

Standard Construction Specifications



DUCKS UNLIMITED

*Great Plains Regional Office*

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## **201 MOBILIZATION**

### **201.10 DESCRIPTION**

The work shall include the supply of all labor, material and equipment to transport all needed labor, material and equipment to and from a project site to successfully complete that project as shown on the plans or described by the Engineer. When work consists of construction in a number of different locations at a given project site, mobilization shall include the transportation of the required labor, material and equipment between the various locations at the project site.

### **201.20 METHOD**

The Contractor shall conduct all mobilization operations in a timely orderly, manner. Unless otherwise approved by the Engineer, mobilization operations shall commence no later than one week after the pre-construction meeting. Mobilization shall commence no later than one week after project completion and be finished within two weeks of project completion. During all operations, the Contractor is responsible for maintaining public and private property in original condition.

### **201.30 METHOD OF MEASUREMENT**

Mobilization shall be measured on a unit basis. The unit shall be shown in the Unit Price Table of the Standard Bid Form for the pay item corresponding to this specification number. Mobilization shall be measured in the following manner:

- 1) Lump Sum (LS): Mobilization shall be measured on a lump sum basis during completion of the entire project.
- 2) Each (EA): Mobilization shall be measured per (each) mobilization required to complete identified phases of a project that need to be completed at different construction times.

### **201.40 METHOD OF PAYMENT**

The completed work for Mobilization, measured as specified, shall be paid for at the contract unit price. Payment shall be made according to the following schedule:

- 1) 25% of contract unit price at project start up.
- 2) 50% of contract unit price at half project completion.
- 3) 100% of contract unit price at project completion.

The unit price bid for mobilization shall include supplying all materials, equipment, labor and any incidental items necessary for performing all mobilization operations described in this specification. Unless separate mobilizations are required to completed different phases of the work shown on the plans, a Contractor may be eligible for a separate mobilization payment when the Contractor is required to discontinue work by the Corporation for reasons other than seasonal termination of work. The payment shall be commensurate to the amount of equipment and materials that are required to be removed from the project site and that payment shall not exceed the original unit price specified for mobilization.

## **202 SITE PREPARATION**

### **202.10 DESCRIPTION**

This specification shall cover the supply of all labor, materials, and equipment required for clearing and grubbing, and site preparation. The work shall include:

- a) Removal from site and disposal of all trees, roots, brush, stone, rubbish and all other surface litter in designated areas by burying or burning.
- b) Coordination of necessary clearing and grubbing operations to allow timely completion of construction staking of a project.
- c) Grubbing to remove grass and debris.
- d) Stripping of six (6) inches of topsoil and re-spreading after construction is completed, unless otherwise specified on the plans.
- e) Final clean up of the site prior to demobilization will require the spreading and shaping of all materials stockpiled or moved to facilitate construction including but not limited to vegetative material.

### **202.20 CONSTRUCTION METHODS**

Clearing shall consist of the cutting, removing, disposal and cleaning up of all timber, brush and fallen timber, stumps, shrubs, and rubbish. Trees and shrubs designated for preservation shall be marked and protected from scoring, barking or other injury during construction operations.

Grubbing shall consist of the removal and disposal of all roots, stumps, imbedded logs or objectionable debris to a depth of not less than twelve (12) inches below the original ground surface. Where no trees or brush exist, grubbing shall consist of removal of grass and debris prior to placement of fill material.

Topsoil stripping and stockpiling shall be performed for the footprint of all embankments and at the surface area of all excavations and at the base of temporary stockpiles and waste area unless otherwise noted on the plans. Unless otherwise specified, upon completion of the construction, the stockpiled material shall be spread and finished to a reasonably smooth surface.

Trees, logs, stumps, brush and other debris shall be burned and buried or chipped, or disposed of in areas designated by the Engineer. All burning is subject to local or state ordinances. Areas such as borrows, pits, and excavations so designated shall be left in a neat and finished appearance free from debris. All materials disposed of shall be covered with clean fill and leveled in such a way as to promote drainage.

### **202.30 METHOD OF MEASUREMENT**

Site preparation shall be measured on a unit basis. The unit shall be shown in the Unit Price Table of the Standard Bid Form for the pay item corresponding to this specification number. Site preparation shall be measured in the following manner:

- 1) Lump Sum (LS): Site preparation shall be measured on a lump sum basis of site preparation operations. No separate measurement will be made for topsoil removal and replacement, clearing and grubbing or coordination of clearing and grubbing operations for construction staking.
- 2) Cubic Yard-Plan (CY-P): Site preparation shall be measured on a plan quantity basis of site preparation operations. This quantity shall be the neat line site preparation quantity for the specified depth at the footprint of the embankment or the surface area of potholes and channels as calculated from the construction plans. This measurement shall not include clearing and grubbing or topsoil

stripping and stockpiling of borrow areas as these quantities are considered incidental to embankment construction unless otherwise noted on the plans. No separate measurement for clearing and grubbing or coordination of clearing and grubbing operations for construction staking will be made.

- 3) Cubic Yard-Staked Quantity (CY-S): Site Preparation shall be measured on a staked quantity basis of site preparation operations. This quantity shall be the area of work, as determined by superimposing the construction staking notes on the original ground elevations, multiplied by the specified depth. This measurement shall not include clearing and grubbing or topsoil stripping and stockpiling of borrow areas as these quantities are considered incidental to embankment construction unless otherwise noted on the plans. No separate measurement for clearing and grubbing or coordination of clearing and grubbing operations for construction staking will be made.
- 4) Linear Feet (LF): Site preparation shall be measured on a linear feet basis. The length shall be the actual staked centerline distance of site preparation completed according to plans and specifications.
- 5) Acre (AC): Site preparation shall be measured on an acre basis. The dimension shall be the actual staked outside dimensions of site preparation completed according to plans and specifications.
- 6) Hourly-Recorded (HR-R): Site preparation shall be measured on a per diem basis. The per diem basis shall be the actual hours as recorded from an approved rpm/hr recording system for each piece of equipment used to complete the excavation portion of this project. No separate recording shall be made for mobilization and idling of equipment, unless otherwise specified.

When Site Preparation is not listed on the Standard Bid Form or when a unit price bid has not been entered for Site Preparation, it shall be considered incidental to the excavation, embankment, structure, and piping operations and no measurement shall be made.

#### **202.40 METHOD OF PAYMENT**

The completed work for site preparation, measured as specified, shall be paid for at the contract unit price. The unit price bid for site preparation shall include supplying all materials, equipment, labor and any incidental items necessary for performing all site preparation operations described in this specification

## 203 EXCAVATION

### 203.10 DESCRIPTION

This specification shall cover the supply of all labor, materials, and equipment required for the excavation, hauling and spreading of materials from within the limits of the cut area as shown on the plans, including but not limited to, excavation of designated areas; peninsula cutoffs; silt removal; pothole and dugout construction; and key trench construction. The work shall include control of water during excavation, the shaping of slopes to the lines and grades shown on the drawings and the disposal of materials within designated areas. Unless otherwise specified, all material to be excavated shall be considered unclassified regardless of their nature or the manner in which they are removed. In the case that drilling, and blasting is required, due to size of density of rock encountered, extra work will be considered.

### 203.20 CONSTRUCTION METHODS

#### 203.21 SITE PREPARATION

Prior to any excavation, sites shall be cleared and grubbed with topsoil removed in accordance with the specification for **SITE PREPARATION**. Material cleared and grubbed shall be disposed of per the Engineer's directions. Topsoil removed shall be stockpiled and later re-spread on those areas at a thickness of four (4) inches, unless otherwise specified.

#### 203.22 EXCAVATION

Excavation shall mean the removal of all materials encountered within the limits of excavation as shown on the drawings or as staked by the Engineer. Excavation shall be performed in as nearly a continuous operation as possible, trimmed and leveled to conform to the required lines, grades and tolerances. Areas over-excavated shall be replaced with suitable materials compacted to a density at least equal to that of the in-situ material or to the satisfaction of the Engineer.

Suitable material excavated from the excavation areas shown on the plans shall be used in any embankments called for on the plans. This shall include areas stripped of topsoil or unsuitable material that need to be backfilled with suitable material or key trenches. Placement of these embankments or backfills shall be done in accordance with the specification for **EMBANKMENT CONSTRUCTION**.

Excavated material unsuitable for embankments shall be deposited in locations shown on the plans or as directed by the Engineer. Unsuitable excavated materials shall be deposited as uniformly and continuously as possible in successive layers. No specific compaction will be required but where the material is placed with equipment other than tractor scrapers, blading and leveling is required to minimize voids. The fill shall be leveled upon completion to conform to lines and grades and enable the area to be seeded.

Rock excavation operations shall be controlled by the Contractor to produce the size gradations specified for other parts of the work, if the rock is designated by the Engineer as suitable for use.

#### 203.23 DISPOSAL OF WASTE MATERIALS

All surplus or unsuitable excavated materials designated as waste by the Engineer shall be disposed of at the locations shown on the plans or as directed by the Engineer.

## 203.24 CONTROL OF SURFACE AND SUBSURFACE WATER

The Contractor is responsible for control of surface water, subsurface water, and drainage during the construction period. All temporary fills, crossings, and culverts necessary to promote drainage during construction will be installed and removed at the Contractor's expense prior to acceptance of the work. Any claims arising from upstream or downstream damages as a result of the construction or failure of these temporary works will be the Contractor's responsibility.

It is the responsibility of the Contractor to control the surface and sub-surface water and drainage in any excavation area, dewatering placement area and borrow area. Should material quality lessen through inadequate drainage, the Contractor may be directed by the Engineer to construct drainage facilities or develop an alternate borrow area at the Contractor's expense.

## 203.30 METHOD OF MEASUREMENT

Excavation shall be measured on a unit basis. The unit shall be shown in the Unit Price Table of the Standard Bid Form for the pay item corresponding to this specification number. No measurement for over-excavation shall be made. Excavation shall be measured in the following manner:

- 1) Lump Sum (LS): Excavation shall be measured on a lump sum basis and no separate measurement shall be made for the volume of material excavated.
- 2) Cubic Yards-Plan Quantity (CY-P): Excavation shall be measured on a plan quantity basis. This quantity shall be the neat line excavation quantities calculated from the construction plans.
- 3) Cubic Yards-Staked Quantity (CY-S): Excavation shall be measured on a staked quantity basis. The quantity shall be calculated by superimposing construction staking notes on original ground and using average end area methods of volume calculation.
- 4) Cubic Yards (CY): Excavation shall be measured on a volume basis. The volume to be paid for shall be made by superimposing final cross-sections on applicable stripped or original ground profile sections and using average end area methods of volume calculation. No measurement for overexcavated materials shall be made.
- 5) Linear Feet (LF): Excavation shall be measured on a linear feet basis. The length shall be the actual staked centerline distance of excavation completed according to plans and specifications.
- 6) Hourly-Recorded (HR-R): Excavation shall be measured on a per diem basis. The per diem basis shall be the actual hours as recorded from an approved rpm/hr recording system for each piece of equipment used to complete the excavation operations. No separate recording shall be made for mobilization and idling of equipment, unless otherwise specified.

When a unit price bid has not been entered for Excavation, it shall be considered incidental to the embankment, structure, and piping operations and no measurement shall be made.

## 203.40 METHOD OF PAYMENT

The completed work for excavation, measured as specified, shall be paid for at the contract unit price. The unit price bid for excavation shall include supplying all materials, equipment, labor and any incidental items necessary for performing all excavation operations described in this specification. No payment shall be made for dewatering or the control and drainage of surface/sub-surface water. No payment for excavation of suitable material will be made when excavating in a designated borrow area to obtain material that is to be placed, measured and paid in accordance with the specification for **EMBANKMENT CONSTRUCTION**.

## **204 EMBANKMENT CONSTRUCTION**

### **204.10 DESCRIPTION**

The work shall include the supply of all labor, material and equipment required to complete the construction of key trenches, dams, dikes, berms, levees or roadway embankments as shown on the plans and as staked in the field. The work shall include:

- a) Excavation of suitable materials from borrows or excavations.
- b) Placement of materials from designated borrow areas or excavation into embankments such as dams, dikes, berms, levees or roadways.
- c) Leveling and trimming of embankments and borrow areas.

### **204.20 CONSTRUCTION METHODS**

#### **204.21 SITE PREPARATION**

Prior to any embankment or key trench construction, sites shall be cleared and grubbed with topsoil removed in accordance with the specification for **SITE PREPARATION**. Material cleared and grubbed shall be disposed of per the Engineer's directions. Topsoil removed shall be stockpiled and later re-spread on those areas at a thickness of four (4) inches, unless otherwise shown on the plans.

#### **204.22 FILL MATERIAL**

Unless otherwise specified, all material shall be placed in loose lifts of not more than eight (8) inches thickness and shall be compacted by suitable compaction equipment to a minimum of 95% of maximum density as determined by the Standard Proctor Method ASTM D698. Moisture content shall be in the range of -1% to +3% of optimum moisture content. Field tests conforming to standard ASTM testing methods will be scheduled at the discretion of the Engineer to ensure compliance with these specifications.

If material is placed into embankments during freezing conditions, any frost developed during embankment construction shall be removed prior to continuing fill operations. Embankments shall not be constructed during periods when the embankment material freezes while being placed and compacted.

Fill material shall be free from boulders, concrete, snow, stumps or other vegetation.

#### **204.23 KEY TRENCH CONSTRUCTION**

The Contractor shall not commence key trench construction until such work as specified in the specification for **SITE PREPARATION** has been completed to the satisfaction of the Engineer.

Where specified on the plans, the key trench excavation shall be made to the lines and grades shown on the drawings but may be altered during construction upon the direction of the Engineer to adjust for variation in soil conditions. Excavated material, if acceptable in quality to the Engineer, may be stockpiled for use in site preparation or embankment construction. Unacceptable materials shall be disposed of by placing into designated areas. The key trench completed to the original ground surface elevation shall be rough leveled prior to commencing embankment construction.



## 204.24 EMBANKMENT CONSTRUCTION

The Contractor shall not commence embankment construction until such work as specified in the specification for **SITE PREPARATION** and the key trench, where specified, has been completed to the satisfaction of the Engineer.

Embankment material excavated from ditches/borrows with tractor-scraper units shall be placed in successive layers across the entire width of the embankment. Each layer must be spread as deposited longitudinally along the embankment with each layer not exceeding eight (8) inches in thickness. With the Engineer's approval, the initial layer may be increased in thickness in wet areas to provide a working pad capable of supporting the hauling equipment. The embankment at all times must be maintained in a reasonably level condition and hauling equipment shall be directed over the full width of each layer to facilitate uniform compaction. Adequate equipment shall be used to obtain the minimum compaction specified in Section 204.22 of this specification.

Where embankment material is excavated with bucket equipment from ditches or borrow, it shall be deposited into the embankment within reach of the equipment. To prevent berm failure, stock piling on berms will not be permitted. Materials shall be placed and spread in layers with each layer after spreading not to exceed eight (8) inches in thickness.

All embankments will be construction staked to final grade elevations shown on the drawings. Embankments shall be brought to these elevations using embankment material graded to a tolerance of +/- 0.1 feet. Topsoil or riprap materials are to be placed on top of embankment construction. Topsoil depths shall be four (4) inches, unless otherwise specified, while riprap depths shall be as specified on the drawings. All embankment construction must be as continuous as possible and the fill maintained such that drainage is assured at all times.

Should fill settlement occur during the construction of the embankment and within seven days of substantial completion, and prior to acceptance of the work, additional material shall be placed and trimmed to achieve final grade by the Contractor at his own expense. After embankments have been constructed to grade, they shall be leveled and trimmed to conform to the lines, grades and cross-sections shown on the plans and/or as staked. Acceptance of finished embankment may be made progressively during the course of construction upon the request of the Contractor. A completed embankment once accepted by the Engineer shall not be used by the Contractor for haulage, access or other purposes without the consent of the Engineer.

Water used in conjunction with embankment construction activities shall be applied and paid as described in the specification for **WATER**.

Cold weather embankment construction - Embankment construction may not proceed if material freezes while being placed and compacted however when weather conditions are such that embankment construction may proceed, the contractor may be permitted to excavate any frozen foundation soils or previously installed fill and proceed with the embankment construction for so long as weather will permit, but only if and to the extent approved by the engineer and with the understanding that additional costs involved shall be borne by the contractor. The frozen soil shall be wasted and replaced with other suitable soil as may be necessary to construct the embankments as specified.

## 204.25 TRIMMING

The crest, side slopes and berms of the embankment shall be leveled and trimmed to conform to the lines and grades shown on the drawings. The crest shall be constructed to the elevation shown on the plans prior to acceptance of the work. Acceptance of the finished embankment may be made progressively during the

course of construction upon the request of the Contractor. Once accepted by the Engineer, the Contractor shall not use a completed embankment for haulage, access or other purposes.

#### 204.26 HAUL ROADS AND BORROW AREAS

The construction, maintenance and removal of all haul roads from the borrow areas shall be the responsibility of the Contractor and be considered incidental to the work. Borrow areas shall be maintained during construction in a graded condition such that drainage is assured and that operations can resume quickly after precipitation periods. No borrow shall be obtain outside of designated borrow areas or designated depths or elevations without approval from the engineer, responsible agency and landowner. Following completion of the work, borrows are to be left in a graded condition acceptable to the Engineer and all haul roads, access roads and temporary crossings are to be removed.

#### 204.27 CONTROL OF SURFACE AND SUBSURFACE WATER

The Contractor is responsible for control of surface water, subsurface water, and drainage during the construction period. All temporary fills, crossings, and culverts necessary to promote drainage during construction will be installed and removed at the Contractor's expense prior to acceptance of the work. Any claims arising from upstream or downstream damages as a result of the construction or failure of these temporary works will be the Contractor's responsibility.

It is the responsibility of the Contractor to control the surface and sub-surface water and drainage in any excavation area, dewatering placement area and borrow area. Should material quality lessen through inadequate drainage, the Contractor may be directed by the Engineer to construct drainage facilities at the Contractor's expense.

#### 204.30 METHOD OF MEASUREMENT

Embankment construction shall be measured on a unit basis. The unit shall be shown in the Unit Price Table of the Standard Bid Form for the pay item corresponding to this specification number. No measurement for embankment constructed beyond the staked limits will be made. Embankment construction shall be measured in the following manner:

- 1) Lump Sum (LS): Embankment shall be measured on a lump sum basis of placed embankment. No separate volume measurement shall be made.
- 2) Cubic Yard-Plan Quantity (CY-P): Embankment shall be measured on a plan quantity basis. This quantity shall be the neat line quantity of placed embankment including site preparation calculated from the construction plans. This measurement shall also include site preparation quantities. Site preparation quantities to be added to embankment quantities shall be calculated as described in the specification for **SITE PREPARATION**. This measurement shall not include clearing and grubbing or topsoil stripping and stockpiling of borrow areas as these quantities are considered incidental to embankment construction.
- 3) Cubic Yard-Staked Quantity (CY-S): Embankment shall be measured on a staked quantity basis of placed embankment. This quantity shall be measured by superimposing the construction staking notes on the original ground elevations and using the average end method of volume calculation. This measurement shall also include site preparation quantities. Site preparation quantities to be added to embankment quantities shall be calculated as described in the specification for **SITE PREPARATION**. When indicated on the plans or unit table, an appropriate shrinkage factor will be applied to this calculation. This measurement shall not include clearing and grubbing or topsoil stripping and stockpiling of borrow areas as these quantities are considered incidental to embankment construction unless otherwise indicated on the plans or unit price table.

- 4) Cubic Yards (CY): Embankment shall be measured on a volume basis of placed embankment. The volume to be paid for shall be made by cross sectioning designated borrow areas minus topsoil quantities and using the average end method of volume calculation. No measurement shall be made for overbuild areas.
- 5) Linear Feet (LF): Embankment shall be paid on a linear feet basis. This quantity shall be measured by the actual staked centerline distance of all embankment constructed according to plans and specifications.
- 6) Hourly-Recorded (HR-R): Embankment shall be measured on a per diem basis. The per diem basis shall be the actual hours as recorded from an approved rpm/hr recording system for each piece of equipment used to complete the embankment operations. No separate recording shall be made for mobilization and idling of equipment, unless otherwise specified.

No separate measurement shall be made for the fill around pipes, pipeline, and water control structures. This work shall be considered incidental to those bid items.

#### **204.40 METHOD OF PAYMENT**

The completed work for embankment construction, measured as specified, shall be paid for at the contract unit price. The unit price bid for embankment construction shall include supplying all materials, equipment, labor, and any incidental items necessary for performing all embankment construction operations described in this specification. No payment shall be made for dewatering or the control and drainage of surface/sub-surface water.

## **205 WATER**

### **205.10 DESCRIPTION**

The work shall include the supply of all labor, material, and equipment required to add water to embankments as directed by the Engineer. The work shall include:

- a) Locating and procuring a suitable water source.
- b) Delivery of water to the site, applying and mixing water with embankment material.

### **205.20 MATERIALS**

Water used for construction shall be reasonably clean and shall not affect normal soil characteristics.

### **205.30 CONSTRUCTION METHODS**

Water shall be applied to the embankment areas (or borrow areas) in a way that maintains the specified moisture content. Sufficient equipment shall be on the project site to secure and maintain the specified moisture content until the required density is secured. Water shall be applied uniformly over the working area.

### **205.40 METHOD OF MEASUREMENT**

Water shall be measured on a unit basis. The unit shall be shown in the Unit Price Table of the Standard Bid Form for the pay item corresponding to this specification number. Water shall be measured in the following manner: **Note MGAL is defined as 1000 gallons.**

- 1) Lump Sum (LS): Water shall be measured on a lump sum basis for applied water. No separate measurement shall be made.
- 2) MGAL - Plan Quantity (MG-P): Water shall be measured on a plan quantity basis. The quantity shall be the one thousand gallon (KGAL) increments as calculated using soil investigation information and listed on the plans or shown on the Standard Bid Form. No measurement shall be made for the volume of water applied.
- 3) MGAL - (MG): Water shall be measured on a volume basis. The water measured shall be the actual amount of applied water in one thousand-gallon (KGAL) increments used in the construction of the project. The amount used shall be measured in the field as agreed to by the Contractor and the Engineer.

### **205.50 METHOD OF PAYMENT**

The completed work for water, measured as specified, shall be paid for at the contract unit price. The unit price bid for water shall include supplying all materials, equipment, labor and any incidental items necessary for performing all water operations described in this specification.

## 301 WATER CONTROL STRUCTURES

### 301.10 DESCRIPTION

The work of this section shall include the supply of all labor, materials, and equipment required to complete the installation of the water control structures as called for on the drawings and/or specified herein. These water control structures may include but are not limited to the following:

- a) Stoplog control structures
- b) Gate control structures
- c) Fixed level control structures
- d) Any other structures specified on the plans

This work shall consist of coupling the structure to the pipe; excavation; bed preparation; installation of structure and associated hardware with the use of a concrete base pad or form, reinforcement, and concrete placement, or framing and supports as shown on the plans. Work shall also include the supply, placing and compaction of backfill to the lines and grades shown on the drawings or as specified.

### 301.20 MATERIALS

#### 301.21 SUPPLY OF MATERIALS

Unless otherwise specified, the Contractor shall supply all couplers, nuts, bolts, riser controls, stoplog channels, sealants, and all accessories necessary to complete the installation as shown on the plans or recommended by the material manufacturer.

The structure material, diameter and length shall be as specified on the plans. All culverts, inlet and outlet pipes, and appurtenances shall match the material and coating of the base riser unless otherwise specified on the plans. All materials supplied by the Contractor shall be subject to inspection by the Engineer.

The following specifications for each material type shall be adhered to.

- 1) Aluminum corrugated metal pipe risers. The minimum acceptable series for aluminum CMP shall be 3000 Series. The material shall meet the requirements of AASHTO M197.
  - a) Pipe shall be close riveted or of a "lock seam" construction. Unless otherwise specified all pipes shall have a 2-2/3" x 1/2" corrugation. The gauge of the pipe shall be as follows unless otherwise specified on the plans:

Pipe Diameter	2-2/3" x 1/2" Corrugations Metal Thickness	3" x 1" Corrugations Metal Thickness
12"-21"	14	NA
24"-36"	12	14
42"-54"	10	12
60"-96"	8	10

- b) All welds shall be 3/16" fillets unless otherwise specified on the plans and should conform to Welded Joint Requirements of the latest edition of the AISC Manual. All bolted connections shall utilize stainless steel bolts, nuts, and washers, grade 18-8 or 304 or better.
    - c) The minimum acceptable series for all structural aluminum, channels, angles, plates, rounds, etc. shall be 5000 Series, unless otherwise specified.

- d) The portion of the riser that will be embedded in the concrete base shall be coated with asphalt mastic prior to installation.
- 2) Steel corrugated metal pipe risers. Where stated as acceptable on the plans, steel corrugated metal risers shall be made of galvanized or aluminized Type II steel. Galvanized steel corrugated metal pipe shall meet the composition requirements of AASHTO M218. The aluminized Type II steel shall conform to the requirements of AASHTO M274.
- a) Pipe shall be close riveted or of a "lock seam" construction. Unless otherwise specified all pipes shall have a 2 2/3" x 1/2" corrugation. The gauge of the pipe shall be as follows unless otherwise specified on the plans:

Pipe Diameter	2-2/3" x 1/2" Corrugations Metal Thickness	3" x 1" Corrugations Metal Thickness
12"-21"	16	NA
24"-36"	14	16
42"-54"	12	14
60"-96"	10	12

- b) Risers made of galvanized or aluminized Type II steel shall be coated unless otherwise indicated on the plans. This coating shall be a 10 mil polymeric film laminate. The coatings shall be applied to both the inside and outside of the riser.
- c) All welds shall be 3/16" fillets unless otherwise specified on the plans and should conform to Welded Joint Requirements of the latest edition of the AISC Manual. All cuts and welds required for riser fabrication shall be brushed or sprayed with a bituminous coating.
- 3) Pre-cast concrete risers. Where stated as acceptable on the plans, pre-cast concrete structures shall conform to the requirements of ASTM C478. The risers shall be of the length shown on the plans. All pipe shall be connected to the riser utilizing a flexible watertight connector as shown on the plans or as approved by the Engineer.
- 4) Fiberglass, High Density Polyethylene (HDPE) Pipe, and Polyvinyl Chloride (PVC) Pipe Risers. Where stated as acceptable on the plans, Fiberglass, HDPE, and PVC risers shall be approved by the Engineer and shall be of the length shown on the Plans.
- a) The minimum acceptable series for all structural aluminum, channels, angles, plates, rounds, etc. shall be 5000 Series, unless otherwise specified.
- b) All bolted connections shall utilize stainless steel bolts, nuts and washers, grade 18-8 or 304 or better.
- c) The pipe stubs for the structure shall incorporate a gasketed bell and spigot design or engineer approved alternate with the ability to accept watertight HDPE or PVC pipe. The gasketed joint shall meet the requirements of ASTM F477 with a minimum watertight performance of 10.8 psi. 36" through 60" diameters shall have a reinforced bell and spigot.
- d) The structure manufacturer shall weld and/or bond all stub joints on both the interior and exterior of the riser.
- e) Fiberglass risers shall be of three-piece construction. The two-piece exterior shell shall consist of two molded fiberglass shells with reinforcing ribs and flanges. The fiberglass shall be a polyester resin. The center stop gate shall be of polyethylene construction.
- f) HDPE risers shall have a smooth interior and annular exterior corrugations. The Engineer shall approve the pipe utilized for the structure. The material shall meet the requirements of ASTM D3350 with a minimum cell classification 335420C. 12" to 48" risers shall meet

the requirements of AASHTO M294, Type S. 54" and 60" risers shall meet the requirements of AASHTO MP7.

- ⇒ PVC structure shall be constructed of ½" thick or greater extruded PVC sheets, connected by anodized aluminum corners, sealed with waterproof caulking, and secured with stainless steel connections. The structure shall be similar to the inline water level control structure as manufactured by Agri-Drain Corp. or approved equal. Structure shall include a metal lid with attachment accessories.
- 5) Where called for the plans, annular connecting bands shall be the same material and have the same coating, corrugations, and gauge as specified for the pipe that is to be connected.
- a) The connecting bands shall be either 24" in width or have a minimum of nine (9) corrugations. The minimum circumferential overlap shall be six (6) inches. If helical pipe is used, a minimum of four (4) re-rolled annular corrugations shall be formed to allow the use of the annular overlapping connecting bands.
- b) To provide for a watertight joint, a closed cell expanded gasket or engineer approved equal shall be used in conjunction with connecting band. The gasket shall be at least 24" in width, 3/8" thick, with an unstretched diameter ten (10) percent less than normal pipe size and shall comply with ASTM D1056, Grade SCE-43. Mastic shall be placed on each side of the gasket.
- c) The binders for the connecting bands will consist of a minimum of 6 rods and tank lugs, three (3) per side, in accordance with the plans. The minimum rod diameter shall be 7/16" with ½" threads. All rods and lugs shall be galvanized.
- 6) When called for on the plans, the Contractor shall supply to the site ready mix concrete, or site mix concrete in accordance with the specification for **CAST-IN-PLACE REINFORCED CONCRETE**. Forms, reinforcing steel or wire mesh, for the concrete pad for the control structure will be the responsibility of the Contractor. Installation of a concrete base for all prefabricated risers shall be considered incidental to the riser installation and no separate measurement or payment shall be made for this work.

### 301.22 HANDLING AND STORAGE OF MATERIALS

All materials shall be handled and stored in careful and workmanlike manner to the satisfaction of the Engineer. Any dents or depressions as a result of storage and handling during transportation or installation shall not be allowed. The Contractor shall be responsible for replacement and reinstallation of the damaged riser at his own expense.

### 301.30 CONSTRUCTION METHODS

#### 301.31 CONTROL OF SURFACE/SUBSURFACE WATER

The Contractor is responsible for control of surface water, subsurface water, and drainage during the construction period. All temporary fills, crossings, and culverts necessary to promote drainage during construction will be installed and removed at the Contractor's expense prior to acceptance of the work. Any claims arising from upstream or downstream damages as a result of the construction or failure of these temporary works will be the Contractor's responsibility.

It is the responsibility of the Contractor to control the surface and sub-surface water and drainage in any excavation area, dewatering placement area and borrow area. Should material quality lessen through inadequate drainage, the Contractor may be directed by the Engineer to construct drainage facilities at the Contractor's expense.

### 301.32 CMP, FIBERGLASS, HDPE, & PVC CONTROL STRUCTURE INSTALLATION

Prior to installation of the control structure, any protective coating that has been removed from the structure exposing the pipe shall be recoated. Welding, drilling, bolting or otherwise attaching devices, temporary or permanent, to the structure to assist in structure installation is prohibited.

The Contractor shall compact the in-situ material below the base elevation prior to assembly and erection of the structure. This bed shall be fully leveled and compacted throughout the full width and length of the trench and to the exact grade as specified, so that the structure shall be uniformly and evenly supported across its footprint.

The control structure, as delivered to the site, shall be cast-in-place into the concrete foundation or as shown on the plans. Cast-in-place concrete, reinforcing, mixing, delivery and placement shall be carried out in accordance with the specification for **CAST-IN-PLACE REINFORCED CONCRETE**.

The structure shall be supported with adequate falsework so as to maintain the lines and grades shown on the plans, and to maintain those lines and grades without movement, until the concrete has reached the strength as specified herein.

Care shall be taken in the placement of the concrete so as not to splash concrete on the control structure. All concrete splashed on the structure shall be cleaned off immediately, to the satisfaction of the Engineer.

Contractor shall install the bottom stoplog as shown on the plans. All other stoplogs, slide gates, tiedowns, lock, grating, railing, and assembly tools shall be removed from the control structure prior to installation of the control structure in the concrete base. All of these items shall be re-installed after completion of structure installation.

Falsework, chairs, or supportive devices used in supporting the control structure in the formwork, and to be permanently incorporated in the concrete shall be of the same material and shall be considered as reinforcement. All such falsework, chairs, and supportive devices shall be approved by the Engineer prior to installation. No supportive devices shall protrude from the finished surface of the concrete, unless approved by the Engineer.

Culvert assembly and installation shall be carried out in accordance with the specification for **CULVERT AND PIPE INSTALLATION**.

### 301.33 CONCRETE CONTROL STRUCTURE INSTALLATION

The Contractor shall compact the in-situ material below the base elevation prior to assembly and erection of the structure. This bed shall be fully leveled and compacted throughout the full width and length of the trench and to the exact grade as specified, so that the structure shall be uniformly and evenly supported across its footprint.

The control structure shall be set or cast-in-place to the lines and grades shown on the plans. Reinforcement, stoplog channels, gate bolts and other items to be cast-in-place shall be installed as called for on the plans. Falsework, chairs, or supportive devices to be permanently incorporated in the concrete shall be of the same material and shall be considered as reinforcement. All such falsework, chairs, and supportive devices shall be approved by the Engineer prior to installation. No supportive devices shall protrude from the finished surface of the concrete unless approved by the Engineer.

The structure shall be finished in accordance with the specification for **CAST-IN-PLACE REINFORCED CONCRETE** and once completed, slide gates, stoplogs, grating or railing as specified in the plans shall be installed.



Any culvert or inlet/outlet pipe to be used in conjunction with a pre-cast or cast-in-place concrete control structure shall be installed according to the specification for **CULVERT AND PIPE INSTALLATION**. That portion of the culvert, which is to be embedded in the concrete, shall have a 1/2" thick butyl or mastic gasket between the culvert and concrete. The gasket shall meet the requirements of ASTM D1056 for "RE" closed all grades while the mastic shall meet AASHTO M190 Type "A" specification.

### 301.34 BACKFILL

If, in the opinion of the Engineer, the site-excavated material is unsuitable for backfill, the Contractor shall supply, from an assigned borrow area, suitable impervious backfill material. No granular backfill will be allowed unless approved by the Engineer. The payment for supplying this impervious fill shall be considered incidental to the water control structure installation.

If no compaction is specified on the plans or in the specifications the Contractor shall compact the backfill to in-situ conditions or embankment compaction requirements whichever is greater.

Initial backfill shall be deposited in horizontal, uniform layers not exceeding six (6) inches in thickness before compaction, and each layer shall be thoroughly compacted throughout to ensure thorough tamping of backfill around the structure and under the haunches of the pipe stubs. This is to be achieved by hand compaction for a distance of two (2) feet from the structure. Hand compaction of fill material shall be accomplished by the application of motor driven hand tampers or other approved equipment in such a manner that every point of the surface of each layer will be compacted. Each layer will be inspected and approved by the Engineer prior to proceeding with the next layer of fill.

After the above initial backfilling has been completed and approved, the remaining backfill, consisting of suitable site material, shall be placed in layers not exceeding eight (8) inches before compaction. Each layer shall be compacted by mechanical means to a density equivalent to that of the surrounding unexcavated material. Each layer will be inspected and approved by the Engineer prior to proceeding with the next layer of backfill.

No boulders, rock, ice, snow, organic material, or debris shall be permitted in the trench. This material will be classified as unsuitable material and treated as such.

Compaction equipment or methods that produce horizontal or vertical earth pressures which may cause excessive displacements or which may damage the installation shall not be used.

Backfill shall be executed to the lines and grades shown on the plans and as specified herein. No separate measurement shall be made for backfill. Compensation shall be included as payment for water control structures.

### 301.35 APPURTENANCE INSTALLATION

Any appurtenances to be used in conjunction with a water control structure shall be installed according to the specification for **STRUCTURE AND CULVERT APPURTENANCES**.

### 301.40 QUALITY CONTROL

#### 301.41 WORKMANSHIP AND MATERIALS

All workmanship and materials furnished and supplied under this specification are subject to close and systematic inspection and testing by the Engineer including all operations from the selection and production of materials through to final acceptance of the specified work. The Contractor shall be wholly responsible for the control of all operations incidental thereto, notwithstanding any inspection or approval that may

have been previously given. The Engineer reserves the right to reject any materials or works, which are not in accordance with the requirements of this specification.

### **301.42 ACCESS**

The Engineer shall be afforded full access for the inspection and control testing of materials, both at the site of work and at any plant or borrow pit used for the supply of the materials, to determine whether the materials are being supplied in accordance with this specification.

### **301.50 METHOD OF MEASUREMENT**

Water control structure installation shall be measured on a unit basis. The unit shall be shown in the Unit Price Table of the Standard Bid Form for the pay item corresponding to this specification number. Water control structure installation shall be measured in the following manner:

- 7) Lump Sum (LS): Water control structure installation shall be measured on a lump sum basis of installed structure(s). No separate measurement of control structure(s) shall be made.
- 8) Each (EA): Water control structure installation shall be measured on an individual basis. Measurement shall be made for each structure installed.

No separate measurement shall be made for the excavation, installation, and removal of cofferdams, dewatering, backfill, compaction, assembly and installation of pipe unless otherwise noted on the plans. This work shall be considered incidental to the water control structure installation measurement described herein.

### **301.60 METHOD OF PAYMENT**

The completed work for water control structures, measured as specified, shall be paid for at the contract unit price. The unit price bid for water control structures shall include the supply of all equipment, materials, labor and any other incidental items necessary to install water control structures as described in this specification and shown on the plans. No payment shall be made for dewatering or the control and drainage of surface/sub-surface water.

## **302 STRUCTURE AND CULVERT APPURTENANCES**

### **302.10 DESCRIPTION**

The work shall include the supply of all labor, materials, equipment and any other incidental item necessary to complete the installation of appurtenances associated with water control structures and culverts as called for on the plans and/or specified herein. These appurtenances include but are not limited to:

- a) Covers, lids and trash racks for water control structures
- b) Stoplogs for water control structures
- c) Water control gates for structures or culverts
- d) T-sections for culverts
- e) Fish screens for water control structures
- f) Locking rods
- g) Lifting hooks

This work shall include the installation of the various appurtenances to the associated water control structure or culvert. Work shall include all hardware necessary to install the appurtenance per manufacturer's recommendations or as specified on the plans or herein.

### **302.20 MATERIALS**

#### **302.21 SUPPLY OF MATERIALS**

Unless otherwise specified, the Contractor shall supply all required appurtenances and those accessories recommended by the material manufacturer or required to complete installation of the appurtenance. All appurtenances shall be constructed as shown on the plans.

Corrugated metal pipe appurtenances and anti-seep diaphragms shall be of the same design, material and gauge as the water control structure or culvert it is attached to unless otherwise shown on the plans.

All bolted connections shall utilize stainless steel bolts, nuts and washers, grade 18-8 or 304 or better.

With the exception of the water control gates, all appurtenances shall be of the same material and color as the associated water control structure unless otherwise specified on the plans or described herein. Painting of non-submerged steel components shall consist of one shop coat of zinc base primer with two coats of alkyd enamel flat paint to both sides of the material. All submerged steel components shall be painted or galvanized. Prior to painting, all components shall be cleaned free of rust and scaling. Painting of submerged components shall consist of 2 part epoxy finish Sherwin Williams Zinc Clad IV, parts B69 A 8 630-1147 and B69 V 8 630-1154 or equivalent as approved by the engineer.

#### **302.22 HANDLING AND STORAGE OF MATERIALS**

All materials shall be handled and stored in a careful and workmanlike manner to the satisfaction of the Engineer.

Any dents or damage caused by mishandling during transportation or installation shall not be allowed. The Contractor shall be responsible for replacement and reinstallation of damaged appurtenances at his/her own expense.

### **302.30 INSTALLATION**

All appurtenances shall be installed per manufacturer's recommendations or as specified on the plans or herein. Water control gates shall be installed to provide a watertight seal with the culvert. The Contractor shall install the gate with all-necessary framework and hardware to allow efficient operation of the gate. Planking/grating, railing, and bracing shall be provided as shown on the plans or specified herein.

Anti-seep diaphragms and associated fittings shall be attached to the culvert at the stations shown on the plans. Diaphragms should be located midway between two adjacent seams or at least four feet from a field joint. Backfill operations shall be carried out as not to damage diaphragms.

### **302.40 QUALITY CONTROL**

#### **302.41 WORKMANSHIP AND MATERIALS**

All workmanship and materials furnished and supplied under this specification are subject to close and systematic inspection and testing by the Engineer including all operations from selection and production of materials through the final acceptance of the specified work. The Contractor shall be wholly responsible for the control of all operations incidental thereto, notwithstanding any inspection or approval that may have been previously given. The Engineer reserves the right to reject any materials or works, which are not in accordance with the requirements of this specification.

#### **302.42 ACCESS**

The Engineer shall be afforded full access for the inspection and control testing of materials, both at the site of work and at any plant used for the supply of the materials, to determine whether the materials are being supplied in accordance with this specification.

### **302.50 METHOD OF MEASUREMENT**

Appurtenances shall be measured on a unit basis. The unit shall be shown in the Unit Price Table of the Standard Bid Form for the pay item corresponding to this specification number. Appurtenances shall be measured in the following manner:

- 1) Incidental (INC): Supply and installation of the appurtenances shall be considered incidental to the construction and installation of the associated water control structure and no measurement shall be made. This shall apply when appurtenances is not listed on the Standard Bid Form.
- 2) Lump Sum (LS): Appurtenances shall be measured on a lump sum basis of installed appurtenances. No separate measurement shall be made for individual appurtenances.
- 3) Each (EA): Appurtenances shall be measured on an individual basis. Measurement shall be made for each appurtenance installed.

### **302.60 METHOD OF PAYMENT**

The completed work for structure and culvert appurtenances, measured as specified, shall be paid for at the contract unit price. The unit price bid for structure and culvert appurtenances shall include supplying all materials, equipment, labor and any incidental items necessary to install appurtenances as described in this specification or shown on the plans.

## 303 CULVERT INSTALLATION

### 303.10 DESCRIPTION

The work of this section shall include the supply of all labor, materials and equipment required to complete the installation of all culverts with associated earthwork called for on the drawings and/or specified herein.

This work shall consist of excavation; cofferdams and dewatering; preparing the bed for the pipe; assembly of the pipe sections, installation of pipe sections; and backfill and compacting to the lines and grades shown on the drawings, as specified.

### 303.20 MATERIALS

#### 303.21 SUPPLY OF MATERIALS

Unless otherwise specified, the Contractor will supply all materials necessary to complete the installation as shown on the plans or recommended by the material manufacturer.

All culverts and inlet and outlet pipes shall be of the diameter and length as shown on the plans. The pipe shall match the material and coating of the base riser unless otherwise specified on the plans. All materials supplied by the Contractor shall be subject to inspection by the Engineer.

The following specifications for each material type shall be adhered to.

- 1) Steel corrugated metal pipe. Where stated as acceptable on the plans, all steel CMP shall be made of galvanized or aluminized Type II steel. Galvanized steel corrugated metal pipe shall meet the composition requirements of AASHTO M218. The aluminized Type II steel shall conform to the requirements of AASHTO M274. Pipe shall be close riveted or of a "lock seam" construction. Unless otherwise specified all pipes shall have a 2 2/3" x 1/2" corrugation. The gauge of the pipe shall be as follows unless otherwise specified on the plans:

Pipe Diameter	2-2/3" x 1/2" Corrugations Metal Thickness	3" x 1" Corrugations Metal Thickness
12"-21"	16	NA
24"-36"	14	16
42"-54"	12	14
60"-96"	10	12

- a) Pipe made of galvanized or aluminized Type II steel shall be coated. This coating shall be a 10 mil polymeric film laminate or unless otherwise specified on the plans. The coatings shall be applied to both the inside and outside of the pipe. All spray coatings shall conform to AASHTO M243.
- b) All welds shall be 3/16" fillets unless otherwise specified on the plans and shall conform to the Welded Joint Requirements of the latest edition of the AISC Manual.
- 2) Where called for the plans, annular connecting bands shall be the same material and have the same coating, corrugations, and gauge as specified for the pipe that is to be connected.
  - c) The connecting bands shall be either 24" in width or have a minimum of nine (9) corrugations. The minimum circumferential overlap shall be six (6) inches. If helical pipe is used, then a minimum of four (4) re-rolled annular corrugations shall be reformed into annular corrugations to allow the use of 21-inch-wide watertight annular overlapping

connecting bands of the same gauge as the pipe. All bands shall have the same coating as the pipe and shall be installed using a 5X grade bituminous sealer at least ¼” thick over the entire pipe area to be banded.

- d) A closed cell expanded gasket shall be used in conjunction with connecting band when called for on the plans. The gasket shall be at least 24” in width, 3/8” thick, with an unstretched diameter ten (10) percent less than normal pipe size and shall comply with ASTM D1056, Grade SCE-43. Mastic shall be placed on each side of the gasket.
  - e) The binders for the connecting bands will consist of a minimum of 6 rods and tank lugs, three (3) per side, in accordance with the plans. The minimum rod diameter shall be 7/16” with ½” threads. All rods and lugs shall be galvanized.
- 3) Aluminum corrugated metal pipe. The minimum acceptable series for aluminum CMP shall be 3000 Series. The material shall meet the requirements of AASHTO M197.
- f) Pipe shall be close riveted or of a "lock seam" construction. Unless otherwise specified all pipes shall have a 2-2/3" x 1/2" corrugation. The gauge of the pipe shall be as follows unless otherwise specified on the plans:

Pipe Diameter	2-2/3" x 1/2" Corrugations Metal Thickness	3" x 1" Corrugations Metal Thickness
12"-21"	14	NA
24"-36"	12	14
42"-54"	10	12
60"-96"	8	10

- g) All welds shall be 3/16” fillets unless otherwise specified on the plans and shall conform to the Welded Joint Requirements of the latest edition of the AISC Manual. All bolted connections shall utilize stainless steel bolts, nuts, and washers, grade 18-8 or 304 or better.
- 4) High Density Polyethylene (HDPE) Pipe. Where stated as acceptable on the plans, watertight HDPE pipe shall have a smooth interior and annular exterior corrugations. The pipe shall be approved by the Engineer and shall be of the length shown on the Plans.
- h) The material shall meet the requirements of ASTM D3350 with a minimum cell classification 335420C.
  - i) The pipe shall incorporate a gasketed bell and spigot design. The gasket shall meet the requirements of ASTM F477 with a minimum watertight performance of 10.8 psi.
  - j) 12” to 48” HDPE pipe shall meet the requirements of AASHTO M294, Type S.
  - k) 54” and 60” HDPE pipe shall meet the requirements of AASHTO MP7.
  - l) 36” through 60” diameters shall have a reinforced bell and spigot. The gasket corrugation shall be reinforced with a closed cell structural foam core.
- 5) Pre-cast concrete pipe shall conform to the requirements of ASTM C443 for gasketed pressure pipe unless otherwise indicated on the plans. Pre-cast concrete box culverts shall conform to the requirements of ASTM C1433.
- 6) PVC pipe shall conform to the requirements of ASTM Designation: D 2241 and be joined by bell and spigot type connections. The belled portion of the pipe for use with rubber gaskets shall conform to the requirements of ASTM Designation: D 3139. The pipe joint shall be tightly sealed against infiltration and exfiltration by means of a locked-in-rubber sealing ring. The connection shall also permit the thermal expansion or contraction of the pipe.

Fittings shall be either injection molded PVC plastic pipe fittings, conforming to the requirements of ASTM Designation: D 2466 or D 3139, or machined pipestock fittings conforming to the requirements of ASTM Designation: D 2241.

- 7) When called for on the plans, the Contractor shall supply to the site ready mix concrete, or site mix concrete in accordance with the specification for **CAST-IN-PLACE REINFORCED CONCRETE**. Forms, reinforcing steel or wire mesh, for the concrete pad for the control structure will be the responsibility of the Contractor. The installation of this concrete shall be considered incidental to the culvert installation and no separate measurement or payment shall be made for this work.

### 303.22 HANDLING AND STORAGE OF MATERIALS

All materials shall be handled and stored in careful and workmanlike manner to the satisfaction of the Engineer. Any dents or depressions as a result of storage and handling during transportation or installation shall not be allowed. The Contractor shall be responsible for replacement and reinstallation of the damaged pipe at his own expense.

### 303.30 CONSTRUCTION METHODS

#### 303.31 CONTROL OF SURFACE/SUBSURFACE WATER

The Contractor is responsible for control of surface water, subsurface water, and drainage during the construction period. All temporary fills, crossings, and culverts necessary to promote drainage during construction will be installed and removed at the Contractor's expense prior to acceptance of the work. Any claims arising from upstream or downstream damages as a result of the construction or failure of these temporary works will be the Contractor's responsibility.

It is the responsibility of the Contractor to control the surface and sub-surface water and drainage in any excavation area, dewatering placement area and borrow area. Should material quality lessen through inadequate drainage, the Contractor may be directed by the Engineer to construct drainage facilities at the Contractor's expense.

#### 303.32 EXCAVATION

The Contractor will be required to excavate the base to the lines of excavation and to a depth of the invert elevations as shown on the plans. Base excavation shall extend a minimum of three (3) feet or one pipe diameter, whichever is greater, beyond the ends and sides of the pipe, or pipes, and the excavation shall be transitioned to meet the existing channel slopes. If necessary, the excavation shall be dewatered in order to prevent disturbing the natural soil conditions at the base of the excavation and to allow the placing and compacting of the backfill material in the dry.

Cofferdams will be required for all excavations in active watercourse channels and in areas of ground water seepage. Cofferdams must be built to withstand all the forces to which they may be subjected and shall be located such as to give sufficient clearance for the construction of cutoff trenches and/or sump pits for dewatering unless otherwise provided. Cofferdam placement, maintenance and removal shall be the responsibility of the Contractor and shall be considered as incidental to the placement of the culvert.

Dewatering shall be accomplished by constructing cut-off trenches and sump pits around the outside perimeter of the pipe beds. These shall be excavated to a depth of no less than two (2) feet below the elevation of the base of the excavation. Trenches and sump pits shall be shored and braced with cribs as necessary. The Contractor will be required to provide sufficient pumping capacity to lower and maintain the ground water approximately one (1) foot below the base of excavation.

The excavated base shall be inspected by the Engineer prior to commencement of backfilling. If the Engineer deems further excavation to be required below the bottom of the excavation line shown on the plans and specified herein, the Contractor shall excavate such additional materials as directed by the Engineer. The work involved in doing this additional excavation will be classified as extra work and will be paid for as such.

The Contractor shall not over excavate below specified lines and grades. If, in the opinion of the Engineer, the Contractor over excavates material in an area, he shall replace at his expense the over excavated material with suitable site material and compact that material to a density equal to the surrounding in-situ material, or to the satisfaction of the Engineer.

Excavated material not required as backfill shall be classified as "surplus material" and will be dealt with as shown on the plans. Unless otherwise specified, disposal of surplus material shall be considered incidental to the bid item culvert and pipe installation.

No separate payment shall be made for excavation. Compensation shall be included as payment for the bid item culvert and pipe installation.

### 303.33 INSTALLATION OF AND ASSEMBLY OF CULVERTS

The Contractor, after preparation of the bed, shall assemble the pipe sections, progressively in accordance with the manufacturer's instructions or as directed by the Engineer.

Concrete pipe shall be laid with the groove end of each section up grade and the sections shall be tightly joined. Lifting holes shall be plugged with a precast plug and sealed with mastic or grout. Concrete culvert sections shall be tied together with approved fasteners and wrapped with a non-woven geotextile fabric.

All pipe supplied to the site shall be inspected prior to assembly, for chipping or damage in handling and shall be repaired as directed by the Engineer. Welding, drilling, bolting or otherwise attaching devices (temporary or permanent) to the structure to assist in structure installation is prohibited.

All materials damaged, distorted by more than five (5) percent of nominal dimensions, lost, broken or deemed unsuitable due to the Contractor's method of installation, handling or from neglect shall be replaced by the Contractor at his expense.

### 303.34 BACKFILL

All materials to be used for bed preparation and backfill will be suitable site material as approved by the Engineer. In the event that no suitable site material is available from designated borrow areas for the pipe installation, the Contractor shall supply suitable material from an approved borrow area. The payment for placing this fill will be classified as extra work and will be paid for as such. Material used for backfill from designated borrow areas will be installed per the details specified in the specification for **EMBANKMENT CONSTRUCTION**. No separate payment will be made for excavation and backfill.

The Contractor shall compact the in-situ material below the invert elevations prior to assembly and erection of the pipe. This bed shall be fully leveled and compacted throughout the full width and length of the trench and to the exact grade as specified, so that the barrel of the pipe shall be uniformly and evenly supported throughout its entire length.

Initial backfill shall be deposited in horizontal, uniform layers not exceeding six (6) inches in thickness before compaction, and each layer shall be thoroughly compacted throughout to ensure thorough tamping of backfill under the haunches and around the pipe. This is to be achieved by hand compaction for a distance of two (2) feet from the pipe circumference. Hand compaction of fill material shall be accomplished by the application of motor driven hand tampers or other approved equipment in such a manner that every point



of the surface of each layer will be compacted. Each layer will be inspected and approved by the Engineer prior to proceeding with the next layer of fill.

After the above initial backfilling has been completed and approved, the remaining backfill, consisting of suitable site material, shall be placed in layers not exceeding eight (8) inches before compaction. Each layer shall be compacted by mechanical means to a density equivalent to that of the surrounding unexcavated material. Each layer will be inspected and approved by the Engineer prior to proceeding with the next layer of backfill.

No boulders, rock, ice, snow, organic material or debris shall be permitted in the trench. This material will be classified as unsuitable material and treated as such.

Compaction equipment or methods that produce horizontal or vertical earth pressures which may cause excessive displacements or which may damage the installation shall not be used.

Backfill shall be executed to the lines and grades shown on the plans and as specified herein. No separate measurement shall be made for backfill. Compensation shall be included as payment for culvert and pipe installation.

### **303.35 ROAD SURFACE AT CULVERT CROSSING**

Any road material removed as necessary for the installation of the culvert shall be replaced with material of the same quality to the width, depth, consistency and compaction of existing road on each side.

### **303.40 QUALITY CONTROL**

#### **303.41 WORKMANSHIP AND MATERIALS**

All workmanship and materials furnished and supplied under this specification are subject to close and systematic inspection and testing by the Engineer including all operations, from the selection and production of materials, to final acceptance of the specified work. The Contractor shall be wholly responsible for the control of all operations incidental thereto notwithstanding any inspection or approval that may have been previously given. The Engineer reserves the right to reject any material or work that is not in accordance with the requirements of this specification.

#### **303.42 ACCESS**

The Engineer shall be afforded full access for the inspection and control testing of materials, both at the site of work and at any plant or borrow pit used for the supply of the materials, to determine whether the materials are being supplied in accordance with this specification.

### **303.50 METHOD OF MEASUREMENT**

Culvert installation shall be measured on a unit basis. The unit shall be shown in the Unit Price Table of the Standard Bid Form for the pay item corresponding to this specification number. Culvert installation shall be measured in the following manner:

- 8) Incidental (INC): Supply and installation of the culverts shall be considered incidental to the construction and installation of the associated water control structure and no measurement shall be made. This shall apply when culvert installation is not listed on the Standard Bid Form.
- 9) Linear Feet (LF): Culvert installation shall be measured on a linear foot basis. The linear feet measured shall be the actual bottom length of an installed culvert size group. No measurement shall be made for couplers.

- 10) Each (EA): Culvert installation shall be measured on an individual basis. Measurement shall be made for each culvert installed.
- 11) Lump Sum (LS): Culvert installation shall be measured on a lump sum basis per size group of culvert placed. No measurement shall be made for linear feet of culvert installed.

No separate measurement shall be made for the excavation, installation and removal of cofferdams, dewatering, backfill, compaction, assembly and installation of pipe. This work shall be considered incidental to the culvert installation measurement described herein.

### **303.60 METHOD OF PAYMENT**

The completed work for culvert and pipe installation, measured as specified, shall be paid for at the contract unit price. The unit price bid for culvert and pipe installation shall include supplying all materials, equipment, labor and any incidental items necessary for the installation of culverts as described in this specification. No payment shall be made for dewatering or the control and drainage of surface/sub-surface water.

## **304 CAST-IN-PLACE REINFORCED CONCRETE**

### **304.10 DESCRIPTION**

The work shall include the supply of all labor, materials, and equipment necessary to complete the construction of all cast-in-place concrete as shown on the plans and/or specified herein. The work shall include, but is not limited to the following:

- a) Supply, erection and removal of all formwork
- b) Supply and placement of reinforcement
- c) Supply, placing and curing of concrete
- d) Finishing of all concrete surfaces as specified

Unless otherwise specified herein or on the plans, the materials and work shall adhere to the requirements of the American Concrete Institute's "Specification for Structural Concrete", ACI 301-05.

### **304.20 MATERIALS**

#### **304.21 CEMENT**

The cement shall be Portland Cement ANSI/ASTM C150, Type II A unless otherwise specified by or acceptable to the Engineer.

#### **304.22 ADMIXTURES**

All air-entraining agents shall conform to the specifications in ASTM C260. Use of calcium chloride shall not be allowed. Use of other admixtures shall only be allowed when approved by the Engineer. Approval will only be given when it is shown that the specified admixture will not affect the integrity of the concrete. Approved use of an admixture still requires concrete to meet specified slump, air and strength requirements.

#### **304.23 WATER**

Mixing water for concrete shall be fresh, clean, and potable.

#### **304.24 AGGREGATES**

Aggregates shall be free from dirt and organic material and shall meet the following gradation:

Aggregate Type	% Passing by Weight						
	1" Sieve	3/4" Sieve	1/2" Sieve	3/8" Sieve	#4 Sieve		
Coarse	100	90-100	20-55	0-15	0-5		
	3/8" Sieve	#4 Sieve	#8 Sieve	#16 Sieve	#30 Sieve	#50 Sieve	#100 Sieve
Fine	100	95-100	80-100	50-85	25-60	10-30	2-10

Aggregates will be inspected and approved by the Engineer prior to use.

### 304.25 REINFORCING STEEL

Reinforcing steel, except as otherwise specified, shall be deformed bars rolled from new billet stock, and shall conform to the requirements of ASTM A615, Grade 60. Sizes, details and locations of bars shall be as shown on the drawings and as may be specified herein.

All reinforcing steel shall be free of all dirt, scale, oil, grease, and other coating that may reduce bonding to concrete. The required reinforcing shall be of the size and grade specified on the plans.

### 304.26 STORAGE AND HANDLING OF MATERIALS

Cement shall be stored off the ground in a dry location at all times.

Aggregates shall be stored separately in a manner that will prevent segregating, mixing, and intrusions of foreign materials.

Reinforcement shall be stored on skids or racks off the ground.

### 304.30 CONSTRUCTION METHODS

All excavation and backfill associated with concrete structures shall be conducted in accordance with the specification for **EXCAVATION** and the specification for **WATER CONTROL STRUCTURES**.

### 304.31 WORKMANSHIP

Work shall be supervised by a competent foreman at all times and shall be performed by skilled and experienced workmen.

### 304.32 MIX REQUIREMENTS

All concrete shall be either site mix or ready-mix to achieve a 4,000 psi 28 day compressive strength, a 1 to 4 inch slump, and 4 to 6 percent air entrainment.

For the installation of corrugated metal pipe risers as described in the specification for **WATER CONTROL STRUCTURES**, the concrete used to pour the base shall have the following design mix:

#### PER CUBIC YARD DESIGN MIX

- 6 bags cement (Portland Cement ANSI/ASTM C150, Type IIA, 94 lb. ea.)
- 36 gallons water (adjust for moisture in aggregate)
- 2875 pounds of aggregates (38% fine aggregate)

Unless otherwise noted the Contractor shall submit a concrete mix design to the Engineer for all other concrete used in construction prior to the pouring of that concrete. Acceptance of this design by the Engineer does not relieve the Contractor's responsibility to meet above strength, slump or air requirements.

### 304.33 MIXING AND PLACING

The Contractor shall notify the Engineer two working days in advance of any concrete pour. This advance notice will allow the Engineer to schedule the concrete testing and inspection services. No concrete shall be poured without notification or approval of the Engineer.

Concrete shall be mixed only in quantities required for immediate use. Mixing procedures shall be approved by the Engineer prior to commencement. Water may be added on site by the Contractor as needed as long as slump and air requirements are met. Failure to adhere to these requirements may result in

rejection of that batch. The minimum mixing time for all site batch mixes shall be 10 minutes and 75 revolutions for all mixes delivered by transit mixers. No concrete shall be placed in forms after mixing longer than 1-1/2 hours.

The concrete temperature shall be maintained between 50°F to 90°F during all phases of mixing and placement. When weather conditions will affect the concrete temperature it shall be kept within the stated range by methods approved by the Engineer.

Cold weather concreting procedures shall include but will not necessarily be limited to; preheating of forms and subgrade prior to pouring, heating of poured concrete for a minimum of 5 days and adequate protection of poured concrete during curing. Preheating of forms and subgrade as well as poured concrete shall be done in a manner to maintain temperatures between 50°F and 90°F. All procedures shall be outlined to the Engineer for approval prior to any concrete pour.

Hot weather concreting procedures shall include but will not necessarily be limited to; temperature control of concrete materials, wetting of subgrade, forms, and reinforcement prior to concrete placement and moist curing of poured concrete. All procedures shall be outlined to the Engineer for approval prior to any concrete pour.

Formwork, falsework, and reinforcing shall be inspected and approved by the Engineer prior to concrete placement. Earth surfaces shall be firm, moist, contain no frost or ice, and be free of debris. All formwork shall be oiled or moistened prior to concrete placement.

All reinforcement shall be accurately placed to the dimensions shown on the drawings and shall be secured in place by bar supports, spacers, chairs, wiring and nails. No welding of reinforcement shall be allowed. Bars shall be located so as to have the minimum concrete cover as shown on the drawings. Unless otherwise specified, the minimum cover when cast against earth shall be three inches at all times.

Where not otherwise shown or specified, bars in tension shall be lapped 36 diameters and bars in compression 24 diameters, but not less than twelve (12) inches in either case.

Bar supports and spacers shall be of steel or plastic and of suitable design and strength to hold the reinforcement accurately in place before and during the placing of concrete.

Footing reinforcement shall be supported on hychairs set on concrete blocks whose top surface is flush with the subgrade, or hung from supports above the forms with sufficient steel hangers. Steel in slabs on the ground shall be supported on hychairs to ensure its proper position in the slab. Hychairs shall be set on concrete bricks or concrete blocks whose top surface is flush with the subgrade surface.

Shop drawings and reinforcing bar shop lists shall be submitted for approval by the Engineer prior to any pour.

Concrete shall be placed by hand, buggy, trough or suitable placement method. Concrete shall not be allowed to freefall more than five feet. Concrete shall be handworked or mechanically vibrated to achieve a dense, homogenous, structure free of cold joints and honeycombing. If cold joints are necessary in pouring a structure the Contractor shall install waterstops at all such joints. All exposed edges shall be chamfered as shown on the plans. All exposed concrete not in forms shall be sealed or closed by giving these areas a float finish prior to the final broom finish.

Formwork shall not be removed until the concrete has hardened adequately to prevent surface damage and support applied loads. Forms shall remain on poured structures a minimum of 3 days unless otherwise directed by the Engineer. For cold weather concrete pours, forms shall remain on poured structures for a minimum of 5 days, unless otherwise directed by the Engineer. Under no circumstances shall backfilling occur prior to the minimum required days listed above.

### 304.34 FINISHING

All minor surface defects, small honeycomb areas, or broken edges shall be repaired using a drypack mortar consisting of 1 part cement and 2-1/2 parts of fine sand. Exposed steel forming ties shall be removed to a depth of one (1) inch below the planned concrete surface and the surface defect repaired with a dry pack mortar. All repairs shall be done in an efficient and timely manner after formwork is removed. Any necessary repairs shall be made prior to application of the concrete finish coat.

All exposed concrete surfaces shall have a grout cleaned or sack rubbed finish per ACI 301-05 or have two (2) coats of a cement-based waterproofing finish, approved by the Engineer, applied. This finish shall extend to a minimum of six (6) inches below the finished backfill lines.

Concrete shall be cured by means of waterproof paper, polyethylene or placement compound. Curing treatment shall be applied after concrete surfaces are finished.

### 304.35 TESTING

Unless otherwise specified, the Engineer or Engineer's representative will perform concrete testing during the course of the work to determine if specifications have been met. Testing shall include slump and air content measurements. Failure to meet specified requirements will mean rejection of that batch. In addition, four cylinders shall be made for compressive strength tests. Cylinders shall be taken randomly during a pour. Until notification by the Engineer, all cylinders shall be stored as close to the placed concrete as possible and covered from, or exposed to, the elements in the same manner as the placed concrete.

One cylinder shall be tested at 7 days and two at 28 days to determine the compressive strength. If either of the 28-day specimens fails to achieve 4000 psi, the fourth cylinder will be tested at 56 days and must achieve 4000 psi. If both cylinders achieve 4000 psi at 28 days, the fourth cylinder may be discarded. Failure of a cylinder to meet the specified strength for any pour shall require the removal of the concrete. In the event that the concrete does not meet the required strength, the Contractor may attempt to show that the placed concrete meets the specifications. This would require that the Contractor, at their own expense, hire a private, licensed concrete testing firm to perform an in-situ test. The firm and the method must be approved by the Engineer.

### 304.40 METHOD OF MEASUREMENT

Reinforced concrete shall be measured on a unit basis. The unit shall be shown in the Unit Price Table of the Standard Bid Form for the pay item corresponding to this specification number. Reinforced concrete shall be measured in the following manner:

- 1) Lump Sum (LS): Reinforced concrete shall be measured on a lump sum basis of placed concrete. No separate measurement of volume shall be made.
- 2) Cubic Yards-Plan Quantity (CY-P): Reinforced concrete shall be measured on a plan quantity basis. The quantity shall be the neat line volume of placed concrete calculated from the construction plans.
- 3) Cubic Yards (CY): Reinforced concrete shall be measured on a volume basis. The volume shall be the actual number of cubic yards of concrete placed. The volume shall be measured in the field using load tickets from the concrete supplier. No measurement for excess or wasted concrete shall be made.

No separate measurement will be made for reinforced concrete placed as a base for water control structures. The concrete shall be considered incidental to those bid items.

**304.50 METHOD OF PAYMENT**

The completed work for cast-in-place reinforced concrete, measured as specified, shall be paid for at the contract unit price. The unit price bid for cast-in-place reinforced concrete shall include supplying all materials, equipment, labor and any incidental items necessary for performing all concrete installation operations described in this specification.

## 305 RIPRAP, REVETMENT & AGGREGATE PLACEMENT

### 305.10 DESCRIPTION

This work shall consist of supply and placement of rock riprap, filterstone, concrete revetment or other aggregate as protective covering along the side slopes, bases of channels, slopes around culverts, and on embankments or such other places as may be indicated on the plans, as specified herein, or as directed by the Engineer.

### 305.20 MATERIALS

#### 305.21 BEDDING MATERIAL

Where called for on the plans and unless otherwise specified, material used for bedding shall be well-graded sand and gravel with the following gradation:

Percent (%) Passing by Weight				
3" Sieve	1" Sieve	1/2" Sieve	#4 Sieve	#100 Sieve
100	75-85	45-65	15-35	0-15

The bedding material shall be from a source approved by the Engineer.

#### 305.22 FILTER FABRIC

Unless otherwise specified, filter fabric shall be utilized, and considered incidental, in the installation of all riprap and revetment. The filter fabric shall be a nonwoven polyester or polypropylene geotextile. This geotextile shall have a minimum grab tensile strength of 150 pounds as determined by ASTM D4632. The geotextile shall have a maximum opening size equivalent to a #70 U.S. standard sieve.

The contractor shall supply all pins and other items necessary to fasten the filter fabric to the ground so it will not slide or form gaps when placing rock riprap.

All materials shall be handled and stored in a careful and workmen-like manner to the satisfaction of the engineer.

For concrete revetment, the geotextile shall be bonded to the base of the concrete block mats with an overlap of two to three feet incorporated on one end and one side adjacent to each other.

#### 305.23 RIPRAP

The contractor shall supply rock, which will consist of fieldstone or rough, unhewn quarry rock. Stone containing shale, sandstone, or other material that will disintegrate readily shall not be used. Class designations shall be based on the following gradations:

Riprap Class	Percent of Total Weight Smaller Than Given Size						
	30"	24"	18"	12"	9"	6"	3"
Class I	100	100	100	100	100	35-80	0-20
Class II	100	100	100	50-75	10-50	0-10	
Class III	100	100	50-75	10-50	0-10		
Class IV	100	85-100	60-80	20-40		0-20	



If the rock riprap class designation is not specified on the construction plans, CLASS I rock riprap shall be acceptable. The rock shall be approved by the Engineer prior to installation.

### 305.24 CONCRETE BLOCK REVETMENT

Concrete block revetment systems shall be supplied in a manner that meets the requirements as specified on the plans. Unless otherwise specified, the concrete shall be in accordance with the specification for **CAST-IN-PLACE REINFORCED CONCRETE**. The cables shall be stainless steel aircraft cable of Type 302 or 304 stainless and of Type 1 x 19 construction. Stainless steel clamps of the type and number recommended by the revetment manufacturer shall be provided. Anchors shall be provided in accordance with the manufacturer's recommendations.

### 305.25 OTHER AGGREGATE

Any other aggregate as called for on the plans shall be supplied in a manner that meets the gradation as specified on the plans. The rock shall be approved by the Engineer prior to installation.

## 305.30 CONSTRUCTION METHODS

### 305.31 SUBGRADE PREPARATION

The areas on which the rock, revetment or other aggregate is to be placed shall be graded to the lines shown on the plans. The soil surface shall be smooth and free from any obstructions to provide adequate contact area between the soil and the bedding material or filter fabric.

### 305.32 BEDDING MATERIAL

When called for on the plans, a six (6) inch layer of bedding material shall be placed as shown prior to the placing of any riprap or revetment.

### 305.33 FILTER FABRIC

The filter fabric shall be placed under all riprap in such a way that there is adequate contact area between the soil and the fabric. Installation shall start on the downstream end of the slope. Pins shall be installed to prevent the filter fabric from sliding or forming gaps during installation of the filter material and placement of the rock riprap.

When filter fabric is to be placed on a slope, an anchor trench shall be constructed on the top of the slope and a toe trench shall be constructed on the lower end of the installation. The trenches shall be perpendicular to the slope and must be at least one foot wide and one foot deep. The filter fabric shall be placed in the anchor trench and the toe trench. The trenches shall be backfilled and compacted to adequately anchor the filter fabric.

Where a seam is needed to provide a continuous coverage of the filter fabric, the two pieces of filter material shall be overlapped a minimum of two feet. Pins shall be placed in the overlap area to prevent slipping during placement of the filter material and rock riprap.

Great care shall be taken to protect the filter fabric from damage either from the wheels or tracks or any sliding caused by the equipment.

The fabric shall not be exposed to the sun for more than seven days. If the fabric meets the requirements of ASTM D4255, less than 30% strength loss at 500 hours, the maximum exposure shall be 30 days.

### 305.34 RIPRAP

Riprap shall be placed by equipment capable of controlling the drop of the rock riprap. The maximum drop of the rock shall be three (3) feet. Pushing or rolling rocks over the geotextile will not be allowed. Placement will be in such a manner that the smaller stones will be uniformly distributed throughout the mass. Sufficient handwork shall be done to provide a neat and uniform surface, with the depth being specified herein and as shown on the plans. The surface may not vary from the theoretical surface by more than 4" at any point for riprap, unless otherwise specified.

### 305.35 CONCRETE BLOCK REVETMENT

The concrete revetment mats shall be laid from the downstream end of the project to the upstream end to ensure the geotextile joints are shingled to direct flow over the joint and prevent undermining. The gaps between each mat shall not be greater than two (2) inches or they shall be filled using a grout mixture as recommended by the manufacturer. The outside edges of the mat system shall be entrenched and buried at least one block into the ground. After installation of the mat system, the top surface shall be covered with topsoil and seeded, if specified on the plans.

### 305.36 OTHER AGGREGATE

Upon completion and approval of the subgrade preparation by the Engineer, the aggregate shall be placed and compacted on the prepared subgrade to the dimensions shown on the plans. The location and method of placement shall be shown on the plans. Equipment used for placement operations shall be approved by the Engineer.

### 305.40 METHOD OF MEASUREMENT

Riprap, revetment and aggregate placement shall be measured on a unit basis. The unit shall be shown in the Unit Price Table of the Standard Bid Form for the pay item corresponding to this specification number. Riprap, revetment and aggregate placement shall be measured in the following manner:

- 1) Lump Sum (LS): Riprap revetment and aggregate placement shall be measured on a lump sum basis of placed riprap. No measurement for volume or weight shall be made.
- 2) Square Yard (SY): Riprap, revetment and aggregate placement shall be measured on a square yard basis. The quantity shall be the neat line measured quantity of the finished surface completed and accepted in-place, at the specified thickness. No separate measurement shall be made for excess riprap or aggregate.
- 3) Cubic Yard - Plan (CY-P): Riprap and aggregate placement shall be measured on a cubic yard-plan basis. The quantity shall be the neat line quantity of installed riprap material calculated from the construction plans. No separate measurement shall be made for excess riprap or aggregate.
- 4) Ton (TN): Riprap and aggregate placement shall be measured on a ton basis. The measurement shall be made by the collection of weight tickets from the supplier and shall be based on the short ton. Measurement shall be based on the actual amount of placed riprap or other aggregate. No measurement shall be made for excess rock.

No separate measurement shall be made for the filter fabric or bedding material used in the riprap placement. The supply and installation of these materials shall be considered incidental to the riprap placement.

**305.50 METHOD OF PAYMENT**

**The completed work for riprap, revetment and aggregate placement, measured as specified, shall be paid for at the contract unit price. The unit price bid for riprap, revetment and aggregate placement shall include supplying all materials, equipment, labor, and any incidental items necessary for performing all riprap and aggregate installation operations described in this speci**

## **306 TOE DRAIN INSTALLATION**

### **306.10 DESCRIPTION**

The work shall include the supply of all labor, materials, and equipment necessary to complete the toe drain installation as shown on the plans and/or specified herein. The work may include, but is not limited to:

- a) Trench excavation
- b) Supplying and installing a drainage medium
- c) Supplying and installing geotextile fabric, pipe and fittings

### **306.20 MATERIALS**

#### **306.21 DRAINAGE MEDIUM**

The drainage medium shall be filter sand meeting the gradation requirements of ASTM C33 - Concrete Sand Gradation Requirements:

% Passing by Weight					
3/8" Sieve	#4 Sieve	#16 Sieve	#50 Sieve	#100 Sieve	#200 Sieve
100	95-100	45-80	10-30	2-10	Less than 5

#### **306.22 PIPE & FITTINGS**

The collector pipe shall be perforated polyvinyl chloride (PVC) pipe with a geotextile wrap as described below. The discharge pipe shall be non-perforated PVC pipe. The collector and discharge pipe shall meet the requirements of AASHTO M278.

#### **306.23 GEOTEXTILE FABRIC**

The filter fabric shall be a nonwoven polyester or polypropylene geotextile. This geotextile shall have a minimum grab tensile strength of 90 pounds as determined by ASTM D1682. The geotextile shall have an equivalent opening size between a #40 - #100 U.S. standard sieve.

The fabric shall not be exposed to the sun for more than seven days. If the fabric meets the requirements of ASTM D4255, less than 30% strength loss at 500 hours, the maximum exposure shall be 30 days.

### **306.30 METHOD OF CONSTRUCTION**

#### **306.31 TRENCH EXCAVATION**

The trench shall be excavated to the dimensions and elevation shown on the plans by a method approved by the Engineer. Where excavations shall be carried out through soft or saturated soil conditions, bracing and shoring of the trench, excavating flatter side slopes, or other method of stabilizing the side slopes may be necessary. In no instance shall the trench remain open at the end of a working day.

#### **306.32 DRAINAGE MEDIUM**

The filter sand used as a drainage medium shall be placed in the loose lifts not greater than 12" and compacted to a minimum relative density of 70% as determined by ASTM D4253 and ASTM D4254. A drainage medium is only required for the collector pipe.

### 306.33 COVER MATERIAL

Material placed over the drainage medium shall be designated on the plans and compacted as required in the construction specification for that material.

### 306.34 COLLECTION AND DISCHARGE PIPE

The collection and discharge pipe shall be installed in the excavated trench on stable material. If material stability is questionable the Engineer will require coarse material placed as a foundation for the pipe. Backfill material shall be embankment material compacted to 95% of standard proctor.

### 306.40 METHOD OF MEASUREMENT

Toe drain installation shall be measured on a unit basis. The unit shall be shown in the Unit Price Table of the Standard Bid Form for the pay item corresponding to this specification number. Toe drain installation shall be measured in the following manner:

- 1) Lump Sum (LS): Toe drain installation shall be measured on a lump sum basis of installed toe drain. No separate measurement shall be made for trench excavation, drainage medium, or collection and discharge pipe.
- 2) TRENCH - Linear Feet (LF): Trench excavation shall be measured on a linear foot basis. The quantity shall be the actual linear feet of trench excavation parallel to the embankment. No measurement for volume of material excavated or excess trench excavation shall be made.
- 3) DRAINAGE MEDIUM
  - a) Lump Sum (LS): Drainage medium shall be measured on a lump sum basis of installed medium. No separate measurement shall be made for volume of medium used or excess drainage medium.
  - b) Cubic Yards - Plan Quantity (CY-P): Drainage medium shall be measured on a plan quantity basis. The quantity shall be the neat line cubic yard measurement of installed drainage medium. No measurement shall be made for drainage medium installed above and beyond the lines and grades shown on the construction plans.
- 4) PIPE - Linear Feet (LF): Pipe shall be measured on a linear foot basis. The quantity shall be the actual linear feet of installed pipe parallel and perpendicular to the embankment. No measurement for excess pipe material shall be made.

### 306.50 METHOD OF PAYMENT

The completed work for toe drain installation, measured as specified, shall be paid for at the contract unit price. The unit price bid for toe drain installation shall include supplying all materials, equipment, labor and any incidental items necessary for performing all toe drain installation operations described in this specification. No payment shall be made for dewatering or the control and drainage of surface/sub-surface water. No payment for excavation of suitable material will be made when excavating in a designated borrow area to obtain material that is to be placed, measured and paid in accordance with the specification for **EMBANKMENT CONSTRUCTION**.

## **311 REMOVAL OF EXISTING CULVERTS AND STRUCTURES**

### **311.10 DESCRIPTION**

The work of this section shall include the excavation, removal, cleaning, and stockpiling of culverts and structures designated to be removed.

### **311.20 CONSTRUCTION METHODS**

#### **311.21 EXCAVATION**

Excavation shall be performed in a workmanlike manner, approved by the Engineer, to prevent damage to salvageable material.

#### **311.22 DISMANTLING AND REMOVAL**

The material shall be dismantled and removed in a careful and workmanlike manner. Equipment or facilities that may damage portions of the material shall not be used. Any salvageable material damaged by the Contractor, during the removal operation, by neglect or poor workmanship, shall be replaced or paid for by the Contractor. All salvageable material shall be cleaned, sorted and stored in an area designated by the Engineer. The Contractor shall prepare a list of all salvaged material.

#### **311.23 DISPOSAL OF MATERIAL**

All salvageable material shall be handled carefully to avoid damage. All material shall be piled neatly at a location, on site, as directed by the Engineer. All salvageable material as identified on the plans shall become the property of the owner and shall not be used by the Contractor for any of his construction operations. Non-salvageable materials shall become the property of the Contractor and removed from the site unless otherwise directed by the engineer.

### **311.30 METHOD OF MEASUREMENT**

Removal of existing culverts and/or structures shall be measured on a unit basis. The unit shall be shown in the Unit Price Table of the Standard Bid Form for the pay item corresponding to this specification number. Removal of existing culverts and/or structures shall be measured in the following manner:

- 1) Lump Sum (LS): Removal of existing culverts and/or structures shall be measured on a lump sum basis of removed culverts and/or structures.
- 2) Each (EA): Removal of existing culverts and/or structures shall be measured on an individual basis. Measurement shall be made for each existing culvert or structure removed.
- 3) Linear Feet (LF): Removal of existing culverts and/or structures shall be measured on a linear foot basis. Measurements shall be made for each linear foot of existing culvert and/or structure removed.

### **311.40 METHOD OF PAYMENT**

The completed work for removal of existing culverts and/or structures, measured as specified, shall be paid for at the contract unit price. The unit price bid for removal of existing culverts and/or structures shall include supplying all materials, equipment, labor and any incidental items necessary for performing removal and salvage operations described in this specification or shown on the plans. No separate payment shall be made for disposal of removed culverts and/or structures.

## **401 SOIL EROSION AND POLLUTION CONTROL**

### **401.10 DESCRIPTION**

The work shall include the supply of all labor, materials and equipment necessary for the construction and maintenance of erosion controls and to minimize the production of sediment and other pollutants to water and air during construction operations. It is the Contractor's responsibility to adhere to all Local, State and Federal regulations regarding the control of soil erosion, sedimentation, and pollution. The work and measures may include, but are not limited to the following as shown on the drawings or as specified herein.

- a) Staging of Earthwork Activities - The excavation and moving of soil materials shall be scheduled so that the smallest possible areas will be unprotected from erosion for the shortest time feasible.
- b) Diversions - Diversions shall be used to divert water away from work areas and/or to collect runoff from work areas for treatment and safe disposition.
- c) Stream Crossings - Stream crossings shall be used where fording of streams by equipment is necessary.
- d) Silt Fence - Silt fence shall be used to trap sediment from areas of limited runoff. Silt fence is temporary and shall be removed when permanent measures are installed.
- e) Sediment Basins - Sediment basins shall be used to settle and filter out sediment from eroding areas to protect properties and streams below the construction site.
- f) Filters – Rock and straw bale filters shall be used to trap sediment from areas of limited runoff. Straw bales are temporary and shall be removed when permanent measures are installed.
- g) Waterways - Waterways shall be used for the safe disposal of runoff from fields, diversions and other structures or measures.

### **401.20 MATERIALS**

#### **401.21 SUPPLY OF MATERIALS**

Unless otherwise specified, the Contractor will supply all materials necessary to complete the installation as shown on the plans or recommended by the material manufacturer.

Silt fences are intended to intercept and detain small amounts of sediment from disturbed areas in order to keep the sediment from leaving the site. The Contractor shall supply and install the silt fence as specified unless otherwise identified on the plans. Silt fence shall be installed on the contour and constructed so that flow cannot bypass the ends. It shall be buried at the base and cleaned of soil when appropriate.

Silt Fence TABLE 1. Specifications for

Description	Heavy Duty	Standard
Geotextile		
Type	Woven	Woven
Width	48 inches	36 inches
Grab Tensile Strength ASTM D4632	100 lb minimum	100 lb minimum
Apparent Opening Size ASTM D4751	20-70 Sieve	20-70 Sieve
UV Stability USTM D4355 500 hr.	70% minimum	70% minimum
Top-fastening Component	Overlap around Woven-wire backing	Sewn-in cord
Net Backing		
Material	Woven Wire or Plastic Mesh	
Minimum Weight	14-1/2 gauge	
Minimum Mesh Opening	2 inches	
Maximum Mesh Opening	6 inches	
Minimum Width	30 inches	
Tensile Strength ASTM D4595	100 lb/ft	
UV Stability ASTM D4355 500 hr.	70% minimum	
	Heavy Duty	Standard
Posts		
Material	Metal	Wood
Minimum Size	1.25 lb/ft	1½ in x 1½ in
Minimum Length	5 feet	4 feet
Minimum Embedment	2 feet	1.5 feet
Maximum Spacing	8 feet	8 feet
Type of Post Fasteners	U-shaped clips No. 16 gauge wire	Gun staples 1.5 inch long
Min. Fasteners Per Post	3	5

## **401.30 CONSTRUCTION METHODS**

### **401.31 GENERAL REQUIREMENTS**

Construction operations shall be conducted in such a manner to reduce erosion and sedimentation to a practical minimum. Temporary or permanent controls shall be constructed to the extent possible prior to clearing and grubbing operations. Clearing and grubbing shall not be done until the area is needed in the construction operation.

The construction site shall be maintained in a clean and sanitary condition during construction operation. Trash barrels shall be provided at the site and periodically emptied.



Installation of all controls shall be accomplished as specified on the plans or with the approval of the Engineer in accordance with the manufacturer's published recommended practice.

#### **401.32 INCIDENTAL EROSION AND POLLUTION CONTROL ITEMS**

These items shall consist of installing measures, supplying all materials and equipment, and performing all work to control erosion and minimize the production of sediment and other pollutants to the water and air during construction operations. Such measures shall include, but are not limited to, silt fences and other measures listed in this specification or deemed necessary by the Engineer.

All state and local laws governing soil erosion and pollution control shall be followed. The Engineer shall have sole authority in determining when pollution control measures are necessary, when pollution control measures are functioning properly, and when silt fences for this item of work are required.

With the exception of silt fence, the Contractor shall determine which soil erosion and pollution control measures to install, provided that the measures are in accordance with applicable laws. The Contractor shall maintain all soil erosion and pollution control measures.

Earth stockpiles shall be in the area located on the drawings and protected with silt fences to control runoff and erosion in such a manner as to minimize the production of sediment and other pollutants to the water during construction operations.

#### **401.40 CHEMICAL POLLUTION**

The Contractor shall provide tanks or barrels to be used to dispose of waste oils or other chemical pollutants produced as a by-product of the work under the contract, such as drained lubricating or transmission oils, greases, soaps, asphalt, etc. At the completion of the work, all storage tanks or barrels shall be removed and disposed of at the Contractor's expense in accordance with all Local, State and Federal regulations.

Sanitary facilities shall not be placed adjacent to live streams, wells, or springs. They shall be located at a distance sufficient to prevent contamination of any water sources.

#### **401.50 AIR POLLUTION**

All Local, State and Federal regulations concerning the burning of brush or slash or disposal of other materials shall be adhered to. Fire prevention measures shall be taken to prevent the start or the spreading of fires that may result from any contract work. Firebreaks or guards shall be constructed at locations as shown on the drawings.

All public access or haul roads used during construction of the project shall be watered or treated with dust palliative when necessary to control the dust raised by the hauling equipment.

#### **401.60 MAINTENANCE, REMOVAL AND RESTORATION**

All measures and works shall be adequately maintained in a functional condition as long as needed during the construction operation. Sediment shall be removed periodically or as directed by the Engineer. Upon sediment removal, all trapped sediment from the controls must be disposed of in the spoil area as shown on the plans. All temporary measures shall be removed and the site restored as nearly to original conditions as practicable as directed by the Engineer. All temporary measures and materials become the property of the Contractor upon removal.

#### **401.70 METHOD OF MEASUREMENT**

Soil erosion and pollution control shall be measured on a unit basis. The unit shall be shown in the Unit Price Table of the Standard Bid Form for the pay item corresponding to this specification number. Soil erosion and pollution control shall be measured in the following manner:

- 1) Lump Sum (LS): Soil erosion and pollution control shall be measured on a lump sum basis of installed devices. No separate payment shall be made for excess material.
- 2) Linear Feet (LF): Soil erosion and pollution control shall be measured on a linear feet basis. The length shall be the actual length of soil erosion control measures installed according to plans and specifications.
- 3) Square Yard (SY): Soil erosion and pollution control shall be measured on a square yard basis. The quantity shall be the neat line measured quantity of the finished surface completed and accepted in-place.
- 4) Each (EA): Soil erosion and pollution control measures shall be measured on an individual basis. The type and number of controls paid for shall be specified on the plans and itemized on the Standard Bid Form.

#### **401.80 METHOD OF PAYMENT**

The completed work for soil erosion and pollution control, measured as specified, shall be paid for at the contract unit price. The unit price bid for soil erosion and pollution control shall include supplying all materials, equipment, labor and any incidental items necessary for performing all operations described in this specification and shown on the plans.