optional inspection port or clean-out.

1.7 SLOT SURFACE DRAIN

- A. Slot surface drain as manufactured by Duraslot or approved equal.
- B. Drain shall be manufactured from corrugated polyethylene pipe with a smooth inner wall, with pipe and fittings conforming to AASHTO M252.
- C. A grate frame that forms a slot shall be mounted in the pipe so as to provide a linear inlet into the top of the pipe to collect surface runoff. The slot shall be manufactured from .063 tempered commercial aluminum and shall have two parallel plates separated by vertical spacers spanning the slot on 6" centers.
- D. The grating within the slot opening shall be ½" - #13 galvanized steel. The slot shall be coated with a primer to protect the aluminum when installed in concrete.
- E. The flange at the bottom of the slot shall be riveted to the pipe with a minimum of two rivets per linear foot. The pipe shall have a section removed to accept the slot so as to maintain the original diameter.
- F. Cover the slot opening during construction to prevent clogging with poured concrete or asphalt. The top of the slot opening should always be set 1/8" to ¼" below finished grade. Follow manufacturer's instructions for installation.

1.8 MANHOLES AND STORM OUTLET STRUCTURES

- A. Standard Precast Concrete Manholes:

1. Description: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.
2. Diameter: As indicated.
3. Ballast: Increase thickness of precast concrete sections or add concrete to base section as required to prevent flotation.
4. Base Section: 8-inch minimum thickness for floor slab and 6-inch minimum thickness for walls and base riser section, and separate base slab or base section with integral floor.
5. Riser Sections: 4-inch minimum thickness, and lengths to provide depth indicated.
6. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated, and top of cone of size that matches grade rings.
7. Joint Sealant: ASTM C 990, bitumen or butyl rubber.
8. Resilient Pipe Connectors: ASTM C 923, cast or fitted into manhole walls, for each pipe connection.
9. Steps: wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of manhole to finished grade is less than 36".
10. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, to match diameter of manhole frame and cover, and height as required to adjust manhole frame and cover to indicated elevation and slope.

B. Manhole Frames and Covers:

1. Description: Ferrous; 24-inch ID by 7- to 9-inch riser with 4-inch minimum width flange and 26-inch diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "STORM SEWER."
2. Material: iron unless otherwise indicated.

1.9 FIELD QUALITY CONTROL

- A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.
1. Submit separate reports for each system inspection.
 2. Defects requiring correction include the following:
 - a. Alignment: Less than full diameter of inside of pipe is visible between structures.
 - b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.

- c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
 - d. Infiltration: Water leakage into piping.
 - e. Exfiltration: Water leakage from or around piping.
- 3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
- 4. Re-inspect and repeat procedure until results are satisfactory.
- B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
 - 1. Do not enclose, cover, or put into service before inspection and approval.
 - 2. Test completed piping systems according to requirements of authorities having jurisdiction.
 - 3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
 - 4. Submit separate report for each test.
 - 5. Gravity-Flow Storm Drainage Piping: Test according to requirements of authorities having jurisdiction, UNI-B-6, and the following:
 - a. Exception: Piping with soil tight joints unless required by authorities having jurisdiction.
 - b. Option: Test plastic piping according to ASTM F 1417.
- C. Leaks and loss in test pressure constitute defects that must be repaired.
- D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

1.10 IDENTIFICATION

- A. Arrange for installation of green warning tape directly over piping and at outside edge of underground structures.
 - 1. Use detectable warning tape over ferrous piping.
 - 2. Use detectable warning tape over nonferrous piping and over edges of underground structures.

END OF SECTION 334100