

**Part 1 GENERAL**

**1.1 WORK INCLUDED**

- .1 This section includes the supply of all labour, materials and equipment and incidentals necessary for the complete installation of all culvert pipes as shown on the drawings and herein specified.

**1.2 RELATED REQUIREMENTS**

- .1 Section 31 23 33.01 Excavating, Trenching and Backfilling.

**1.3 REFERENCES**

- .1 ASTM International
  - .1 ASTM C76M-10a, Standard Specification for Reinforced Concrete Culvert, Storm Drain and Sewer Pipe (Metric).
  - .2 ASTM C443M-10, Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets (Metric).
  - .3 ASTM D698-07e1, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup> (600 kN-m/m<sup>3</sup>)).
- .2 CSA International
  - .1 CSA A3000-08, Cementitious Materials Compendium.
  - .2 CSA A257 Series-09, Standards for Concrete Pipe and Manhole Sections.

**1.4 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop drawings:
  - .1 Submit shop drawings in accordance with CSA-A23.3 and CSA-A23.4 and include following items:
  - .2 Methods of handling, erection and sealing.
  - .3 Openings, sleeves, inserts and related reinforcement.
- .3 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for pipes and backfill and include product characteristics, performance criteria, physical size, finish and limitations.
- .4 Samples:
  - .1 Inform Departmental Representative at least 4 weeks before beginning Work, of proposed source of bedding materials and provide access for sampling.
- .5 Certification: to be marked on pipe.

## **1.5 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials in accordance with manufacturer's recommendations.
  - .2 Store and protect pipes from damage.
  - .3 Replace defective or damaged materials with new.
- .4 Carefully lower culvert pipes into trench in such a manner as to prevent damage to them. Under no circumstances shall culvert pipes be dropped into a trench.

## **Part 2 PRODUCTS**

### **2.1 REINFORCED CONCRETE PIPE CULVERT**

- .1 Reinforced concrete pipe shall conform to CSA A257.2, Class 65D (ASTM C76 Class III), 100D (ASTM C76 Class IV), or 140D (ASTM C76 Class V) for reinforced concrete pipe (pipe class to be as indicated on the drawings)
- .2 Diameter as indicated on the Drawings
- .3 Joints: bell and spigot type with rubber gasket. This is a push-on joint and must be watertight.
- .4 Rubber gaskets for joints: to CSA A257.

### **2.2 GRANULAR BEDDING AND BACKFILL**

- .1 Granular bedding and backfill material to Section 31 23 33.01 - Excavating, Trenching and Backfilling.

## **Part 3 EXECUTION**

### **3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for pipe culvert installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of Departmental Representative.
  - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

- .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.
- .2 Prior to placing the pipe in the ditch or trench, inspect each pipe for defects. Remove all defective pipes from the site and replace with sound material. All dirt and gravel must be kept out of the joint and all gaskets kept clean.

### **3.2 TRENCHING**

- .1 Do trenching Work in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.
- .2 Obtain Departmental Representative's approval of trench line and depth prior to placing bedding material or pipe.

### **3.3 BEDDING**

- .1 Dewater excavation, as necessary, to allow placement of culvert bedding in dry condition.
- .2 Place 200 mm minimum thickness of approved granular material on bottom of excavation and compact to 95% minimum of maximum density to ASTM D698.
- .3 Shape bedding to fit lower segment of pipe exterior so that width of at least 50% of pipe diameter is in close contact with bedding and to camber as indicated or as directed by Departmental Representative, free from sags or high points.
- .4 Place bedding in unfrozen condition.

### **3.4 HEADWALLS**

- .1 New precast concrete headwalls are to be constructed of the materials and to the dimensions as shown on the Drawings. This shall include connection to the culvert pipe to make a tight connection that will not permit soil or debris to wash into the pipe behind the headwall.

### **3.5 GENERAL**

- .1 Where it is specified that new culverts are to be supplied and installed as part of new roadway construction, or existing culverts are to be removed and replaced with new culvert pipe, this work will be constructed, measured and paid in accordance with this Section.
- .2 Any culverts shown on the Drawings and required to be removed for the purpose of accommodating pipeline installation shall be removed and reinstalled in accordance with the requirements of this Section.
  - .1 Where the condition of an existing culvert including headwalls is deemed by the Departmental Representative to be acceptable for re-installation, re-install the existing culvert.

- .2 There will be no separate payment for such culvert pipe removals and replacements as this will be considered incidental to the work. Where a culvert pipe or headwall that would have been acceptable for re-installation is damaged by the Contactor and cannot be re-used, the Contractor will replace the culvert pipe with a new culvert pipe meeting this specification at no cost to the Owner.
  - .3 Where the condition of an existing culvert and/or headwall is deemed by the Departmental Representative to not be acceptable for re-installation: supply and install, at the tendered price for culvert pipe and/or headwall, a new culvert pipe and/or headwall meeting this specification. Use appropriate care to excavate, remove, clean, and store the culvert to prevent damage to the material.
  - .4 When multiple culverts are removed prior to being re-installed, properly mark culverts for re-installation in the correct location.
  - .5 Provide and use new connectors, gaskets, etc.
  - .6 Re-installation to follow the same procedures as required herein for new culvert pipe.
  - .7 Adjust or reinstall existing headwalls as required with the same materials as on site, or materials to match the existing.
- .3 Utilize laser beam instrumentation and techniques to determine intermediate line and grade for all culvert pipes except where and when the Departmental Representative may allow other methods to be used.
  - .4 Install new culvert pipes according to the sizes, locations, and grades indicated on the drawings.
  - .5 Lay culvert pipes in the trench so after the culvert is completed the interior surface will conform accurately to the grades and the alignment of the ditch or other location. All adjustments of line and grade of pipes laid directly upon the bottom must be done by scraping away or filling in the backfill under the body of the pipe and not by blocking or wedging up.
  - .6 Any pipes which have a bell end of larger diameter than the pipe shall have the bed of the trench dug out at the bell to conform to this shape and avoid any point loadings of the pipe on the trench.
  - .7 Where an existing culvert pipe is being extended, the new pipe shall be installed as described herein, including preparation of the existing pipe as required for the connection, connection to the existing pipe, re-bedding under the existing pipe at the point of connection, and removal of debris.
  - .8 Construct new headwalls of the materials and to the dimensions shown on the Drawings. Connect to the culvert pipe to make a tight connection that will not permit soil or debris to wash into the pipe behind the headwall.
  - .9 Install culvert pipes to manufacturer's recommendations and in accordance with recognized good practice. Provide and use proper

implements, tools and facilities for safe and efficient execution of the work.

- .10 Inspect culvert pipes in the field before and after laying. Remove any defective or damaged culvert pipe and replace with new sound material at the Contractor's expense.
- .11 Lay culvert pipes true to line and grade with uniform bearing under the full length of the barrel of the culvert pipe. Remove and re-lay any culvert pipe which is not in true alignment or shows any undue settlement after laying.
- .12 Until there is at least 300 mm of cover over new or re-installed culvert pipes, no walking on or working over them will be allowed, except as necessary for backfilling the trench and compaction of the bedding material.

### **3.6 LAYING CONCRETE PIPE CULVERTS**

- .1 Begin at downstream end of culvert with flanged end of first pipe section facing upstream unless otherwise indicated on the Phasing Plan.
- .2 Ensure barrel of each pipe is in contact with shaped bed throughout its length.
- .3 Allow water to flow through pipes during construction only as permitted by Departmental Representative.

### **3.7 JOINTS: CONCRETE PIPE CULVERTS**

- .1 Rubber gasket joints:
  - .1 Install in accordance with manufacturer's written recommendations.
  - .2 Ensure that tapered ends are fully entered into flanged ends.

### **3.8 BACKFILLING**

- .1 Backfill around and over culverts as indicated or as directed by Departmental Representative.
- .2 Place granular backfill material, in 150 mm layers to full width, alternately on each side of culvert, so as not to displace it laterally or vertically.
- .3 Compact each layer to 95% maximum density to ASTM D698 taking special care to obtain required density under haunches.
- .4 Protect installed culvert with minimum 600 mm cover of compacted fill before heavy equipment is permitted to cross.
  - .1 During construction, width of fill, at its top, to be at least twice diameter or span of pipe and with slopes not steeper than 1:2.
- .5 Place backfill in unfrozen condition.

**3.9 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 -  
Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials,  
rubbish, tools and equipment in accordance with Section 01 74 11  
- Cleaning.

**END OF SECTION**

## **1 GENERAL**

### **1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 03 30 00 - Cast-In-Place Concrete.
- .4 Section 31 05 16 - Aggregate Materials.
- .5 Section 31 23 33.01 - Excavating, Trenching and Backfilling.
- .6 Section 31 24 13 - Temporary Roadway Embankment.

### **1.2 REFERENCES**

- .1 American Society for Testing and Materials International, (ASTM)
  - .1 ASTM A760,
  - .2 ASTM A761,
  - .3 ASTM C 117-13, Standard Test Method for Material Finer Than 0.075 mm (No. 200) Sieve in Mineral Aggregate by Washing.
  - .4 ASTM C 136-06, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
  - .5 ASTM C 144-11, Standard Specification for Aggregate for Masonry Mortar.
  - .6 ASTM D 698-12, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup> (600 kN-m/m<sup>3</sup>)).
- .2 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-8.2-M88, Sieves, Testing, Woven Wire, Metric.
- .3 Canadian Standards Association (CSA International)
  - .1 CAN/CSA-S6 Canadian Highway Bridge Design Code.
  - .2 CSA A3000-08, Cementitious Materials Compendium.

### **1.3 DESIGN CRITERIA**

- .1 Live Loading: CL-625 Truck.
- .2 Design unit weight of soil of 22 kN/m<sup>3</sup>.
- .3 Width: as indicated. Rise: as indicated.
- .4 Seismic acceleration ratio = 0.05g.
- .5 Design height of cover as indicated, considering both finished road grade and temporary travel grades. Minimum cover = 1.28 m.

### **1.4 SUBMITTALS**

- .1 Submittals to be in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Inform Departmental Representative at least 4 weeks prior to beginning Work, of proposed source of bedding materials and provide access for sampling.

- .3 Submit manufacturer's instructions, printed product literature and data sheets for pipes and backfill and include product characteristics, performance criteria, physical size, finish and limitations.
- .4 Design drawings shall be stamped by a Professional Engineer licensed to practice in the province of Nova Scotia.
- .5 Mill certificate for the steel material shall be provided upon request.

## **1.5 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Manufacturer's written instruction and Section 01 61 00 - Common Product Requirements.
- .2 Carefully lower culvert sections into place in such a manner as to prevent damage to them. Under no circumstances shall culvert sections be dropped into place.

## **1.6 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate waste materials for reuse and recycling.
- .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal paper plastic, polystyrene and corrugated cardboard packaging material in appropriate on-site bins for recycling.
- .4 Divert unused metal materials from landfill to metal recycling facility as approved by Departmental Representative.
- .5 Divert unused concrete materials from landfill facility as approved by Departmental Representative.
- .6 Divert unused aggregate materials from landfill to quarry facility for reuse as approved by Departmental Representative.
- .7 Fold up metal banding, flatten and place in designated area for recycling.

## **2 PRODUCTS**

### **2.1 MATERIALS**

- .1 Steel plate to conform to CSA G401-01 (ASTM Standard A907 or A570 as applicable).
- .2 Corrugated steel structural plate shall meet the general requirements for 381mm x 140mm corrugation profile as specified in CSA G401-14 (ASTM A761 and A796). Bolt holes shall be 25mm diameter using 19mm diameter (M20) bolts.
- .3 All structural plate shall be zinc coated after fabrication to provide an average coating weight of 915 g/m<sup>2</sup> of sheet. Zinc coating in accordance with CAN/CSA G164 (ASTM A123).
- .4 Bolts and nuts for the structural plate connections shall be heavy hex, meeting the requirements of ASTM A449 (bolts) and ASTM A563 (nuts). Anchor bolts shall meet ASTM A307. All fasteners and anchor bolts shall be zinc coated in

accordance with ASTM A153.

- .5 Steel for unbalanced channel shall be 5.0mm minimum thickness and conform to CSA G401-01 (ASTM A36).

## 2.2 FOUNDATION BEDDING AND BACKFILL

- .1 Granular bedding and backfill material to Section 31 05 16 - Aggregate Materials, 32 11 16.01 - Granular Sub-base, and Section 31 23 33.01 - Excavating, Trenching and Backfilling.
- .2 Backfill material in the engineered backfill zone to be clean, well graded, granular material meeting the strength, compressibility and electro-chemical requirements specified by the structure manufacturer.
- .3 The engineered backfill material must conform to the following electro-chemical limits:

Resistivity	2000-5000 ohm-cm
Chlorides	< 100 ppm
Sulphates	< 200 ppm
pH	5 to 10
Max 1% organic content	

or

Resistivity	>5000 ohm-cm
Chlorides	-
Sulphates	-
pH	5 to 10

## 3 EXECUTION

### 3.1 GENERAL

- .1 The existing concrete box culvert and steel bin walls may be left in place to divert the existing brook during construction. Following construction of the proposed corrugated arch culvert, the existing concrete culvert and bin walls shall be removed in accordance with the requirements of this Section.
  - .1 There will be no separate payment for such culvert pipe removals as this will be considered incidental to the work.

### 3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for concrete footing and culvert installation in accordance with manufacturer's written instructions.
- .2 Visually inspect substrate in presence of Departmental Representative.
- .3 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
- .4 Proceed with installation only after unacceptable conditions have been remedied

and after receipt of written approval to proceed from Departmental Representative.

### **3.1 EXCAVATION**

- .1 Do excavation Work in accordance with Section 31 23 33.01 - Excavating Trenching and Backfilling.
- .2 Obtain Departmental Representative's approval of excavation extents and depth prior to placing foundation or culvert.
- .3 Dewater excavation, as necessary, to allow placement of footings and culvert in dry condition.
- .4 Prior to placing the arch culvert sections, inspect each section for defects. Remove all defective sections from the site and replace with sound material. All dirt and gravel must be kept out of the joint and gaskets kept clean.

### **3.2 FOUNDATION**

- .1 Connect or anchor culvert to cast-in-place concrete foundation in accordance with manufacturer's instructions.
- .2 Footings to be founded on competent bearing stratum consisting of dry base of compact to dense glacial till or bedrock. Footings to be underlain directly by layer of Clean Rock Fill in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.
- .3 Bearing stratum to be inspected by professional geotechnical engineer designated by Departmental Representative, as required.
- .4 Place Clean Rock Fill on a firm, dry base, in lifts not exceeding 300 mm and compacted to a minimum of 100% of Maximum Dry Density in accordance with ASTM D698.

### **3.3 ASSEMBLY**

- .1 The structural plate culvert shall be assembled in place as detailed and described in the assembly procedures on the manufacturer's shop drawings. The Contractor shall be responsible to ensure the provision of trained, knowledgeable personnel for construction supervision.
- .2 Culvert components shall be carefully formed to the corrugation profile and curved to the required radius along the inner crest, in the manufacturer's plant. The maximum tolerance on calculated rise for a given curvature shall be plus or minus 6mm (length of straight edge not less than 75% of chord length).
- .3 To verify the proper geometry, a test ring will be constructed to check span and rise dimensions.
- .4 Structural plates shall be temporarily labeled with adhesive stickers identifying the plate and project, and permanently stamped with an ID number on the inside tangent approximately 500mm from the end of the plate.

### **3.4 BACKFILLING**

- .1 Backfill around and over culverts as indicated or as directed by Departmental

Representative.

- .2 The engineered backfill envelope shall extend half the span beyond the maximum span of the culvert on either side, up to the minimum height of cover stated in the design.
- .3 The engineered backfill material shall meet the manufacturer's requirements as specified on the manufacturer's drawings.
- .4 The backfill material shall be uniformly placed in compacted lifts on both sides of the culvert, as directed by the Departmental Representative. The backfill lifts shall not exceed 200mm in depth (before compaction) and shall be compacted to a minimum of 95% standard Proctor Dry Density (ASTM D698) unless otherwise noted on the manufacturer's drawings. The difference in levels of the backfill on the two sides at any transverse section shall not exceed 400mm.
- .5 Compact each layer to 98% of Standard Proctor Maximum Dry Density to ASTM D 698.
- .6 Heavy equipment cannot be operated within 1000mm of the structure. Fill within 1000mm of the structure must be placed and compacted using light equipment or by hand.
- .7 Place backfill in unfrozen condition.

**END OF SECTION**