SECTION 33 41 00 - STORM UTILITY DRAINAGE PIPING

PART 1 - GENERAL

- 1.1 SECTION INCLUDES
 - A. Roadway and/or site storm drainage system up to five feet of any on-site building
- 1.2 RELATED SECTIONS
 - A. Section 31 21 00, Utility Trenching and Backfill
 - B. Section 32 13 18, Cement and Concrete for Exterior Improvements
- 1.3 RELATED DOCUMENTS

A. AASHTO

- 1. M199: Precast Reinforced Concrete Manhole Sections
- 2. M252: Corrugated Polyethylene Drainage Pipe
- 3. M294: Corrugated Polyethylene Pipe, 12 to 604 inch Diameter

B. ASTM

- 1. A74: Cast Iron Soil Pipe and Fittings
- 2. A615: Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
- 3. C143: Standard Test Method for Slump of Hydraulic-Cement Concrete
- 4. C443: Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
- 5. C478: Circular Precast Reinforced Concrete Manhole Sections
- 6. C564: Rubber Gaskets for Cast Iron Soil Pipe and Fittings
- 7. C923: Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals
- 8. C1173: Flexible Transition Couplings for Underground Piping Systems
- 9. D1785: Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
- 10. D2321: Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity Flow Applications
- 11. D2564: Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
- 12. D3034: Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
- 13. D4101: Propylene Injection and Extrusion Materials
- 14. F477: Elastomeric Seals (Gaskets) for Joining Plastic Pipe
- 15. F656: Primers for Use in Solvent Cement Joints of Poly(Vinyl Chloride) (PVC) Plastic Pipe and Fittings
- 16. F679: Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings
- 17. F1336: Poly(Vinyl Chloride) (PVC) Gasket Sewer Fittings
- C. AWWA
 - 1. C104: Cement-Mortar Lining for Ductile-Iron Pipe and Fittings
 - 2. C105: Polyethylene Encasement for Ductile-Iron Pipe Systems
 - 3. C110: Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In. for Water

- 4. C111: Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
- 5. C115: Flanged Ductile-Iron Pipe With Ductile-Iron or Gray-Iron Threaded Flanges
- 6. C116: Protective Fusion-Bonded Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings
- 7. C150: Thickness design of Ductile Iron Pipe
- 8. C151: Ductile-Iron Pipe, Centrifugally Cast
- 9. C153: Ductile-Iron Compact Fittings
- 10. C219: Bolted, Sleeve-type Couplings for Plain-End Pipe
- 11. M41: Ductile Iron Pipe and Fittings
- D. Caltrans Standard Specifications, 2018
 - 1. Section 51, Concrete Structures
 - 2. Section 52, Reinforcement
 - 3. Section 65, Concrete Pipe
 - 4. Section 66, Corrugated Metal Pipe
 - 5. Section 70, Miscellaneous Drainage Facilities
 - 6. Section 72, Slope Protection
 - 7. Section 75, Miscellaneous Metal
 - 8. Section 90, Concrete
- E. Caltrans Standard Plans, 2015
 - 1. Plan D94A: Metal and Plastic Flared End Sections
 - 2. Plan D94B: Concrete Flared End Sections
 - 3. Plan D97A: Corrugated Metal Pipe Coupling Details No. 1, Annular Coupling Band Bar and Strap and Angle Connection
 - 4. Plan D97C: Corrugated Metal Pipe Coupling Details No. 3, Helical and Universal Couplers
 - 5. Plan D97D: Corrugated Metal Pipe Coupling Details No. 4, Hugger Coupling Bands
 - 6. Plan D97E: Corrugated Metal Pipe Coupling Details No. 5, Standard Joint
 - 7. Plan D97F: Corrugated Metal Pipe Coupling Details No. 6, Positive Joint
 - 8. Plan D97G: Corrugated Metal Pipe Coupling Details No. 7, Downdrain
 - 9. Plan D98A: Slotted Corrugated Steel Pipe Drain Details
 - 10. Plan D98B: Slotted Corrugated Steel Pipe Drain Details

1.4 DEFINITIONS

- A. AASHTO: American Association of State Highway and Transportation Officials
- B. ASTM: American Society for Testing Materials
- C. AWWA: American Water Works Association
- D. CMP: Corrugated metal pipe
- E. DIP: Ductile iron pipe
- F. HDPE: High-density polyethylene
- G. NPS: Nominal pipe size

- H. PE: Polyethylene
- I. PVC: Polyvinyl Chloride
- J. RCP: Reinforced concrete pipe
- 1.5 SUBMITTALS
 - A. Product data for the following:
 - 1. Piping materials and fittings
 - 2. Special pipe couplings
 - 3. Polymer-concrete, channel drainage systems (trench drains)
 - 4. Joint sealants
 - 5. Plastic area drains
 - 6. Cleanout plugs or caps
 - 7. Precast concrete catch basins, inlets, curb inlets, junction structures and area drains, including frames and grates
 - 8. Precast clean out boxes and box covers
 - 9. Concrete, metal and plastic flared end sections
 - B. Shop drawings: Include plans, elevations, details and attachments for the following:
 1. Precast concrete manholes, frames and covers
 - C. Design Mix Reports and Calculations: For each class of cast in place concrete
 - D. Field Test Reports: Indicate and interpret test results for compliance with performance.
- 1.6 DELIVERY, STORAGE AND HANDLING
 - A. Delivery and Storage
 - Piping: Inspect materials delivered to site for damage; store with minimum of handling. Store materials on site in enclosures or under protective coverings. Store plastic piping and jointing materials and rubber gaskets under cover out of direct sunlight. Do not store materials directly on the ground. Keep inside of pipes and fittings free of dirt and debris.
 - 2. Metal Items: Check upon arrival; identify and segregate as to types, functions, and sizes. Store off the ground in a manner affording easy accessibility and not causing excessive rusting or coating with grease or other objectionable materials.
 - B. Handling
 - 1. Handle pipe, fittings, and other accessories in such manner as to ensure delivery to the trench in sound undamaged condition. When handling lined pipe, take special care not to damage linings of pipe and fittings; if lining is damaged, make satisfactory repairs. Carry, do not drag, pipe to trench.
 - 2. Handle precast concrete pipe, manholes and other precast structures according to manufacturer's written instructions.
 - 3. Protect imported bedding and backfill material from contamination by other materials.

PART 2 - PRODUCTS

- 2.1 CAST IRON PIPE AND FITTINGS: 2 INCH THROUGH 15 INCH
 - A. Hub and spigot, ASTM A74, service class
 - B. Gaskets: ASTM C564, rubber, compression type, thickness to match class of pipe
 - C. Special Pipe Coupling: ASTM C1173. Rubber or elastomeric sleeve and band assembly fabricated to match outside diameters of pipes to be joined
- 2.2 PVC PIPE AND FITTINGS-SMALLER THAN 4 INCH
 - A. Pipe shall be in accordance to ASTM D1785, Schedule 40.
 - B. Joints: Solvent Cement, ASTM D2564
 - C. Include primer according to ASTM F656
 - D. Special Pipe Coupling: ASTM C1173. Rubber or elastomeric sleeve and band assembly fabricated to match outside diameters of pipes to be joined.
- 2.3 PVC PIPE, 4 INCH AND LARGER
 - A. Pipe
 - 1. 4 inch through 15 inch: ASTM D3034, SDR 35 [Check external load and laying condition, SDR 23.5 and 26 are also available if a stronger pipe is required].
 - 2. 18 inch through 36 inch: ASTM F679, T-1 wall
 - B. Bell and spigot joints
 - C. Fittings:
 - 1. 4 inch through 27 inch: ASTM F1336
 - 2. 30 inch through 36 inch: ASTM D3034, SDR 35
 - D. Joint Gasket: Elastomeric seal, ASTM F477
 - E. Special Pipe Coupling: ASTM C 1173. Rubber or elastomeric sleeve and band assembly fabricated to match outside diameters of pipes to be joined
- 2.4 REINFORCED CONCRETE PIPE
 - A. Designated by Class, rubber gasketed joints, Type II or V cement
 - 1. Circular Reinforced Concrete Pipe: Caltrans Standard Specification Section 65-2.02C(2). Class III
 - 2. Oval shaped (Elliptical) Reinforced Concrete Pipe: Caltrans Standard Specification Section 65-2.02D. Class HE-III and VE-III
 - B. Rubber Gasketed Joints: Caltrans Standard Specification Section 65-2.02F
 - C. Special Pipe Couplings: Portland cement collar as indicated

2.5 PIPE CLEANOUTS

- A. Piping: Same as storm drain line if possible
- B. Top Plug or Cap: Same material as piping if possible. Plug or cap to be secure but removable, threaded or non-threaded.
- C. Box Size: As required to provide access and allow easy removal and reinstallation of cap
- D. Box Types
 - 1. Non-Traffic Areas: Portland cement concrete box and box cover, light duty
 - 2. Traffic Areas: Portland cement concrete box and box cover or steel or cast iron cover, heavy duty, both box and cover to be rated for AASHTO H20 loading
- E. Box Cover Markings: "S.D.," unless otherwise specified
- F. Available Manufacturers: Subject to compliance with requirements, box manufacturers offering products that may be incorporated into the Project include, but are not limited to the following:
 - 1. Associated Concrete Products, Inc.
 - 2. Brooks Products Inc.
 - 3. OldCastle Precast/Christy Concrete Products, Inc.
- 2.6 AREA DRAINS
 - A. Grate and Riser: Area drain shall be as manufactured by Nyloplast or approved equal. Riser shall be constructed of 6 inch PVC SDR 35 piping per paragraph 2.1(A) of this section and connected to area drain by a gasket joint. Riser shall be vertical except as otherwise noted in the plans. Riser may include a reducer if necessary to make connection to the storm drain line.
 - B. Elevation and Grading: Area Drain rim elevation shall be set and area around area drain shall be graded to drain away from any adjacent structures, walks, or roadways and towards area drain.
- 2.7 CURB INLETS, CATCH BASINS, DROP INLETS, JUNCTION STRUCTURES, AREA DRAINS, ETC.
 - A. General: Size, shape, configuration, depth, etc. of structure and frame, grate, or cover shall be as indicated.
 - B. Portland Cement Concrete and Reinforcing: Section 32 13 18, Cement and Concrete for Exterior Improvements.
 - C. Precast Structure: Rate for AASHTO H20 loading in traffic areas.
 - D. Steps: ASTM C 478 or AASHTO M199. Manufacture from deformed, ½ inch steel reinforcement rod complying with ASTM A615 and encased in polypropylene complying with ASTM D4101. Include pattern designed to prevent lateral slippage off step.

Acceptable manufacturer is Hanson Concrete Products, (Milpitas, CA) (Tel 408-262-1091).

- E. Frames, Grates and Covers: Caltrans Standard Specification Section 75-1.02, 75-1.02.B and 75-2
 - 1. Galvanize steel frames, grates and covers
 - 2. Grates and covers shall be non-rocking
 - 3. Rate for AASHTO H20 loading in traffic areas
- F. Thermoplastic Markings:
 - 1. Markings can be purchased at the Fairfield-Suisun Sewer District office and shall be placed on all new drainage basins.
- 2.8 MANHOLES
 - A. Manholes shall be pre-cast concrete of the size and shape shown on the Plans and shall conform to ASTM C478. Equivalent poured-in-place structures may be used at the Contractor's option. Concrete shall consist of Caltrans Type I/II cement. Rate for AASHTO H20 loading in traffic areas.
 - B. All interior concrete surfaces shall be coated with "Xypex Crystalline" or approved equivalent. Use of a water-resistant admix is acceptable, at Contractor option.
 - C. Frames and Covers: As indicated and in accordance with Caltrans Standard Specification Section 75-2.02B. Manhole covers shall have the words "STORM DRAIN" in letters not less than 2 inches cast into the cover. The clear opening for all manhole covers shall be 24 inches.
 - D. Frames and lids for manholes shall be match-marked in pairs before delivery to the job site. The lids shall fit into their frames without rocking.
 - E. Reinforcing Bars: Reinforcing bars shall be of intermediate grade billet steel conforming to ASTM A615 and shall be of the size shown on the Standard Details or in the Plans. Bars shall be of the round deformed type, free from injurious seams, flaws, or cracks, and shall be cleaned of all rust, dirt, grease and loose scales.
 - F. Portland Cement Concrete: Concrete for manhole bases, inlets, and other concrete structures shall conform to the requirements of Caltrans Standard Specifications Section 90 and as herein specified. The concrete shall be Class "A" containing six (6) sacks of portland cement per cubic yard of concrete. The grading of the combined aggregate shall conform with the CDT requirements of the three-quarter inch maximum. The consistency of the fresh aggregate shall be such that the slump does not exceed four inches, as determined by ASTM C143. The concrete shall have a minimum design compressive strength of 3,000 psi after 28 days.
 - G. Steps: ASTM C478 or AASHTO M199. Manufacture from deformed, ½ inch steel reinforcement rod complying with ASTM A615 and encased in polypropylene complying with ASTM D4101. Include pattern designed to prevent lateral slippage off step. Acceptable manufacturer is Hanson Concrete Products, or approved equal.

2.9 JOINT SEALANT FOR PRECAST STRUCTURES AND MANHOLES

- A. Mortar: Caltrans Standard Specification Section 51-1.02F
 - 1. Use to seal around pipes at connections to structures and manholes. Also use to seal joints between precast sections of structures and manholes.
- B. Gaskets: Preformed flexible rubber or plastic gasket
 - 1. Rubber Gaskets: ASTM C443
 - 2. Plastic Gaskets: Federal Specification SS-S-00210 (GSA-FSS), Type I, Rope Form; or alternate standard which may exist. Acceptable material is "Ram-Nek," as manufactured by Henry Company, or approved equal.
- 2.10 PIPE TO STRUCTURE CONNECTOR/SEAL
 - A. A flexible pipe to manhole connector shall be used for all pipe penetrations to pre-cast and/or cast-in-place concrete structures.
 - 1. The seal shall provide a flexible, positive, watertight connection between pipe and concrete wastewater structures. The connector shall assure that a seal is made between (1) the connector and the structure wall, and (2) between the connector and the pipe. The seal between the connector and the manhole wall shall be made by casting the connector integrally with the structure wall during the manufacturing process in such a manner that it will not pull out during coupling. The seal between connector and pipe will be made by way of a stainless steel take down band compressing the gasket against the outside diameter of the pipe.
 - 2. The connector shall be molded from materials whose physical/chemical properties meet or exceed the physical/chemical resistant properties outlined in ASTM C923. The connector and stainless-steel hardware shall meet or exceed the performance requirements proscribed in ASTM C923.
 - 3. The connector shall be of size specifically designed for the pipe material being used and shall be installed in accordance with recommendations of the manufacturer.
 - 4. Connectors shall be Z-LOK or G3 connectors manufactured by A-LOK Products Inc. or approved equivalent.

PART 3 - EXECUTION

3.1 PIPE INSTALLATION

- A. General: Install pipe, fittings, and appurtenances utilizing best practices, manufacturer's instructions, and in accordance with Section 6 and 7 of ASTM D 2321 for plastic pipe, Caltrans Standard Specification Section 65-2.03 for reinforced concrete pipe, Caltrans Standard Specification Section 66-1.03 for corrugated metal pipe, and chapter 11.3.3 of AWWA M41 for cast iron and ductile iron pipe.
- B. Pipe Depth and Trench Configuration: Conform to typical trench section(s) indicated.
- C. Excavation, Bedding, Backfill, and Compaction: Section 31 21 00, Utility Trenching and Backfill

- D. Handling: Carefully handle during loading, hauling, unloading and placing operations to avoid breakage or damage. Use strap type slings for lifting and placing; no chains or hooks will be permitted. Comply with the manufacturer's recommendations.
- E. Laying: Before lowering pipe into the trench, remove all stakes, debris, loose rock and other hard materials from the bottom of the trench. Lay accurately in conformance with lines and grades indicated. Start laying the pipeline at the low end and proceed upstream. Lay bell and spigot pipe with the bell end facing upstream. Lay pipe on a bed prepared by handwork, dug true to grade. Furnish firm bearing for pipe throughout its entire length with bell holes provided at the ends of each pipe length of sufficient size to permit making up the particular type of joint being used. Adjust pipe to line and grade by scraping away or filling and tamping material under the body of the pipe for the entire pipe length and not by blocking or wedging. After final positioning, hold pipe in place in trench with backfill material placed equally on both sides of the pipe at as many locations as required to hold the pipe section in place.
- F. Curved Alignment: When necessary to conform to the alignment specifically indicated, lay pipe on a curved alignment by means of asymmetrical closure of joints or bending of the pipe barrel. Use shorter lengths of pipe than the standard length if necessary to achieve curvature specified. Do not exceed the recommendations of the pipe manufacture for deflections at the joints or pipe bending.
- G. Closure: Close open ends of pipes and appurtenance at the end of each day's work or when work is not in progress.
- 3.2 SPECIAL PIPE COUPLINGS
 - A. General: Use where required to join piping and no other appropriate method is specified. Do not use instead of specified joining methods.
 - B. Installation: Manufacturers' instructions
- 3.3 INSTALLATION OF CURB INLETS, CATCH BASINS, DROP INLETS, JUNCTION STRUCTURES, AREA DRAINS, ETC. AND MANHOLES
 - A. Excavation, Bedding, Backfill, and Compaction: Section 31 21 00, Utility Trenching and Backfill
 - B. Poured in Place Structures: Install as indicated and Caltrans Standard Specification Section 51.
 - 1. Shape bottoms to convey flows as indicated.
 - C. Precast Structures: Install as indicated.
 - 1. Seal all joints and pipe entrances and exits.
 - 2. Place concrete in bottom and shape to convey flows as indicated.
- 3.4 POURED-IN-PLACE CONCRETE
 - A. Concrete shall be mixed in accordance with applicable provisions of Section 90 of Caltrans Standard Specifications.

- B. Construction of concrete structures shall conform to applicable provisions of Section 51 of the Caltrans Standards Specifications. Unless otherwise noted herein or in the Plans, exposed surfaces of structures shall be Class 1 surface finish.
- C. Curing shall conform to applicable portions in Section 90 of Caltrans Standard Specifications. No pigment shall be used in curing compounds. All work shall be subject to inspection. No concrete shall be placed until the Project Manager has approved the forms and reinforcement.
- D. Concrete shall not be cropped freely where reinforcing bars will cause segregation, nor shall it be dropped freely more than six feet. Spouts, elephant trunks, or other approved means shall be used to prevent segregation.
- 3.5 PIPELINE FLUSHING
 - A. Newly constructed storm drain pipes shall be flushed with water to clean. A metal screen shall be used to collect and remove any rock, silt and other debris that is flushed out during cleaning.
- 3.6 DEFLECTION TESTING
 - A. Upon completion of work, perform a deflection test on entire length of installed plastic pipeline. Completed work includes superimposed loads adjacent to and over the pipeline, such as compacted backfill and earthwork, and does not include paving, concrete curbs and gutters, sidewalks, walkways, and landscaping.
 - B. Under external loads, deflection of pipe in the installed pipeline shall not exceed 4.5 percent of the average inside diameter of pipe.
 - C. Determine whether the allowable deflection has been exceeded by use of a pull-through device or a deflection-measuring device.
 - D. Pull-Through Device:
 - 1. Provide a spherical, spheroidal, or elliptical ball, a cylinder, or circular sections fused to a common shaft.
 - a. Circular sections shall be so spaced on the shaft that distance from external faces of front and back sections will equal or exceed diameter of the circular section.
 - b. Pull-through device may also be of a design approved by the Uni-Bell Plastic Pipe Association, provided that the device meets the applicable requirements specified in this paragraph, including those for diameter of the device.
 - 2. Ball, cylinder, or circular sections shall conform to the following:
 - a. A diameter, or minor diameter as applicable, of 95 percent of the average inside diameter of the pipe; tolerance of plus 0.5 percent will be permitted.
 - b. A homogeneous material throughout, with a density greater than 1.0 as related to water at 39.2 degrees F, and a surface Brinell hardness of not less than 150.

- c. Center bored and through bolted with a ¼ inch minimum diameter steel shaft having a yield strength of not less than 70,000 pounds per square inch, with eyes or loops at each end for attaching pulling cables.
- d. Each eye or loop shall be suitably backed with a flange or heavy washer such that a pull exerted on opposite end of shaft will produce compression throughout remote end.
- 3. Pull-Through Device:
 - a. Pass the pull-through device through each run of pipe, either by pulling it through or flushing it through with water.
 - b. If the device fails to pass freely through a pipe run, replace pipe which has the excessive deflection and completely retest in same manner and under same conditions as specified.
- E. Deflection measuring Device:
 - 1. Sensitive to 1.0 percent of the diameter of the pipe being tested and accurate to 1.0 percent of the indicated dimension.
 - 2. Obtain approval of deflection measuring device prior to use.
- F. Deflection Measuring Device Procedure:
 - 1. Measure deflections through each run of installed pipe.
 - 2. If deflection readings in excess of 4.5 percent of average inside diameter of pipe are obtained, retest pipe by a run from the opposite direction.
 - 3. If retest continues to show a deflection in excess of 4.5 percent of average inside diameter of pipe, remove pipe which has excessive deflections, replace with new pipe, and completely retest in same manner and under same conditions.
- G. Warranty Period Test: Pipe found to have a deflection of greater than 5 percent of average inside diameter when deflection test is performed just prior to end of 1 year warranty period shall be replaced with new pipe and tested as specified for leakage and deflection.

3.7 CLEANING

A. Thoroughly clean storm drain lines, manholes, catch basins, field inlets, culverts, and similar structures, of dirt, debris, and obstructions of any kind.

3.8 TELEVISION INSPECTION

- A. After completion of the pipe installation, service connections, flushing and cleaning, and prior to placement of pavement, the drain line shall be televised with a color closed-circuit television with tilt-head camera recorded in DVD format. The original disc and log sheets shall be provided to the Owner for review.
- B. The following observations from television inspections will be considered defects in the construction of sewer pipelines and will require correction prior to placement of pavement:
 - 1. Low spot (1 inch or greater mainlines only)
 - 2. Joint separations (3/4 inch or greater opening between pipe sections)
 - 3. Cocked joints present in straight runs or on the wrong side of pipe curves.
 - 4. Chips in pipe ends

- 5. Cracked or damaged pipe
- 6. Dropped joints
- 7. Infiltration
- 8. Debris or other foreign objects
- 9. Other obvious deficiencies
- 10. Irregular condition without logical explanation

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK