B912 - PRECAST CONCRETE CULVERTS WITH SPANS GREATER THAN 3.0 m (As specified in OPSS 912 November 2025)

912.1 GENERAL

This work is for the fabrication, delivery and installation in open cut of precast concrete culverts with spans greater than 3.0 m. It includes requirements for excavation, bedding, backfilling, and cover material.

The designer selects the appropriate size that accommodates the design flow.

Manufacture of precast concrete culverts typically requires eight weeks. Adequate time must be allocated to the project schedule for manufacture.

The designer shall specify materials used for backfill, geotextile, and granular cover in Contract Documents/Drawings.

912.2 REFERENCES

- MTO Memo SCB-SO-2021-01 Design Process for Precast Concrete Box Culverts of Span Greater Than 3.0 m
- SSP 599S30, Requirement for Waterproofing of Precast Concrete Culverts
- OPSS 1355 - Material Specification for Precast Concrete - Materials and Production
- MTO Publication - Structural Manual
- MTO Drainage Management Manual
- Drainage Management Technical Guidelines
- CDED B206-1 Earth Grading
- CDED B314 Untreated Subbase, Base, Surface, Shoulder, Selected Subgrade and Stockpiling
- CDED B517 Dewatering
- CDED B902 Excavation and Backfill for Structures
- OPSS 539 Protection Systems
- OPSS 1205 Clay Seal
- OPSS 1355 Precast Concrete

912.3 TENDER ITEMS

Item Code	Title	Col Type	U.O.M.	PQP
0912-0110	Precast Concrete Box Culvert, Fabrication (Span ≥ 3.0 to < 4.0 m)	Variation	m	Y
0912-0120	Precast Concrete Box Culvert, Fabrication (Span ≥ 4.0 to < 5.0 m)	Variation	m	Y
0912-0130	Precast Concrete Box Culvert, Fabrication (Span ≥ 5.0 to ≤ 6.1 m)	Variation	m	Y
0912-0XXX	Precast Concrete Appurtances, Fabrication	Normal	m	Y
0912-0XXX	Precast Concrete Box Culvert, Delivery (Span ≥ 3.0 to < 4.0 m)	Variation	m	Y
0912-0XXX	Precast Concrete Box Culvert, Delivery (Span ≥ 4.0 to < 5.0 m)	Variation	m	Y
0912-0XXX	Precast Concrete Box Culvert, Delivery (Span ≥ 5.0 to ≤ 6.1 m)	Variation	m	Y
0912-0XXX	Precast Concrete Appurtances, Delivery	Normal	m	Y

0912-0XXX	Precast Concrete Box Culvert, Installation (Span ≥ 3.0 to < 4.0 m)	Variation	m	Y
0912-0XXX	Precast Concrete Box Culvert, Installation (Span ≥ 4.0 to < 5.0 m)	Variation	m	Y
0912-0XXX	Precast Concrete Box Culvert, Installation (Span ≥ 5.0 to ≤ 6.1 m)	Variation	m	Y
0912-0XXX	Precast Concrete Appurtances, Installation	Normal	m	Y
0912-0310	Clay Seal	Normal	lump sum	N

Standard sizes should be specified whenever possible. Designers should choose the next largest size meeting the hydraulic opening requirements.

912.3.1 Non-Standard Tender Items

The use of a non-standard tender item may be considered when non-standard dimensions must be used, such as to match and extend existing culverts.

912.4 SPECIFICATIONS

The construction requirements for the above tender items are contained in OPSS 912.

Material requirements for the above tender items are contained in OPSS 1355.

912.5 SPECIAL PROVISIONS

SSP 599S30 for waterproofing of precast culverts should always be used with OPSS 912.

912.6 STANDARD DRAWINGS

Structural Standard Drawing SS114-4 shall be completed and inserted into the Contract.

Applicable standard drawings are contained in the 3000 series of the Ontario Provincial Standard Drawings Manual.

912.7 DESIGN

912.7.1 General

Refer to MTO Memo SCB-SO-2021-01 - Design Process for Precast Concrete Box Culverts of Span Greater Than 3.0 m.

For all precast concrete culverts with spans greater than 3 m recommendations for design, including protection systems, excavation, dewatering, bedding, backfilling, cover, clay seals, treatments at inlet/outlet for scour protection shall be provided in the Foundation Investigation and Design Report (FIDR).

The FIDR shall address any issues related to complex subsurface conditions, including requirements for camber, articulation and construction staging. This includes use of a temporary culvert during embankment preload/surcharge and then proceeding to a permanent precast concrete culvert installation.

The survey information provides profiles along the drainage course at both existing and new culvert locations and other drainage courses.

The general alignment, size and type of culvert are established by the designer, based on acceptable drainage and hydraulics theory, environmental constraints, including possible fish passage and structural and foundations concerns. The designer shall use accepted drainage design methods by which to establish the culvert design that satisfies required drainage standards or criteria for the highway project.

The MTO Drainage Management Manual shall be used in the design of the precast concrete culvert, grades and the setting of upstream invert elevations. Complete requirements for design, analysis methods and other information are available in the MTO Drainage Management Manual.

912.7.2 Advantages of Precast Concrete Culverts Versus Cast-in-Place Open Footing Culverts

Where feasible, consideration should be given to a precast concrete culvert installation instead of a cast in-place open footing culvert. Advantages of using a precast concrete culvert include:

a) Relatively short construction time resulting in reduced environmental impact;

b) Feasibility for installation during cold weather conditions;

c) Relatively short period of use and maintenance of detours and subsequently quicker roadway reinstatement;

d) Reduced dewatering duration; and

e) Placing and curing concrete in shop conditions.

When articulation and/or cambering is required to accommodate predicted settlements, a precast concrete culvert is the preferred option.

The designer shall refer to the FIDR for discussion of alternatives and comparison of precast concrete culvert versus cast-in-place open footing culvert. Recommendations for the preferred alternative may be found in the FIDR.

912.7.3 Excavation and Backfilling

912.7.3.1 Excavation

Excavation for the foundation system shall be to the founding elevations recommended in the FIDR. Founding soils shall be competent materials capable of supporting applicable loads as described in the FIDR. Sub-excavation of weaker soils shall be carried out as recommended in the FIDR.

Design guidelines, documentation requirements and quantity calculations are found in CDED B902.

Earth and rock excavation required for appurtenances are included under the tender items, Earth Excavation for Structure or Rock Excavation for Structure, as applicable. Due to the high unit cost of rock excavation, the designer shall endeavour to reduce the volume of excavation by relocating the culvert or skewing to optimize fit.

912.7.3.2 Excavated Earth Material

Excavated earth material may be used for embankment construction or used as native backfill beyond the structure as determined by the designer based on the FIDR. Surplus or unsuitable excavation material should be managed as outlined in CDED B206-1.

912.7.3.3 Dewatering and/or Temporary Flow Passage System

Requirements for the design, operation, and removal of a dewatering or temporary flow passage system or both to control water during construction, and the control of the water prior to discharge to the natural environment and sewer systems shall comply with OPSS 517. Refer to CDED B517 for design and documentation requirements for dewatering.

Recommendations for IDF and Return periods for the temporary flow passage system shall be obtained from the Drainage and Hydrology Report.

Recommendations for Design Engineer requirements from the Contractor and preconstruction survey requirements shall be obtained from the FIDR.

Although the Contractor is responsible for a dewatering plan, the designer shall note any recommendations included in the Foundation Investigation and Design Report, if available.

Information on subsurface conditions required for design of the dewatering system, including Record of Borehole sheets and laboratory testing results, can be found in the foundation report included with the tender documents.

A Groundwater Impact Assessment Report shall also be reviewed and appended to the FIDR.

The designer shall review the FIDR and include any “red flag” requirements identified in the Contract Package such as susceptibility to basal heave, boiling, sloughing.

912.7.3.4 Fill Material

To prevent damage to the culvert due to loads, fill materials are provided as protective and support layers. Fill material for culvert installations is placed in distinct bedding, backfill and cover layers.

The FIDR will include recommendations for the specification, supply and placement of fill material or any special conditions for bedding, backfill and cover layers.

The designer shall specify the fill materials required for the installation in the Contract Documents, based on the recommendations of the FIDR.

For backfill to concrete structures, the designer is recommended to specify use of Granular A, Granular B, or a combination of Granular A or B. In certain circumstances, when Granular A or B material is not available or in order to reduce high granular costs, rock backfill may be used as backfill material. Before opting for rock backfill, a cost comparison must be completed to determine the more economical alternative.

For backfill beyond concrete structures, the designer is recommended to as backfill to concrete structures, with the additional option to specify Native Material.

Refer to CDED B314 for design guidelines, documentation requirements and quantity calculations for fill material.

912.7.3.5 Protection Systems

Protection systems shall be considered where the stability of excavation, safety or function of an existing roadway, railway or any structure or slope may be threatened or impaired due to the construction of a precast concrete culvert.

Where a protection system is required for installation of the precast concrete culvert, the design, installation, monitoring, and removal are the Contractor's responsibility in accordance with OPSS 539. The designer shall include a Performance Level and the Contractor shall design and construct the protection system to satisfy the performance requirements. The FIDR shall be included in the Contract Package for the Contractor's reference. The Designer shall review Complex soil conditions, high groundwater tables or other installation issues, if identified in the FIDR so as to red flag these conditions in the Contract Package.

The Foundation Investigation Report (FIR) shall be provided when the contract is advertised for the Contractor's reference.

When required, a protection system shall be paid for under the Protection System tender item.

912.7.3.6 Clay Seals

The designer shall select a natural clay or a Geosynthetic Clay Liner in accordance with OPSS 1205 and recommendations in the FIDR. Refer to CDED B-902 for design and documentation requirements for clay seals.

Warrants for clay seals to be installed at the culvert sites may include:

a) The natural sub-base and culvert foundation materials are of a granular nature;

b) The embankment material is of a non-cohesive nature; or

c) There is significant hydraulic head differential between the upstream and downstream ends of the culvert.

912.7.3.7 Camber

A camber is typically designed in consideration of a predicted settlement profile anticipated along the length of the culvert. The FIDR will contain information and design requirements for the camber depths needed for a precast concrete culvert installation.

912.7.4 Frost Protection

The designer shall refer to the FIDR for recommendations for frost protection. Special treatment of precast concrete culverts may be required for frost protection. Foundation reports shall contain information regarding recommended fill materials and the configuration and extent of frost taper excavations.

Frost tapers are not required when the frost line falls above the culvert or when the culvert is constructed in rock fill.

912.7.5 Scour Protection

Special consideration for scour protection at the culvert inlet or outlet may be required and the designer shall refer to the MTO Drainage Management Manual for assistance.

Scour protection shall be based on the erodibility of the founding soils/rock and the scouring forces due to the water velocities.

912.7.6 Geotextile

The designer shall refer to the FIDR to determine which class and filtration opening size (FOS) to specify this on the Contract Documents.

912.8 COMPUTATION

912.8.1 Sources of Information

The main sources of information for the above tender items are the Regional Structural Section, the FIDR, survey, drainage and hydrology information.

912.8.2 Method of Calculation

912.8.2.1 Precast Concrete Box Culvert, Fabrication

The unit of measurement is the length in metres.

Working with design cross-sections, standard drawings, drainage profiles and the size of culvert previously determined, the designer calculates the culvert length. The design length (L) of the culvert is the distance between the toes of embankment slopes where they meet the streambed profile measured to the nearest 0.1 metre.

912.8.2.2 Precast Concrete Box Culvert, Delivery
Precast Concrete Box Culvert, Installation

The unit of measurement is the length in metres.

Working with design cross-sections, standard drawings, drainage profiles and the size of culvert previously determined, the designer calculates the culvert length. The design length (L) of the culvert is the distance between the toes of embankment slopes where they meet the streambed profile measured to the nearest 0.1 metre.

912.9 DOCUMENTATION

912.9.1 Contract Drawings

New precast concrete culverts and existing culverts requiring extension receive a site number and shown on the plans and profiles of the contract drawings. Culvert alignment and skew is shown on the plans. Locations and details of culvert appurtenances are shown on the plans and labelled. Appropriate invert elevations are to be shown.

Requirements for protection systems and dewatering/temporary flow passage systems shall be noted on the Contract Drawings.

Stratigraphical sections and profiles shall be included in the Contract Drawings. The Designer shall ensure that the invert elevations on these drawings in no way conflict with the Contract Drawings.

Any requirements for cambering shall be illustrated on the contract drawings.

Material types required for bedding, backfilling and cover requirements shall be clearly noted on the contract drawings.

Requirements for the placement of the bedding, backfill and cover shall be noted on the contract drawings.

The contractor, not the designer, is responsible for selecting the appropriate culvert installation method at the time of installation based on the soil types found on the construction site in accordance with the Occupational Health and Safety Act and Regulations for Construction Projects.

912.9.2 Quantity Sheets

Information is entered on the “Quantities - Structures” sheet. Information includes culvert number, station and location. Offset is included when required. The length of each culvert is entered under the appropriate column heading labelled with the tender item name, indicating the precast concrete culvert size. There should be two tender items for each precast concrete culvert required, one for fabrication and one for delivery and installation.

Granular material quantities used for bedding and levelling courses, cover, backfill and frost tapers shall be shown under the appropriate column headings for granular material tender items, when applicable.

Concrete and steel reinforcement quantities for cast-in-place concrete appurtenances are included on the “Quantities - Structures” sheet, with location and description details sufficient to link the quantities to the precast concrete culvert locations.

912.9.3 Documentation Accuracy

Length of culvert rounded to the nearest 0.1 m. Stations are recorded in whole numbers.

912.9.4 Non-Standard Special Provisions (NSSPs)

An NSSP to alert the Contractor of subsurface and groundwater conditions is included on a project specific basis, when recommended in the FIDR.

In some cases, a levelling slab may be required using mass concrete, clear stone, or other material. The requirement would be shown by non-standard detail in the contract drawings. An appropriate tender item should be used for levelling slab material (for example mass concrete or clear Stone, etc.)