

## SECTION 302

### DRAINAGE STRUCTURES

#### I. GENERAL

##### 1.1. DESCRIPTION OF WORK

The Contractor shall furnish all labor, supervision, material (except as herein provided), tools, equipment, supplies, and services; and, shall perform all Work necessary for the installation and construction of pipe culverts, endwalls, box culverts, precast concrete and metal arches, storm drains, drop inlets, manholes, spring boxes, junction boxes, and intake boxes and removing and replacing existing structures in accordance with these specifications and in conformity to the lines and grades shown on the Drawings or as designated by the Owner.

##### 1.2. MATERIALS

Materials shall be furnished by the Contractor in accordance with Section 200. *This Section is not intended for the use of thermoplastic pipe.*

##### 1.3. SUBMITTALS

- A. Submittals shall be made by the Contractor in accordance with the procedures set forth in Section 105 and as described below:
- B. The Contractor shall furnish copies of the manufacturer's specifications and details for cast in place installations indicated on the Drawings, Standard Details, and the VDOT *Road and Bridge Standards*, latest edition, listing specific materials proposed.
- C. Submittal of designs for precast items included on the drawings will not be required provided fabrication is in accordance with the VDOT *Road and Bridge Standards*, latest edition. Submittal of designs for precast structures on VDOT's approved list will not be required provided the Contractor submits a certification that the item will be fabricated in accordance with the pre-approved design drawings.
- D. The Contractor shall furnish the Owner with an affidavit stating that products to be installed on this project comply with specification requirements.
- E. The "Acceptance Procedures for Aggregates" shall be in accordance with Section 200.

#### II. EXECUTION

##### 2.1. PROCEDURES

- A. Trenching, excavation, bedding and backfill operations shall be performed in accordance with the requirements of Section 303. Concrete construction shall conform to the requirements of the VDOT *Road and Bridge Specifications*, Section 404. Reinforcing steel placement shall conform to the requirements of Section 406.

B. **When lift holes are provided in concrete pipe or precast box culverts, the Contractor shall install a lift hole plug furnished by the manufacturer in accordance with the requirements of the VDOT *Road and Bridge Specifications*, Section 232.02(a)1. After pipe installation and prior to backfilling, plugs shall be installed from the exterior of the pipe or box culvert and snugly seated.**

C. Bedding stone depth shall be 6-inches for pipes and structures. Undercut excavation and the replacement of excavated undercut material shall be as specified in Section 303.

D. Pipe Culverts:

Not more than one type of pipe shall be used in any one-pipe line. When field cutting corrugated metal pipe is permitted by the Owner, damaged areas of the protective coating shall be repaired in accordance with the requirements of VDOT *Road and Bridge Specifications*, Section 233.

1. Jacked Method:

- a. The Contractor shall submit to the Owner a complete plan and schedule for jacked pipe installation prior to beginning such work. The submission shall include complete details of sheeting, shoring, and bracing for protecting the roadbed plus materials and equipment. The Contractor shall not proceed with pipe installation until the plan has been reviewed and approved by the Owner.
- b. When work is stopped, the heading shall be bulkheaded.
- c. The jacked method shall be by means of tunneling or boring. The jacked tunneling method shall be applicable for installing concrete pipe 30- through 108-inches in diameter and smooth-wall steel pipe 30- through 48-inches in diameter. The jacked boring method shall be applicable for installing concrete pipe 12- through 108-inches in diameter and smooth-wall steel pipe 12-3/4- through 48-inches in diameter.
- d. Pipe shall have a design strength and wall thickness so as to withstand the jacking operation.
- e. Construction shall be performed in such a manner that the ground surface above the pipeline will not settle. Installation of the pipeline shall immediately follow heading or tunneling excavation. Voids occurring behind the pipe during installation shall be filled with hydraulic cement grout, placed under pressure, upon completion of the jacking operation.
- f. Joint sealant material on concrete pipe shall be placed ahead of the jacking frame. At his own expense, the Contractor shall replace or repair, as directed by the Owner, pipe that is damaged during jacking operations. Joints of steel pipe shall be butt welded, watertight, as installation progresses.

2. Open Trench Method:

- a. The Contactor shall provide, as may be necessary, for the temporary, legal, diversion of stream flow in order to permit the installation of the pipe under dry conditions.
- b. Foundations shall be in accordance with Section 303.
- c. Bedding:
  - (i) Bedding material for pipe foundations shall be aggregate No. 57, conforming to the requirements of Section 200 as applicable unless otherwise specified and shown on the Drawings.
  - (ii) Pipe bedding shall be lightly and uniformly compacted and shall be carefully shaped so that the lower section of the pipe exterior is in full contact with the bedding material. Bedding material shall be shaped to accommodate the bell when bell and spigot pipe is used. The depth of bedding material shall be at least 6- inches.
- d. Placing pipe:
  - (i) Pipe shall be placed beginning at the downstream end of the pipeline. The lower segment of pipe shall be in contact with the shaped bedding for its entire length. Bell or groove ends of rigid pipe shall be placed facing upstream.
  - (ii) Paved or partially lined pipe shall be placed so that the longitudinal centerline of the paved segment coincides with the flow line.
  - (iii) At intervals not to exceed 100 feet, pipe will be inspected before backfill is placed. Pipe found to be out of alignment, unduly settled, or damaged shall be taken up and reinstalled or replaced. The pipe interior shall be cleaned as the pipe is being installed.
  - (iv) When placing concrete pipe constructed with elliptical reinforcing, the pipe shall be oriented in accordance with the manufacturer's marking of top or bottom.
- e. Joining pipe:
  - (i) The method of joining rigid pipe sections shall be such that ends are fully entered and inner surfaces are flush and even.
  - (ii) Joints shall be sealed with any one or combination of the following to form a leak-resistant joint; rubber, preformed plastic, mastic gaskets, and concrete pipe joint wrapping; or cold-applied pipe joint sealer wrapped with filter fabric.
  - (iii) Rubber ring gaskets shall be installed to form a flexible, leak-resistant seal.

- (iv) The Contractor shall double wrap each pipe joint with non-woven geotextile fabric strip and attach the fabric to the pipe with a minimum of two (2) non-metallic straps. The width of the fabric strip shall be at least two (2) feet wide and centered over the joint. The fabric shall be laid transversely in the trench of each joint prior to laying pipe and shall be centered over the joint. The inside of all concrete pipes shall be mortared to the spring line of the pipe. When pipes enter structures, the inside of the pipe/structure joint shall be fully mortared.
- (v) Flexible pipe sections shall be aligned and firmly joined by approved coupling bands to form a leak-resistant joint.
- (vi) Permissible construction tolerances between the proposed inverts as shown on the Drawings as the as-built condition:
  - (1) Maximum deviation of any invert from plan grade:  $\pm 0.05'$ .
  - (2) Total deviation of both inverts at each end of a particular line:  $\pm 0.08'$ .
  - (3) Maximum slope deviation  $\pm 0.02\%$  between any two points in the line from the plan slope.
  - (4) The strictest of the above shall apply. Any lines not properly installed in compliance with the above shall be removed and reinstalled to the proper alignment and in accordance with all other specification requirements, by the Contractor at no additional expense to the Owner.

**f. Structural plate pipe, pipe arches, and arches: Erection shall be in accordance with the manufacturer's assembly diagrams and instruction sheets. Splices in the haunch areas of structural plate pipe arches shall be constructed using the reverse shingle method or the side plates shall be provided without longitudinal seams in the haunch areas. The complete line shall be assembled before backfill is placed. Bolts be tightened to a torque of 150 to 250 foot-pounds. If spiraling occurs during installation, bolts shall be loosened and the pipe assembly adjusted to the correct position.**

**Bolts shall conform to the requirements of ASTM A307 except where high-strength or other special types of bolts are required. Nuts for bolts for bolts conforming to the requirements of A307 shall conform to the requirements of ASTM A563 and washers shall conform to the requirements of ASTM F884. Lock washers shall conform to the requirements of ANSI B18.21.1 High strength anchor bolts shall conform to the requirements of AASHTO M314, Grade 55 with the supplemental requirements of S1. Galvanization of steel anchor bolts, nuts, and washers shall conform to the requirements of ASTM A153.**

- g. Arch substructures:** Each side of an arch shall rest in a groove formed into the masonry or on a galvanized angle or channel securely anchored to or embedded in the substructure. Where the span of the arch is more than 15 feet or the skew angle is more than 20 degrees, a metal bearing surface having a width at least equal to the depth of the corrugation shall be provided.

Metal bearings for arches shall be cold-formed galvanized channel conforming to the requirements of ASTM A 569, at least 3/16 inch in thickness, with the horizontal leg securely anchored to the substructure at points spaced on centers of not more than 24 inches. When the metal bearing is not embedded in a groove in the substructure, one vertical leg shall be punched to allow bolting to the bottom row of plates.

**Bolts, washers and nuts shall conform to the requirements of 2.1.D.2.f (above).**

- h. Backfilling**

Backfilling shall be in accordance with Sections 200 and 303.

- i. Tunneling operations:**

The jacked tunneling method shall be applicable for installing concrete pipe 30 through 108 inches in diameter and smooth-wall steel pipe 30 through 48 inches in diameter. Where the plans specifically identify tunneling as the means of pipe installation, tunneling shall be performed by the Contractor as follows:

The tunnel shall be excavated in such a manner and to such dimensions that shall permit placing of the proper supports necessary to protect the excavation. The Contractor shall take the proper precautions to avoid excavating earth or rock or shattering rock beyond the limits of excavation necessary for the safe and proper installation of the pipe. Damage from excavating and blasting, either to surface or subsurface structures, shall be repaired or replaced by the Contractor as indicated below at his own expense. Adequate provisions shall be made for the safety and health of the workers required by the work being performed.

No pipe shall be placed until the foundation is in a condition satisfactory to the Owner. Tunnel dimensions shown on the plans are minimum dimensions. Any excess excavation and subsequent backfill, concrete or grout fill shall be at the Contractor's expense. The pipe shall be laid in the tunnel true to line and grade. If required by the plans or if required for safety, suitable steel or timber sheeting, shoring, and bracing shall be used to support the sides and roof of the excavation. Supports may be left in place provided they clear the encasement or carrier pipe. No separate payment shall be made for supports left in place. Installation of the pipeline shall immediately follow tunneling excavation.

**If indicated or specified, the entire void between the outside of the pipe and the tunnel walls or the inside face of the tunnel lining shall be grouted in accordance with ASTM C 476 unless the permanent sheeting, bottom, sides, and roof of the tunnel are in a condition satisfactory to the Owner. The minimum thickness of grout backfill shall be maintained throughout. Grout required for backfill in excess of the excavation tolerances specified herein shall be at the Contractor's expense.**

**Any pipe damaged during construction operations shall be repaired or removed and replaced by the Contractor at his expense.**

**If corrugated galvanized metal pipe is used, joints may be made by field bolting or by connecting bands, whichever is feasible. When reinforced concrete pipe 24 inches and larger in diameter with tongue-and-groove joints is used for the encasement pipe, the interior joints for the full circumference shall be sealed, packed with mortar, and finished smooth and even with the adjacent section of pipe.**

E. Precast Drainage Structures:

1. Concrete shall have a design strength at 28 days of at least 4,000 psi and an air content of 6 +/- 2 percent. The design of the concrete mixture and the method of casting, curing, handling, and erecting shall be subject to review by the Owner. Precast units may be shipped after reaching 85 percent of the design strength as determined by control cylinders tested in accordance with the requirements of VDOT *Road and Bridge Specifications*, Section 404. Units shall retain their structural integrity during shipment and shall be subject to inspection at the job site
2. Precast units located adjacent to cast-in-place concrete items, such as flumes, ditches, and gutters, shall be connected to the adjacent unit by means of No.4 smooth steel dowels spaced on approximately 12-inch centers throughout the contact length and extending at least 4-inches into both the precast unit and the cast-in-place item. If holes to receive the dowels are provided in the precast unit, they shall be not more than 5/8-inch in diameter. Other methods of providing the connection, such as keyed joints, shall be approved by the Owner prior to fabrication.
3. The chamber section shall be installed in the plumb position. The throat and top sections shall have positive restraints, such as adjacent concrete, pavement, or soil on all sides to prevent displacement and shall have a positive interlock, such as dowels, with the chamber section. The throat and top sections shall be installed to conform to the normal slope of the finished grade, and may be canted up to a maximum grade of 10%. The chamber may be built up a maximum of 12-inches at any point to provide for complete and uniform bearing of the throat and top sections on the chamber flat slab top or other approved top section. The built up section shall be constructed using whole concrete spacer units where feasible, and partial and whole sections of concrete block or brick with high strength grout and mortar. High strength grout shall be used to provide the final grade adjustment and uniform bearing. The width of the built up section shall match the wall thickness of the chamber section. The concrete block and brick shall be

thoroughly bonded with mortar and the inside and outside of the built-up section shall be plastered with mortar except that the concrete spacer unit shall not be plastered.

4. Precast Arches:

a. Protection against corrosion:

- (i) The concrete cover of reinforcement shall be at least 1½- inches.
- (ii) In corrosive or marine environments or other severe exposure conditions, reinforcement shall be epoxy coated in accordance with the requirements of Section 200, and as shown on the Drawings.
- (iii) Exposed reinforcing bars, inserts, and plates intended for bonding with future extensions shall be protected from corrosion as directed by the Owner.
- (iv) Reinforcement shall be designed and detailed in consideration of fabrication and construction tolerances so that the minimum required cover and proper positioning of reinforcement shall be maintained.
- (v) Sufficient anchorage shall be provided at the terminus of lines of precast units. Anchorage may consist of a cast-in-place end section at least 3-feet in length with a headwall or collar around the precast unit(s) provided adequate connection can be made between the collar and units.
- (vi) Joints between units shall be sealed by preformed plastic or mastic gaskets or grout. When preformed gaskets are used, they shall be of a type listed on the VDOT's approved products list.
- (vii) Pipe openings will not be allowed in the precast arch but may be provided through the wingwalls. When required, openings shall conform to the requirements of Section 200.

5. Precast Box Culverts:

a. Protection against corrosion:

The following minimum concrete cover shall be provided for reinforcement:

- (i) For boxes with more than 2-feet of fill over the top slab: 1-1/2- inches. For boxes with less than 2-feet of fill over the top slab: top reinforcement of top slab: 2-1/2-inches: bottom reinforcement of top slab: 2-inches; all other reinforcement 1-1/2-inches.
- (ii) The minimum cover for reinforcement may be reduced by not more than ½ inch, provided the reinforcement having reduced cover is epoxy coated or the concrete surfaces adjacent to the reinforcement are coated

in accordance with VDOT *Road and Bridge Specifications*, Section 416.

(iii) Reinforcing steel for box culverts used in 0- to 2-foot fills, used in corrosive or marine environments or used in other severe exposure conditions shall be epoxy coated. When epoxy coated reinforcing steel is required due to these conditions, the minimum cover specified shall not be reduced.

b. The type of sealant used in joints between units shall be from the VDOT approved list of preformed plastic or mastic gaskets.

Where double or greater lines of precast units are used, a buffer zone of 3- to 6-inches between lines shall be provided. This buffer zone shall be backfilled with porous backfill conforming to the requirements of VDOT *Road and Bridge Specifications*, Section 204.

The porous backfill shall be drained by a 3-inch diameter weep hole, formed by non-rigid tubing, located at the top of the bottom haunch, centered in the outlet end section and at approximately 50-foot intervals along the length of the box. Weep holes shall be covered with a 3-foot square section of filter barrier cloth firmly attached to the outside of the box. A 3-foot width of filter barrier cloth shall also be centered over the buffer zone for the entire length of the structure after placement of the porous backfill material. Filter barrier cloth shall conform to the requirements of Section 200.

Forming weep holes and furnishing and placing of the filter barrier cloth shall be included in the price bid per linear foot for the Precast Box Culvert.

c. At the terminus of precast units, sufficient anchorage shall be provided. This anchorage may consist of a cast-in-place end section at least 3-feet in length with a headwall and curtain wall or a collar cast-in-place around the units provided adequate connection can be made between the collar and units.

When the ends of precast units are skewed, the end section shall be cast monolithically. The skew may be provided by forming, saw cutting, or other methods approved by the Owner. Regardless of the method used, the variation in the precast unit from the exact skew shall be not greater than 1-1/2-inches at any point.

d. Pipe openings shall conform to the requirements of Section 200.

F. Drop Inlets, Manholes, Spring Boxes, Intake Boxes, and End Walls:

1. Masonry construction shall not be initiated when the air temperature is below 40 °F in the shade.
2. **The foundation shall be explored below the bottom of the excavation to determine the type and condition of the foundation. Foundation exploration shall extend to a**

depth equal to ½ inch per foot of fill height or 8 inches, whichever is greater. The Contractor shall report the findings of the foundation exploration to the Owner for approval prior to placing the structure.

3. **Where unsuitable foundation is encountered at the established grade, as determined by the Owner, such material shall be removed and replaced.**
4. **Backfill for areas where unsuitable material has been removed shall be placed and compacted in accordance with the requirements of Sections 200 and 303.**
5. **Bedding material shall be placed in accordance with the Standard Drawings and shall be #57 stone, unless the field installation conditions and the Owner allow aggregate No. 25 or 26. Bedding material shall conform to the requirements of Section 200.**
6. **Bedding shall be uniformly compacted. The depth of bedding material shall be as specified in the Contract Documents.**
7. Brick and concrete block masonry shall be placed so that each unit will be thoroughly bonded with mortar. Joints shall be full-mortar joints not more than ½-inch in width. Where brick masonry is used, headers and stretchers shall be arranged to bond the mass fully. Every seventh course shall be placed entirely with headers. Inside joints shall be neatly pointed, and the outside of such walls shall be plastered with mortar as they are placed.
8. Iron fittings entering the masonry shall be placed as the work is built up, thoroughly bonded, and accurately spaced and aligned.
9. Inlet and outlet pipe connections shall conform to the same requirements as the pipe to which they connect and shall be of the same size and kind. Pipe sections shall be flush on the inside of the structure wall and shall project outside sufficiently for proper connection with the next pipe section. Masonry shall fit neatly and tightly around the pipe.
10. Immediately following finishing operations, hydraulic cement concrete shall be cured and protected in accordance with Section 502.
11. Backfilling shall be performed in accordance with the requirements of Section 303.
12. When grade adjustment of existing structures is specified, frames, covers, and gratings shall be removed and the walls shall be reconstructed as required. Cleaned frames shall be reset at the required elevation.

G. Testing and Inspection:

All elements of the drainage system constructed during this project shall receive, at a minimum, a visual inspection by the Owner to ensure compliance with the Contract Documents. Any element found not in compliance will be removed, repaired, reconstructed, and retested, as necessary, by the Contractor until testing indicates that the system is in accordance with the

Contract Documents. Any work required to correct deficiencies shall be at no additional cost to the Owner.

H. Cleaning:

Upon completion, each pipe and structure shall be cleaned of silt, debris, and foreign matter and shall be kept clear of such accumulation until final acceptance.

### III. MEASUREMENT FOR PAYMENT

#### 3.1. GENERAL

- A. Measurement will be made on the basis of completion of the Work in accordance with the Contract Documents and this Section.
- B. Measurement of quantities will be made by the Contractor in the presence of the Owner.
- C. Area computations shall be made on the surface. Pay measurements for area computations will not exceed plan dimensions as shown on the Drawings, unless otherwise approved by the Owner in writing.
- D. No payment will be made for length, width, or depth, in excess of that shown on the Drawings or specified in the Specifications for any construction, unless otherwise approved by the Owner in writing.
- E. Linear foot and vertical foot measurements shall be measured along the horizontal plane of the ground or paved surface.
- F. The term "Each" when used as an item of payment will mean complete payment for the Work described in the Contract Documents.
- G. The word "Lump Sum" when used as an item of payment will mean complete payment for work described in the item, including all materials, labor, and equipment necessary to complete the work in accordance with the Contract Documents.
- H. The term "Complete in Place" will mean that the item of work shall be furnished and installed in accordance with the Contract Documents complete with all appurtenances necessary for the item to be used for its intended function. Testing and acceptable results shall be included.
- I. The cost of excavation, backfill, and disposal of surplus material for drop inlets, intake boxes, manholes both new and reconstructed, spring boxes, junction boxes, and base sections of pipe tee units used as drop inlets and manholes shall be included in the bid price for such items. No additional or separate payment will be made. In the event steps or invert shaping are required, the cost thereof shall also be included in the price for such items.
- J. Bedding stone depth shall be 6-inches and shall be considered incidental to the pipe and structures. Undercut excavation and the replacement of excavated undercut material shall be as specified in Section 303.

### 3.2. MEASUREMENT OF QUANTITIES

- A. Pipe will be measured in linear feet. Pipe will be measured through the fittings from center of the structure to center of structure or to the terminal end. When a partial section is required, the actual length of the partial section will be measured in place. Pipe shall be paid for at the contract unit price per linear foot, complete in place. Payment will be made at 90% of the unit price bid per linear foot for each size pipe installed in place, including satisfactory testing. The remaining 10% shall be paid following successful completion of pipeline and structure installation, restoration of affected areas, and Owner acceptance of all testing. All such payments shall be subject to applicable retainage. Payment will include the cost of the following:
1. Backfilling, compacting, and compaction testing
  2. Cleaning prior to acceptance, as required
  3. Dewatering
  4. Disposal of surplus and unsuitable material
  5. Excavation
  6. Main line fittings
  7. Pipe anchor blocks
  8. Restoration in right-of-way and shoulders and easements (including curb and gutter restoration), unless otherwise specified on the drawings.
  9. Storm sewer and appurtenances
  10. Stripping and stockpiling topsoil
  11. Temporary seeding and stabilization
  12. Temporary sheeting and bracing.
  13. Joint Wrapping & Sealing, including geotextile fabric
- B. Pipe culverts will be measured and paid in linear feet. Pipe will be measured through the fittings from center of the structure to center of structure or to the terminal end. When a partial section is required, the actual length of the partial section will be measured in place.
- C. Pipe tees and elbows will not be measured separately.
- D. Pipe reducers will not be measured separately and will be measured and paid in linear feet of pipe for payment at the larger pipe size.
- E. Jacked pipe will be measured in linear feet to the nearest 1/10 of a foot. Jacked pipe will be paid at the contract unit price per linear foot for each size pipe installed, complete in place including all work associated with bore pit.
- F. Reinstalled pipe will be measured and paid in linear feet along a line parallel to the flow line. This price shall include excavation involved in removing pipe, hauling, cleaning, relaying, backfilling, necessary cutting for joining to other sections of pipe, furnishing new coupling bands, disposing of surplus excavation, disposing of surplus and damaged materials, and replacing any otherwise usable sections damaged or broken because of the negligence of the Contractor.
- G. End sections will be measured in units of each, complete-in-place.
- H. End walls and arch substructures will be measured per each.

- I. Box culverts will be measured in linear feet along the centerline of the barrel from face of curtain wall to face of curtain wall. This price shall include all work including, but not limited to designing, casting, reinforcing, installing, waterproofing, sealing joints, anchoring, and providing buffer zones for multiple lines.
- J. Pipe grates will be measured and paid in linear feet, complete and in place. This price shall include fabricating, furnishing, galvanizing, and installing.
- K. Drop inlets, yard inlets, catch basins, and intake boxes will be measured as each as complete units, including the frame and grate or cover. Drop inlets, yard inlets, catch basins, and intake boxes will be paid for at the contract unit price per each. Where curb or curb and gutter extend along the drop inlet, the contract unit price for drop inlets shall include that part of the curb or gutter within the limits of the structure.
- L. Base sections of pipe tee units used as drop inlets and manholes will be measured and paid in linear feet horizontally of pipe specified. The riser section and additional costs for the tee shall be included in the price for the drop inlet or manhole.
- M. Manhole (4- or 5-foot diameter) installed complete in place, 0' to 6' in depth. Measurements will be made to the nearest foot from the bottom of the frame and cover to the invert out.

Payment will be made at the unit price bid for each standard depth manhole (0' to 6') installed and satisfactorily tested, and will include the cost of the following:

- 1. All appurtenances required for satisfactory operation
- 2. Cleaning prior to acceptance, as required
- 3. Dewatering
- 4. Excavation, bedding, backfill, and compaction
- 5. Manhole, complete including frame and cover, benches, inverts and troughs
- 6. Openings and seals
- 7. Sheeting and shoring
- 8. Steps, unless otherwise noted

- N. Manhole Extra Depth, installed complete in place.

Measurement of the manholes (4- or 5-foot diameter) in excess of 6-feet in depth will be made based on the vertical feet of manhole installed in excess of 6-feet, measured to the nearest foot from 6 feet below the bottom of the frame and cover to the invert out in depth.

Payment will be made at the unit price bid for each additional vertical foot of manhole (in excess of 6 feet in depth) installed and satisfactorily tested and will include the cost of the following:

- 1. All appurtenances required for satisfactory operation
- 2. Cleaning prior to acceptance, as required
- 3. Dewatering
- 4. Excavation, bedding, backfill, and compaction
- 5. Openings and seals
- 6. Sheeting and shoring
- 7. Steps, unless otherwise noted

O. Conflict Manhole, installed complete in place.

Measurement will be made as each. Payment will be made at the unit price bid for each conflict manhole installed and satisfactorily tested will include the cost of the following:

1. All appurtenances required for satisfactory operation
2. Cleaning prior to acceptance, as required
3. Dewatering
4. Ductile iron pipe
5. Excavation, bedding, backfill, and compaction
6. Manhole, complete including benches, inverts and troughs, and frame and cover
7. Openings and seals
8. Sheeting and shoring
9. Steps, unless otherwise noted

P. Concrete spring boxes will be measured and paid as each.

Q. Junction boxes will be measured as a complete unit including frame and cover, and paid as each.

R. Reconstructed manholes will be measured and paid as each as a complete unit.

S. Precast arches will be measured and paid in linear feet along the centerline of the invert from face of headwall to face of headwall. This price shall include designing, forming, casting, reinforcing, excavating, wingwalls, installing, waterproofing, sealing joints, anchoring and bedding, and providing buffer zones for multiple lines. The cost for cast-in-place work other than that specified on the Drawings shall be included in the price for precast arches.

### 3.3. PAY ITEMS

Payments shall be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Pipe (Size and Type)	LF
Pipe culverts	LF
Jacked pipe (Size and Type)	LF
Reinstalled pipe	LF
End sections (Standard and Size)	EA
End walls an arch substructures	EA
Box culverts	LF
Pipe grates	LF
Drop inlet	EA
Yard inlet	EA
Catch basin	EA
Intake boxes	EA
Base Sections (Drop Inlets and Manholes)	LF
Manholes (0-6 feet)	EA
Manhole extra depth (in excess of 6 feet)	VF
Conflict manhole	EA

Concrete spring boxes	EA
Junction boxes	EA
Reconstructed manholes	EA
Precast arch (Size)	LF

End of Section