



N.C. DEPARTMENT OF TRANSPORTATION

Hydraulics Unit

Culvert Identification Field Guide



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Culvert Identification Field Guide

A culvert is a metal, concrete, or plastic structure that conveys runoff surface water underneath a road, railroad, driveway, or any other obstruction to the natural flow of water rather than a storm drain system. Common types of culverts include round pipes, pipe arches, and box culverts, which may include multiple culverts or a combination of different sizes, types, and elevations at the same location.

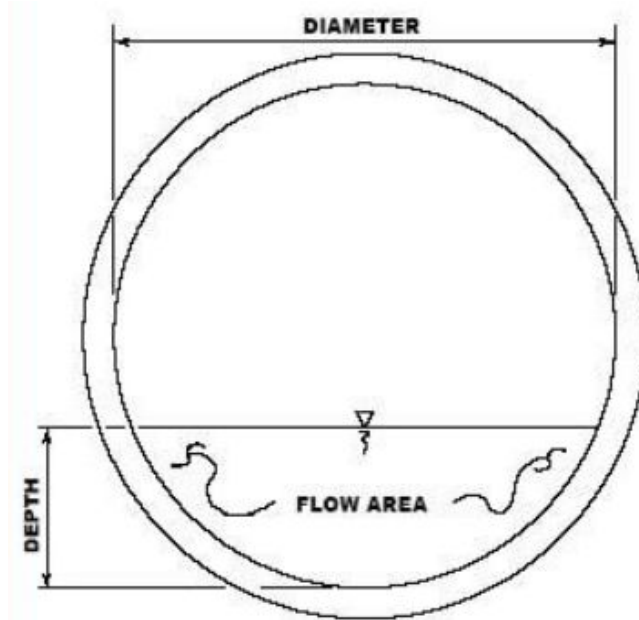
The following guide is intended to assist in the identification of a variety of culverts commonly used by the North Carolina Department of Transportation (NCDOT).

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Round Pipes

Round pipes are the most commonly used within the NCDOT Right of Way. Materials used for round pipes include Reinforced Concrete (RCP), Corrugated Metal (CMP), and plastic. Plastic comes in High Density Polyethylene (HDPE) and Polyvinyl Chloride (PVC). However, plastic pipes are most commonly used for storm drain systems. Measurement is recorded as the inside diameter of the pipe in inches. Sizes begin at 15 inches and continue from 18 to 144 inches in half foot increments. These pipes may or may not have headwalls. For round pipes, the most common headwall material types are concrete and metal; however, there are other kinds such as masonry, stone, and riprap that may be found in the field.

Reinforced Concrete Pipe (RCP)



Round Pipe Typical Section



Projecting RCP (left) and RCP w/ Concrete Headwall (right)

Corrugated Metal Pipe (CMP)



Projecting CMP



CMP w/ Corrugated Metal Headwall

Plastic Pipe

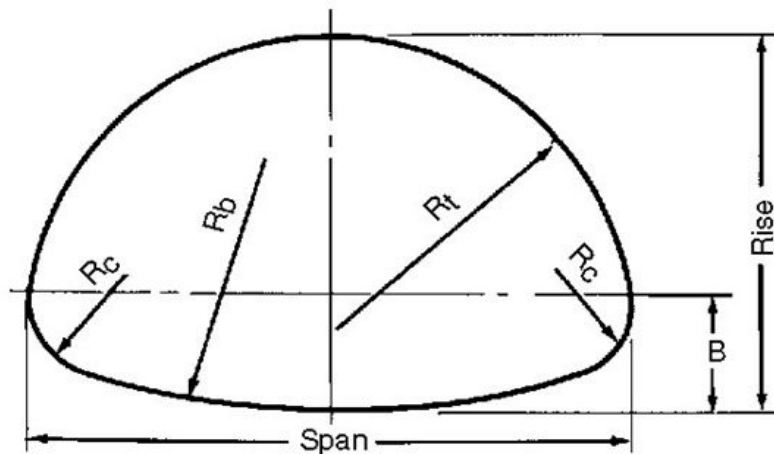


Projecting HDPE culvert

Pipe Arches

Pipe arches come in Corrugated Metal (CMP) or Reinforced Concrete (RCP); although, Corrugated Metal is much more common in NCDOT Right of Way. There are two types of Corrugated Metal pipe: Corrugated Metal Pipe Arch (CMPA) and Corrugated Metal Structural Plate Pipe Arch (CMSPPA). Both have a similar shape, but CMPA is rolled while Structural Plate is bolted together. Sizes of CMPA range from 60" x 46" up to 142" x 91" while Structural Plate ranges from 5'-11" x 5'-4" to 20'-7" x 13'-2". Measurement is typically recorded as width x height (aka span x rise). These arch pipes may or may not have headwalls. The most common type of headwall for these pipes is metal; however, others including concrete, masonry, stone, and riprap may be found in the field.

Corrugated Metal Pipe Arch (CMPA)



CMPA Typical Section



Projecting CMPA (left) and CMPA w/ Corrugated Metal Headwall (right)

Corrugated Metal Structural Plate Pipe Arch



Structural Plate Arch being constructed in the field



Bottomless Structural Plate Arch Inlet (note bolted plates)

Reinforced Concrete Pipe Arch (RCPA)

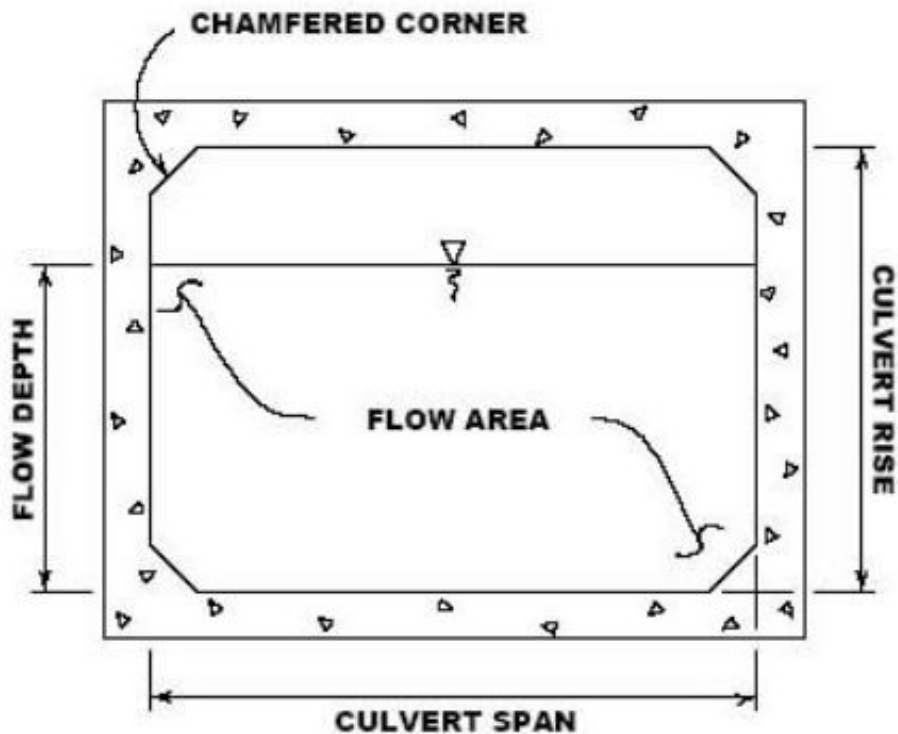


Stockpile of RCPA

Box Culverts

The two types of Box Culverts found in NCDOT Right of Way are Reinforced Concrete (RCBC) and Aluminum (ABC). Measurement is recorded as width x height (aka span x rise) of the inside of the box. RCBCs can be single or multi-barrel culverts, with sizes typically ranging from 3' x 3' to 14' x 14' in half foot increments. ABCs are single barrel structures with sizes ranging from 8'-9" x 2'-6" to 35'-5" x 13'-8". All box culverts require headwalls, which are typically concrete or metal. Some culverts may be three-sided (bottomless) due to environmental or constructibility reasons, such as fish passage or bedrock. These are typically found in the western part of the state.

Reinforced Concrete Box Culvert (RCBC)



RCBC Typical Section

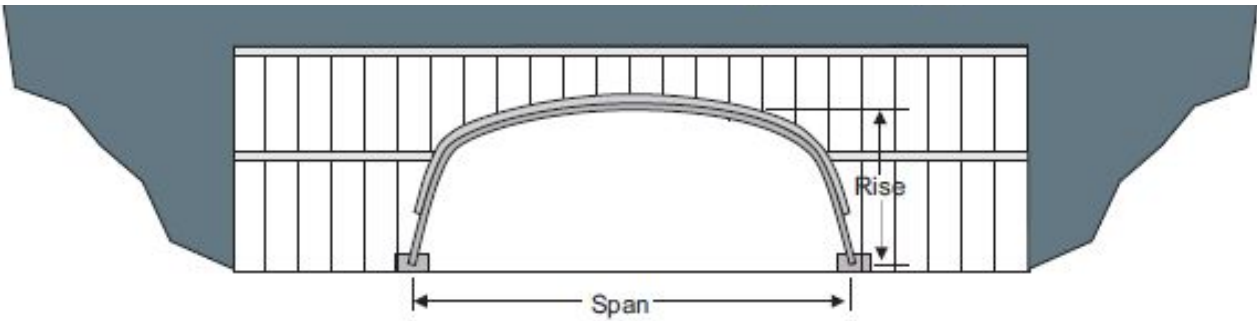


Single Barrel RCBC w/ Headwall



Dual Barrel RCBC with Headwall

Aluminum Box Culvert (ABC)



ABC Typical Section



ABC w/ Corrugated Metal Headwall

Bottomless Culverts



Bottomless CMPA Culverts with Stone Headwall (left) and Concrete Headwall (right)

Headwalls/Endwalls

Headwalls and endwalls are a culvert end option that improve hydraulic efficiency and/or provide structural support for the culvert. Headwalls are found at the inlet side of the pipe and endwalls are at the outlet side. They come in a variety of sizes, shapes, and configurations. As mentioned in the previous sections, the most common ones are concrete and metal.



Concrete Headwall with wing walls for RCP



Corrugated Metal Headwall for CMPA



Masonry Headwall with wing walls for Double Barrel RCP



Sandbag Endwall for CMPA (outlet)



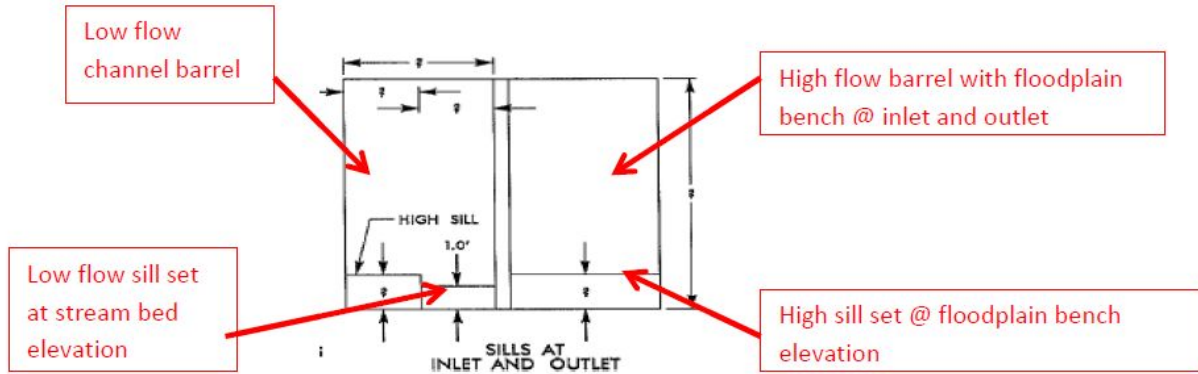
Timber Endwall for CMPA (outlet)



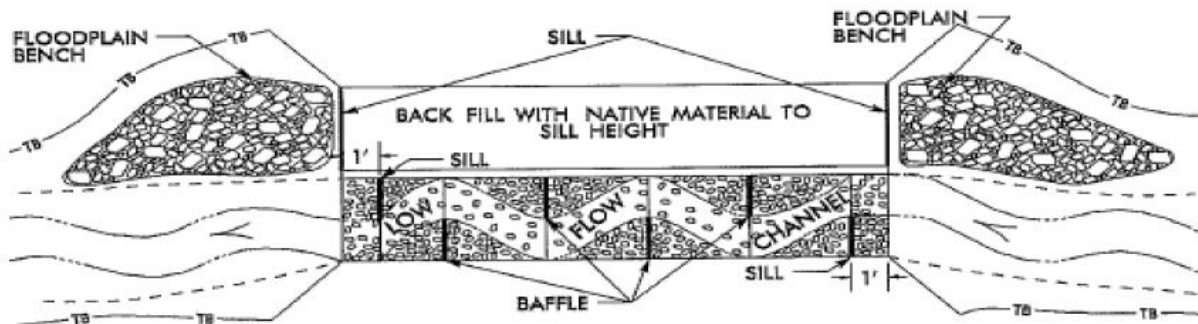
Stone Headwall for RCP

Sills and Baffles

Sills and baffles are vertical extensions attached to the culvert bottom that are used to help retain native material within the culvert. Sills are found at the inlet and outlet of the culvert while baffles are found along the interior of the culvert. Sills and baffles can be concrete or metal that may vary in size and shape.



Profile View of Box Culvert Inlet, featuring high and low flow sills



Top View of Culvert with Sills and Baffles



CMP with Metal Sills (at entrance) and Baffles (inside culvert)



Concrete Baffles in RCBC

Commonly Used Terms

Low-flow channel – one channel of a multiple barrel culvert may be installed at a lower elevation to ensure adequate fish passage during times of low-flow

Invert – bottom floor of the structure itself

Inlet/outlet – opposite ends of culvert. Water enters the culvert at the inlet and exits and the outlet. Inlet elevations are built higher than the outlet elevation to allow water to flow in the correct direction.

Upstream/downstream – water flows FROM upstream TO downstream

Bed-to-crown – difference in elevation between the lowest road elevation (above the culvert) and the upstream invert elevation, measured to the nearest tenth of a foot.

NBIS - National Bridge Inspection Standards. Any culvert that measures in excess of twenty feet wide along the roadway alignment is subject to NBIS regulatory inspection requirements by FHWA, and at NCDOT is assigned a six-digit inventory ID number.

Span – inside width of the culvert

Rise – inside height of the culvert

RCP – Reinforced Concrete Pipe

CMP – Corrugated Metal Pipe

CSP – Corrugated Steel Pipe

CAP – Corrugated Aluminum Pipe

CAAP - Corrugated Aluminum Alloy

CMPA – Corrugated Metal Pipe Arch

CSPA – Corrugated Steel Pipe Arch

CAPA – Corrugated Aluminum Pipe Arch

ABC – Aluminum Box Culvert

RCBC – Reinforced Concrete Box Culvert

Three-Sided Culvert – bottomless culvert typically put on footers or keyed into bedrock

Headwalls/Endwalls – Headwalls are found at the inlet side of the pipe and endwalls are at the outlet side.