

1. GENERAL

1.1 RELATED WORK

- .1 Section 31 23 00 – Excavation, Trenching and Backfilling.
- .2 Section 31 37 00 – Riprap.
- .3 Section 31 32 19 – Geosynthetics.

1.2 DEFINITIONS

- .1 Class B Bedding
 - .1 The pipe shall be bedded in granular material which shall have a thickness as specified on the standard drawing.
 - .2 The granular material shall be hand placed and compacted to a density of 95% Standard Proctor in 150mm layers for the full width of the trench up to 300mm above the crown of the pipe.

1.3 MEASUREMENT AND PAYMENT

- .1 Measurement for the removal, salvage and reinstallation of existing culverts and drainage structure including sloped ends, will be made in lineal metres based on the total invert length of pipe removed and reinstalled. Payment will be made at the unit price bid per lineal metre for the various types and sizes of culverts, as specified within the Bid Forms. This payment will be full compensation for excavation, removing and salvaging or disposing of the pipe, couplers, and fasteners, preparing the culvert bed including supplying, placing and hauling the gravel material, reinstalling the pipe, backfilling and compaction and the supply and placement of hand-laid rip-rap, and all materials, labour and supervision, equipment, tools and incidentals necessary to complete the Work to the satisfaction of the Engineer. When a culvert is identified by the Engineer to be salvaged and the culvert is damaged by the Contractor during the removal operations due to its negligence, the Contractor shall replace the damaged culvert at its sole expense. Where the Contractor chooses to construct embankments before installing culverts, there will be no payment for subsequent excavation of these embankment materials.
- .2 Measurement for the supply and installation of culverts, and downdrains will be made in lineal metres based on the total invert length of pipe installed, including elbows and sloped end sections. Payment will be made at the unit price bid per lineal metre for the various types and sizes of culvert, as specified within the Bid Forms. This payment will be full compensation for removing and disposing existing pipe and bedding, if applicable, supplying all culvert pipe materials including couplers and appurtenances, excavation, preparing the culvert bed including supplying, hauling and placing the granular material, installing the pipe, backfilling and compaction and the supply and placement of hand-laid riprap, and all materials, labour and supervision, equipment, tools and incidentals necessary to complete the Work to the satisfaction of the Engineer. No separate payment will be made for the installation of oakum in joints. Payment for this work will be included in the unit price bid for supplying and installing the culverts.

- .2 Measurement for supply and installation of flared ends will be made per each unit installed. Payment will be made at the unit price bid per unit for the various types and sizes of flared end installed, as specified within the Bid Forms. This payment will be full compensation for supplying all flared end materials including couplers, jointing material and appurtenances, excavation, preparing the flared end bed including supplying, hauling and placing the granular material, installing the pipe, backfilling and compaction and the supply and placement of hand-laid riprap, and all materials, labour and supervision, equipment, tools and incidentals necessary to complete the Work to the satisfaction of the Engineer. No separate payment will be made for the installation of oakum in joints. Payment for this work will be included in the unit price bid for supplying and installing the flared ends.

2. PRODUCTS

2.1 CORRUGATED STEEL PIPE

- .1 Culverts shall be corrugated steel pipe, manufactured in accordance with CAN3-G401 and shall be zinc coated by a hot dip galvanizing process. The wall thickness shall be 1.6mm in the 300mm, 400mm, 500mm and 600mm sizes and 2.0mm in the 700mm, 800mm and 900mm culvert sizes, or as required by the loading criteria. The corrugation pattern shall be 68mm pitch and 13mm depth. The pipe sections shall be connected with corrugated band couplings, also conforming to CAN3-G401. Ends shall be cut square or bevelled as indicated.
- .2 Prefabricated end sections as indicated.

2.2 CONCRETE PIPE

- .1 Reinforced concrete pipe conforming to CAN A257 and ASTM C655, using flexible rubber gaskets meeting CAN A257 and ASTM C443. Use Type HS, high sulphate-resistant, cement in the manufacture of reinforced concrete pipe and fittings. Class of pipe strength as specified.
- .2 Lifting Holes
 - .1 Required for pipe greater than 900mm diameter; lift holes not to exceed two in a piece of pipe.
 - .2 Provide pre-fabricated plugs to effectively seal lift holes after installation of the pipe.
- .3 Cement Mortar Joint Filler
 - .1 Portland cement: to CSA A3000, Type HS, high sulphate- resistant.
 - .2 Sand: to ASTM C144
 - .3 Mortar: one (1) part by volume of cement to two (2) parts of clean, sharp sand mixed dry. Add sufficient water after mixing to give optimum consistency for hand application.
- .4 Prefabricated end sections as indicated.

2.3 CULVERT BEDDING

.3 Granular material:

- .1 Gradation to be within specified limits when tested to ASTM C136 and ASTM C117 (AASHTO T11 and T27) and giving a smooth curve without sharp breaks when plotted on a semi log grading chart.
- .2 Bedding Sand:
 - .1 Natural sand or crushed rock screenings to follow grading requirements:

Sieve Designation	% Passing
10.0mm	100
5.0mm	50-100
2.5mm	30-90
0.315mm	10-50
0.08mm	0-10

- .1 Liquid limit: ASTM D4318 (AASHTO T89), maximum 25.
- .2 Plasticity index: ASTM D4318 (AASHTO T90), maximum 6.

2.4 CULVERT BACKFILL

- .1 Material for culvert backfill shall be a mixture of the excavated material obtained from the excavations on the road alignments, where suitable. Use of random culvert backfill shall be subject to the approval of the Engineer.

3. EXECUTION

3.1 TRENCHING AND EXCAVATION

- .1 The excavation for the culvert base shall be carried out to a depth of not less than 100mm below the invert grade, as established by the Engineer, and shall be of sufficient width to permit pipe assembly and to accommodate the operation of compaction equipment on either side of the culvert.

3.2 CULVERT BEDDING

- .1 Place a minimum 100mm thick layer of compacted granular material on the bottom of the excavation. Place material in uniform layers not exceeding 150mm thickness, and compact each layer to at least 95% Standard Proctor Density before placing the succeeding layer. Any soft and yielding or other unsuitable material below this level shall be removed to the depth required by the Engineer and backfilled with approved granular material compacted to a uniform density of 95% Standard Proctor Density throughout the entire length of the culvert.
- .2 The base for culverts installed along main water courses or through yielding areas shall consist of gravel bedding compacted to the excavated depth and extending over a width of three times the diameter of the pipe. The depth of this base shall be not less than 300mm. An impervious compacted bedding material shall be provided for a minimum length of 3m or three times the diameter of the pipe, whichever is greater, at the inlet end of the culvert to achieve a seal against seepage.

- .3 Trench line and grade requires the Engineer's approval prior to placing bedding material or pipe.
- .4 Do not backfill until the pipe grade and alignment are checked and accepted by the Engineer.

3.3 LAYING CORRUGATED STEEL PIPE CULVERTS

- .1 Commence pipe placing at the downstream end on the prepared granular bedding with separated sections securely joined together by means of a coupling band.
- .2 Do not allow water to flow through pipes during construction, except as permitted by the Engineer.
- .3 All culverts shall be laid so that the horizontal seams fall at the sides of the culverts.
- .4 The pipe shall be laid true to line and grade as established by the Engineer, and the pipe shall be carefully handled to prevent damage to the galvanized coating. Damaged pipe sections shall be immediately reported to the Engineer and repaired and/or replaced according to its direction.
- .5 The centreline of the culvert shall not vary from the designated horizontal alignment by more than 75mm. The invert grade shall not vary from the designated invert grade elevation by more than 12mm, provided positive flow is maintained.

3.4 LAYING CONCRETE PIPE CULVERTS

- .1 Begin at downstream end of culvert with the female end of first pipe section facing upstream.
- .2 Ensure the barrel of each pipe is in contact with the culvert bedding throughout its length.
- .3 Do not allow water to flow through pipes during construction, except as permitted by the Engineer.
- .4 The pipe shall be laid true to line and grade as established by the Engineer and the pipe shall be carefully handled to prevent damage. Damaged pipe sections shall be immediately reported to the Engineer and repaired and/or replaced according to its direction.
- .5 The centreline of the culvert shall not vary from the designated horizontal alignment by more than 75mm. The invert grade shall not vary from the designated invert grade elevation by more than 12mm provided positive flow is maintained.

3.5 JOINTING CONCRETE PIPE CULVERTS

- .1 Joints may be made with rubber gaskets, bituminous jointing compound or Portland cement mortar where a specific joint type is not otherwise specified by the Engineer.
 - .1 Rubber gasket joints:
 - .1 Install to the manufacturer's recommendations.

- .2 Ensure that the male ends are fully entered into the female ends.
- .2 Bituminous filled joints:
 - .1 Make joints with an excess of filler to form a continuous bead around the outside of the pipe and finish the joint smooth on the inside.
- .3 Mortar Joints:
 - .1 Prepare the mortar as specified herein.
 - .2 Clean the surface of the pipe ends and wet with water before the joint is made.
 - .3 Place mortar in the lower half of the female end of pipe section in place.
 - .4 Apply mortar to the upper half of the male end of pipe section being installed.
 - .5 Join the pipe ends and force joint tight, taking care to ensure that the inner surface of the abutting pipe sections are flush and even.
 - .6 Clean the inside of the pipe and annular space between the ends of the pipes after each joint is made.
 - .7 Fill the joint with mortar and finish the mortar surface smooth and even.
 - .8 For pipes 800mm or less in diameter, fill the joints before the mortar in the joints has set.
 - .9 For pipes 800mm and greater in diameter, postpone filling the joint until backfilling has been completed. Re-clean the joints before applying the mortar.

3.6 CULVERT BACKFILL

- .1 After assembly of the culvert on the bedding, the culvert shall be backfilled with approved granular and native backfill. Backfill shall be brought up on both sides of the culvert simultaneously and shall be compacted with a method approved by the Engineer to a minimum density of 95% Standard Proctor Density.
- .2 The backfill shall be spread and compacted in 150mm layers and special care shall be taken to ensure proper filling and compacting under the haunches and within the culvert corrugations. Heavy equipment shall not be allowed over the culvert until a minimum of 0.5m of fill is obtained above the crown of the pipe.

3.7 EXTENSION OF EXISTING CULVERTS

- .1 Extensions to existing culverts will be considered as new installations. Where an existing culvert is to be extended, the removal, salvage and reinstallation of the existing sloped end sections may be required as shown on the Drawings or as directed by the Engineer.
- .2 Where the existing pipe was manufactured to imperial dimensions and the new pipe is manufactured to metric dimensions and a mismatch occurs at the joint, the Contractor shall caulk the joint with oakum to obtain a water resistant joint.

3.8 RIPRAP

- .1 Riprap to be placed in accordance with Section 31 37 00 – Riprap.
- .2 Install riprap at both ends of the culvert as detailed.
- .3 Grade and level the slopes to receive the riprap. Lay geotextile material on the slopes anchored at the top in accordance with 31 32 17 Geosynthetics.

- .4 Place rock in a staggered manner to form a running bond pattern on each layer and between layers. Remove foreign matter from rock surfaces during placement. The riprap face shall appear closely packed and uniform.
- .5 Where required, install a trash rack as detailed on the Drawings.

END OF SECTION