SECTION 33 41 00

REINFORCED CONCRETE PIPE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. This section includes construction of reinforced concrete pipe for storm drainage, culverts, and sanitary sewer, including appurtenances normally installed as a part of these systems. Construction may include surface preparation; trench excavation; shoring; dewatering; lay, align and join pipe installation of appurtenances; bedding and backfilling; surface restoration; and other related work.

1.02 RELATED SECTIONS

A. The following is a list of SPECIFICATIONS, which may be related to this section:

1. Section 01 57 19, Temporary Environmental Controls
2. Section 31 11 00, Clearing and Grubbing.
3. Section 31 14 13, Topsoil Stripping and Stockpiling.
4. Section 31 23 00, Excavation and Fill.
5. Section 31 23 19, Dewatering.
6. Section 31 23 33, Trenching and Backfilling.
7. Section 31 25 00, Erosion and Sedimentation Control

1.03 REFERENCES

A. The following is a list of standards, which may be referenced in this section:

1. ASTM International (ASTM):

a. A615, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.

b. C76, Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.

c. C150, Standard Specification for Portland cement.

d. C260, Standard Specification for Air-Entraining Admixtures for Concrete.

e. C361, Standard Specification for Reinforced Concrete Low-Head Pressure Pipe.

f. C443, Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.

g. C506, Standard Specification for Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe.

h. C507, Standard Specification for Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe.

i. C655, Standard Specification of Reinforced D-Load Culvert, Storm Drain and Sewer Pipe.

j. C827, Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens from Cementitious Mixtures.

k. C990, Standard Specifications for Joints in Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants.

l. C1417, Standard Specification for Reinforced Concrete Sewer, Storm Drain and Culvert Pipe for Direct Design.

m. C1479, Standard Practice for Installation of Precast Concrete Sewer, Storm Drain, and Culvert Pipe Using Standard Installation.

n. C1619, Standard Specifications for Elastomeric Seals for Joining Concrete Pipe.

o. C1628, Standard Specifications for Joints for Concrete Gravity Flow Sewer Pipe, Using Rubber Gaskets.

2. U.S. Bureau of Reclamation (USBR): M-1, Standard Specifications for Reinforced Concrete Pressure Pipe.

1.04 SUBMITTALS

A. Details of fittings and specials shall be furnished for approval by ENGINEER.

B. Unless otherwise specified, CONTRACTOR shall submit to ENGINEER for approval SHOP DRAWINGS showing the exact dimension of the joints including the permissible tolerances for each size of pipe being furnished and the size, type and locations of gasket materials. Approval of the joint detail DRAWINGS shall not relieve CONTRACTOR of any responsibilities to meet all of the requirements of these SPECIFICATIONS, or of the responsibility for correctness of CONTRACTOR’s details.

C. CONTRACTOR shall cooperate with ENGINEER in obtaining and providing samples of all specified materials.

D. CONTRACTOR shall submit certified laboratory test certificates for all items required in this section.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Responsibility for Material:

1. CONTRACTOR shall be responsible for all materials intended for the WORK that are delivered to the construction site and accepted by CONTRACTOR. Payment shall not be made for materials found to be defective or damaged in handling after delivery and acceptance. Defective or damaged materials shall be removed and replaced with acceptable materials at CONTRACTOR's expense.

2. CONTRACTOR shall be responsible for the safe and proper storage of such materials.

B. Pipe Acceptance:

1. In addition to any deficiencies not covered by ASTM C76 for non-pressurized pipe ,ASTM C361 for low head pipe or ASTM C507 for Elliptical Pipe, concrete pipe, which has any of the following visual defects, will not be accepted.

    a. Porous spots on either the inside or the outside surface of a pipe having an area of more than ten (10) square inches and a depth of more than one-half (1/2) inch.

    b. Pipe, which has been patched to repair porous spots, cracks, or other defects, when such patching was not approved by ENGINEER.

    c. Exposure of the reinforcement when such exposure would indicate that the reinforcement is misplaced.

    d. Pipe that has been damaged during shipment or handling even previously approved before shipment.

    e. Concrete pipe, at delivery to the job site, shall have cured and reach the design strength as required by ASTM C76 for non-pressurized pipe, ASTM C316 for low head pipe or ASTM C507 for Elliptical Pipe and be at least five (3) days (seventy-two [72] hours) old.

2. Acceptance of the pipe at point of delivery shall not relieve CONTRACTOR of full responsibility for any defects in materials due to workmanship.

C. Pipe Handling:

1. Pipe and accessories furnished by CONTRACTOR shall be delivered to, unloaded, and distributed at the site by CONTRACTOR. Each pipe shall be unloaded adjacent to or near the intended laying location.

2. Pipe fittings, specials, valves, and appurtenances shall be unloaded and stored in a manner that precludes shock or damage. Such materials shall not be dropped.

3. Pipe shall be handled in a manner intended to prevent damage to the pipe ends or to any coating or lining. Pipe shall not be skidded or rolled against adjacent pipe. Damaged coatings or lining shall be repaired by CONTRACTOR, at

CONTRACTOR's expense in accordance with the recommendations of the manufacturer and in a manner satisfactory to ENGINEER. Physical damage to the pipe or accessory shall be repaired by CONTRACTOR at CONTRACTOR's expense, and in a manner satisfactory to ENGINEER.

D. Gasket Storage: All gaskets shall be stored in a cool place, preferably at a temperature of less than seventy degrees Fahrenheit (70°F.), and in no case shall the gaskets be stored in the open, or exposed to the direct rays of the sun.

PART 2 PRODUCTS

2.01 MATERIALS

A. General: Precast concrete pipe, which does not conform to ASTM C76 for non-pressurized pipe, ASTM C361 for low head pipe or ASTM C507 for Elliptical Pipe or to any other requirement specified herein, shall not be approved for storm sewer, culvert, or sanitary sewer installations.

B. Allowable ASTM Specifications: All material, manufacturing operations, testing, inspection, and making of concrete pipe shall conform to the requirements of ASTM C76 for non-pressurized pipe, ASTM C361 for low-head pipes or ASTM C507 Elliptical Pipe, latest revision thereof, listed in Article References.

C. Marking:

1. The following shall be clearly marked on both the interior and exterior surface of the pipe:

    a. Appropriate ASTM Specification: ASTM 76, ASTM C361 or ASTM C507

    b. Class and size.

    c. Date of manufacture.

    d. Name or trademark of manufacturer.

D. Diameter of Pipe: The diameter indicated on the DRAWINGS shall mean the inside diameter of the pipe.

E. Wall Thickness and Class of Pipe: The wall thickness and reinforcing steel, if any, shall comply with ASTM C76 for non-pressurized pipe, ASTM C361 for low head pipe or ASTM C507 for Elliptical Pipe and the class of pipe designated on the DRAWINGS. No elliptical reinforcing shall be allowed in any circular pipe. All jacking pipe shall be specifically designed by the pipe manufacturer to withstand all forces that the pipe may be subjected to during the jacking operations.

F. Fittings and Specials: Fittings and specials shall be made up of pipe segments having the same structural qualities as the adjoining pipe and shall have the interior treated the same as the pipe.

G. Lifting Holes: Lifting holes will be allowed for storm sewer pipe provided, however, only two lifting holes per pipe length will be allowed.

H. Cement: Unless otherwise required by ENGINEER, or specified otherwise on the DRAWINGS, Type II Modified Portland Cement complying with the requirements of ASTM C150 will normally be acceptable in the manufacture of concrete pipe.

I. Joints:

1. The joint design for concrete pipe shall be bell and spigot or tongue and groove. Where rubber gaskets are required or specified, the bell or tongue shall be of confined gasket or single offset spigot configuration to properly contain and seat the rubber gasket. The joint assemblies shall be accurately formed so that when each pipe section is forced together in the trench the assembled pipe shall form a continuous watertight conduit with smooth and uniform interior surface, and shall provide for slight movement of any piece of the pipeline due to expansion, contraction, settlement or lateral displacement. If a gasketed joint is used, the gasket shall be the sole element of the joint providing water tightness. The ends of the pipe shall be in planes at right angles to the longitudinal centerline of the pipe, except where bevel-end pipe is required. The ends shall be furnished to regular smooth surfaces.

2. The jointing material used for concrete pipe storm sewer installations thirty six-inch (36") diameter and greater shall be a rubber gasketed joint. For storm sewers less than thirty six-inch (36") diameter the jointing material may be either a rubber gasket or a flexible plastic sealing compound, unless otherwise specified on the DRAWINGS. Only rubber gasketed joints will be acceptable for concrete pipe sanitary sewer installations. All joints and jointing material shall conform to the following minimum requirements.

a. Rubber Gasketed Joints:

1) Rubber gasket joints for tongue and groove or bell and spigot pipe using a confined gasket joint shall consist of an O-ring rubber gasket or other approved gasket configuration and shall conform to the requirements of ASTM 361, ASTM C443, ASTM C1619, or ASTM C1628 for the pipe designated. Unless otherwise approved by ENGINEER, the standard joint configuration shall be as noted in Subsection 3.04.F.
2) Rubber gasket joints for tongue and groove or bell and spigot pipe using a single offset joint shall consist of a non-circular rubber gasket or other approved gasket configuration and shall conform to the requirements of ASTM C76 or ASTM 361 for the pipe designated. Unless otherwise approved by ENGINEER, the standard joint configuration shall be as noted in Subsection 3.04.F.
3) Gaskets may be natural rubber, isoprene or neoprene conforming to ASTM C1619.

b. Flexible Plastic Joint Sealing Compound: Preformed plastic gaskets conforming to the minimum and application requirements set forth in PART 3 may be used as a joint sealant for storm sewer installations in lieu of rubber gaskets.

1) The flexible plastic gasket shall be in conformance with ASTM C990.
2) The plastic sealing compound shall be packaged in extruded preformed rope-like shape of proper size to completely fill the joint when fully compressed. The material shall be protected in a suitable, removable, two-piece wrapper so that no wrapper may be removed as the compound is applied to the joint surface without disturbing the other wrapper, which remains attached to the compound for protection. The sealing compound shall be impermeable to water, have immediate bonding strength to the primed concrete surface and shall maintain permanent plasticity, and resistance to water, acids, and alkalis.

c. Mortared Joints: Mortared joints shall only be used in special circumstances and only where specifically authorized by ENGINEER. It is the intent of these SPECIFICATIONS to limit the use of mortared joints to the minimum extent possible except where unusual field conditions require deviation from the jointing material specified.

J. Protective Coatings: Normally, no additional exterior or interior protective coatings shall be required for concrete pipe. However, whenever adverse corrosive conditions warrant additional interior protection, those pipe segments will be noted on the DRAWINGS.

K. Concrete Cutoff Collars: Concrete shall meet the requirements of Section 03 31 00, Structural Concrete.

PART 3 EXECUTION

3.01 GENERAL

A. The pipe and pipe coatings shall be inspected by ENGINEER for damage or defects before being placed in the trench. Damaged or defective pipe shall not be installed.

B. All pipes that do not meet the requirements of PART 2 of this section will be rejected and replaced at CONTRACTOR’s expense.

C. CONTRACTOR shall install storm sewer pipe of the type, diameter, load class, wall thickness and protective coating that is shown on the DRAWINGS.

D. Proper equipment, implements, tools and facilities shall be provided and used by CONTRACTOR for safe and convenient installation of the type of pipe being installed.

3.02 SURFACE PREPARATION

A. Within Easement, Cultivated, Landscaped, or Agricultural Area:

1. All vegetation, such as brush, sod, heavy growth of grass or weeds, decayed vegetable matter, rubbish and other unsuitable material within the area of excavation and trench side storage shall be stripped and disposed of in accordance with the requirements of Section 31 11 00, Clearing and Grubbing.

2. Topsoil shall be removed to a depth of eight (8) inches or the full depth of the topsoil, whichever is less. Topsoil shall be removed from the area to be excavated and stockpiled, or, CONTRACTOR may elect to import topsoil to replace that lost during excavation.

B. Within Unpaved Roadway Areas: CONTRACTOR shall strip the cover material from graveled roadways or other developed, but unpaved traffic surfaces to the full depth of the existing surfacing. The surfacing shall be stockpiled to the extent that it is acceptable and useable for restoration purposes.

C. Within Paved Areas:

1. The removal of pavement, sidewalks, driveways, or curb and gutter shall be performed in a neat and workmanlike manner. Concrete pavement, asphalt, sidewalks, driveways, or curb and gutter shall be cut with a power saw to a depth of two (2) inches prior to breaking. The concrete shall be cut vertically in straight lines and avoiding acute angles.

2. Bituminous pavement, sidewalks, driveways, or curb and gutter shall be cut with a power saw, pavement breaker, or other approved method of scoring the mat prior to breaking or excavation. The bituminous mat shall be cut vertically, in straight lines and avoiding acute angles.

3. Any overbreak, separation, or other damage to the existing bituminous or concrete outside the designated cut lines shall be replaced at CONTRACTOR's expense.

4. Excavated paving materials shall be removed from the job site and shall not be used as fill or backfill.

3.03 DEWATERING

A. All pipe trenches and excavation for structures and appurtenances shall be kept free of water during pipe laying and other related work. The method of dewatering shall provide for a dry foundation at the final grades of excavation in accordance with Section 31 23 19, Dewatering. Water shall be disposed of in a manner that does not inconvenience the public or result in a menace to public health. Pipe trenches shall contain enough backfill to prevent pipe flotation before dewatering is discontinued. Dewatering shall continue until such time as it is safe to allow the water to rise in the excavation.

3.04 INSTALLATION

A. General: Precautions shall be taken to prevent foreign material from entering the pipe before or while it is being placed in the line. During laying operations, no debris, tools, clothing or other materials shall be placed in the pipe. The open ends of pipe shall be closed with a watertight plug, or with other devices approved by ENGINEER, at times when pipe laying is not in progress.

B. Pipe:

1. Storm sewer pipe shall be installed in accordance with the manufacturer's recommendations for installing the type of pipe used, unless otherwise shown on the DRAWINGS.

2. Pipe lines shall be laid to the grades and alignment shown on the DRAWINGS or staked by ENGINEER. Variation from the prescribed grade and alignment shall not exceed one-tenth (0.10) foot, and the rate of departure from, or return to, the established grade or alignment shall be not more than one (1) inch in ten (10) feet, unless approved by ENGINEER. No deviation from grade shall cause a depression in the sewer invert that could retain fluids or solids.

3. Pipe with lifting holes shall be installed such that the lifting holes are in the crown of the pipe. All lifting holes shall be properly grouted with cement mortar immediately after the pipe is installed and prior to commencement of backfilling.

4. Pipe with lifting anchors shall be installed such that the lifting anchors are in the crown of the pipe. All lifting anchor recesses in the wall of the pipe at the lifting anchors need not be grouted.

C. Pipe Fittings:

1. Pipe fittings shall be laid so as to form a close concentric joint with the adjoining pipe to avoid sudden offsets of the flow line. Pipe sections shall be joined together in accordance with the manufacturer's recommendations.

2. Pipe fittings and appurtenances shall be carefully lowered into the trench with suitable tools or equipment to prevent damage to the pipe and protective coatings and linings; pipe and accessory materials shall not be dropped or dumped into the trench.

D. Gaskets: No gaskets that show signs of deterioration, such as surface cracking or checking, shall be installed in a pipe joint. The neoprene gaskets used, when the air temperature is ten degrees Fahrenheit (10°F) or lower shall be warmed to temperature of sixty degrees Fahrenheit (60°F) for a period of thirty (30) minutes before being placed on the pipe.

E. Flexible Plastic Joint Sealing Compound:

1. All surfaces of the tongue and groove or bell and spigot shall be primed with an approved priming compound prior to the installation of the sealing compound. The installation of the priming compound and the sealing compound shall be accomplished in strict accordance with the manufacturer's instructions, as to the method of application, quantity of material, the grade of the materials, and the application temperatures.

2. Gaskets installed on both male and female joint surfaces (double gasketing) shall be required for all deflected pipe joints, as well as arch or elliptical pipe joints.

F. Acceptable Joint for Concrete Storm and Sanitary Sewer Installations: Except where a specified type of pipe joint or jointing material is noted on the DRAWINGS, joints

and jointing material for concrete sewer installations shall be in conformance with the following table.

Allowable Type of Joints				
Application	**Tongue and Groove with Flexible Plastic Sealing Compound**	**Bell and Spigot (Single Offset) (ASTM 1628 or ASTM C443)**	**Bell and Spigot with USBR M-1 Type R-4 Joint (Confined Gasket) (ASTM C361)**	**Bell and Spigot with USBR M-1 Type R-2 Joint**
1. Non-Pressurized Storm Sewers				
a. Open Cut 36" & larger		X	X	
b. Open Cut 15" to 33"	X	X	X	X
c. Jack or Bored/ Cased			X	X
2. Pressurized Storm Sewers				
a. Open Cut			X	X
b. Jack or Bored/ Cased			X	X
3. Pressurized and Non-Pressurized Sanitary Sewers				
a. Open Cut			X	X
b. Jack or Bored/ Cased			X	X

NOTES:

1) Where more than one type of joint is acceptable, CONTRACTOR may use either type subject to the physical characteristics and manufacturing method of the pipe and approval of ENGINEER.

2) All elliptical pipe or arch pipe shall be double gasketed, or per ASTM C443

3) In addition to the gasket requirements, if the average joint gap in 36-inch diameter pipe or larger pipe exceeds 3/4-inch, the void shall be filled and troweled smooth with an approved non-metallic, non-shrink grout conforming to ASTM C827 or a flexible plastic sealant conforming to ASTM C990 so to provide a smooth interior surface at the joint.

4) For pipe sizes 18-, 24-, 30-, and 36-inch in diameter, the reinforcement in the bell and spigot shall conform to ASTM C76 for the class of pipe specified or to ASTM C361 for a minimum pressure head of 25 feet.

G. Obstructions not shown on the DRAWINGS may be encountered during the progress of the WORK. Should such an obstruction require an alteration to the pipe alignment or grade, ENGINEER will have authority to order a deviation from the DRAWINGS, or ENGINEER may arrange for the removal, relocation, or reconstruction of any structure, which obstructs the pipeline.

H. Joints of precast concrete boxes and precast concrete pipe shall be grouted in accordance with the manufacturer's recommendations or as designated on the DRAWINGS.

3.05 BEDDING AND BACKFILLING

A. Select bedding and backfill material may be required and shall be so shown on the DRAWINGS. Select bedding materials shall conform to the designated gradation requirements in Section 31 23 33, Trenching and Backfilling.

B. Bedding material shall be placed under and around all pipes as shown on the DRAWINGS. Bedding shall be placed in a manner that will minimize separation or change in its uniform gradation. Bedding shall be distributed in six-inch (6") maximum layers over the full width of the trench and simultaneously on both sides of the pipe. Special care shall be taken to ensure full compaction under the haunches and joints of the pipe.

C. Backfill compaction shall not be attained by inundation or jetting, unless approved in writing by ENGINEER. Backfill material shall be uniformly compacted the full depth of the trench.

3.06 CONCRETE CUTOFF COLLARS

A. Concrete cutoff collars shall be placed around pipes as shown on the DRAWINGS or as directed by the ENGINEER.

3.07 SURFACE RESTORATION

A. All streets, alleys, driveways, sidewalks, curbs or other surfaces broken, cut or damaged by CONTRACTOR shall be replaced in kind or as shown on the DRAWINGS.

3.08 CLEAN UP

A. All rubbish, unused materials, and other non-native materials shall be removed from the job site. All excess excavation shall be disposed of as specified, and the right-of-way shall be left in a state of order and cleanliness.

END OF SECTION