

- Culvert; or
- Bridge.

Crossings will normally be done using a bridge for higher flows and deeper crossings or using a culvert. Culverts are discussed in Clause A5.2.1. Bridge crossings are described in Clause A5.2.2.

Culverts are hydraulically short conduits that convey runoff flow through a roadway embankment. Culverts are constructed from a variety of materials and are available in many different shapes and configurations. Culvert selection factors include roadway profiles, channel characteristics, flood damage evaluations, construction and maintenance costs, and estimates of service life.

Culverts and multiple barrel culverts shall meet the requirements listed in Section A5.2.1.1 and A5.2.1.2, regarding placement and sizing.

Decisions whether to use a bridge or a culvert, or multiple barrel culverts, shall be based on the best-value assessment when considering the impacts of the crossing opening on the channel flow and flood plain, scour effects, construction methods, public safety, and maintenance concerns.

Sizing of culvert and bridge openings is dependent on the waterway hydraulics regarding high water clearance, allowable upstream flooding depths, submergence of inlets, and scour effects.

This section provides a description of the constraints and criteria for crossing designs with a general discussion on the design methodology. It is recommended that the Design Engineer refer to specific references on bridge and culvert hydraulic design for a more detailed discussion on the engineering principles. Suggested references include the following:

- AustRoad publication Waterway Design: A Guide to the Hydraulic Design of Bridges, Culverts and Floodways (35); and
- FHWA publication HDS 5 Hydraulic Design of Highway Culverts (21)

A5.2.1. Culverts

A5.2.1.1. Culvert type

When selecting a culvert type, the following factors shall be considered:

- Application;
- Shape;
- Material; and
- End treatment.

These factors are discussed in detail below:

I. Application:

- For purposes of application, the following definitions apply:
 - c. Cross drain: Concrete box or pipe culvert placed transversely under the highway section, with end walls or some other end treatment.
 - d. Side drain: Culvert pipes that are used longitudinally to connect roadway ditches under driveways, ramps, or intersections. Same principles apply to side drains as for cross drains.
 - e. Median drain: Culvert pipe used to drain median ditches to the outside of roadway. Median end may be open or connected to a flush inlet structure.

II. Shape and material: