SECTION 5.9

STREAM ENCLOSURE/CROSSING CONSTRUCTION AND REPAIR

SECTION 5.9
STREAM CROSSING CONSTRUCTION AND REPAIR

Culverts, bridges, and fords/low water crossings are three common ways to span streams and ditches. While the scope of this manual does not provide actual construction guidelines or design specifications, it does provide a broad overview of factors to consider when contemplating one of the three practices.

Bridges are the most expensive structure to install, and are most often used for longer stretches over water too deep to accommodate culverts or fords/low water crossings. Bridges can be designed so that conveyance beneath the bridge is virtually unchanged. Culverts are much less expensive than bridges, and are more often used when conditions permit. Fords/low water crossings are usually used as temporary measures during construction. However, permanent fords/low water crossings may be appropriate in low traffic, rural areas.

The potential introduction of pollution into a channel is low for bridges and channels. There is a much higher potential at fords/low water crossings, as vehicles actually enter the channel.

Maintenance of properly-installed bridges and culverts is low. These structures are often protected with riprap to reduce scouring. Fords/low water crossings are much higher maintenance than bridges and culverts, and should be checked following major storm events for washouts and rock displacement.

Stream enclosures, also known as "long culverts", are often used in the headwater areas of many streams and ditches to convey runoff without disturbing the above ground land use. Guidelines provided in this section (Practice 901) as well as those presented in Section 5.2 should be consulted when such enclosures are being considered.

Last Print/Revision Date: October 13, 1996

PRACTICE 901
CULVERTS

DESCRIPTION

- Hydraulically short conduit which conveys flow through a roadway embankment, or through some other type of obstruction.

Exhibit 901a: Permanent Road Culvert (Source: CBBEL Files)

PURPOSE

- Provide a channel crossing with minimal impact to conveyance.

WHERE APPLICABLE

- When it is necessary to convey water under a roadway embankment or some other obstruction.

ADVANTAGES

- May allow for channel crossing with minimal impact to the environment or conveyance.
- Less expensive than a bridge.

CONSTRAINTS

- Improper design can cause upstream flooding.
- May increase velocity and cause downstream erosion problems.

DESIGN AND CONSTRUCTION GUIDELINES

Materials

- Concrete or corrugated metal pipe.
- Selection of materials should be based on structural strength, hydraulic roughness, durability, and corrosion and abrasion resistance.

Installation

- Varies with each project.
- Design permanent stream crossings in accordance with Indiana DOT standards and specifications, considering maximum loadings anticipated, safety, flow capacities, and other requirements for DOT installation approval. The local DOT can provide necessary guidance.
- Keep clearing and excavation of the streambanks and bed and approach sections to a minimum.
- Divert all surface water from the construction site onto undisturbed

areas adjoining the stream. Line unstable stream banks with riprap or otherwise appropriately stabilize them.

- Keep stream crossing at right angles to the stream flow.
- Align road approaches with the center line of the crossing for a minimum distance of 30 feet. Raise culvert fill a minimum of I ft above the adjoining approach sections to prevent erosion from surface runoff and to allow flood flows to pass around the structure.
- Ensure that bypass channels necessary to dewater the crossing site are stable before diverting the stream. Upon completion of the crossing, fill, compact, and stabilize the bypass channel appropriately.
- Install protective ground covers to provide permanent erosion protection and improve visual quality but not interfere with driver site distance from roadway.
- Ensure that permanent measures needed to control erosion from road water runoff (such as riprap and paved channels, paved flumes, or riprap outlet protection) meet all construction requirements for those practices.

Special Considerations

- Culvert capacities may be calculated using "Hydraulic Charts for the Selection of Highway Culverts" (Hydraulic Engineering Circular No. 5, 1965), and "Capacity Charts for the Design of Highway Culverts" (Hydraulic Engineering Circular No. 10, 1965). The appropriate charts are dictated by the parameters of roughness, slope, headwater depth, tailwater depth, length, and either inlet or outlet control.
- When replacing a culvert and/or changing its size, it is important to consider both upstream and downstream ramifications. Choosing a culvert that is too small may cause upstream flooding. Choosing a culvert that is much larger than an existing under-sized culvert, will reduce the storage caused by the existing, under-sized culvert and therefore may cause increased discharges downstream.

MAINTENANCE

- Inspect periodically and after major storms to check for channel blockage, erosion of abutments, channel degradation, riprap displacement, slope failure, and piping. Make all needed repairs immediately to prevent further damage to the installation.
- Most culvert maintenance problems occur at the outfall. See Activity 5.10 for Outlet Protection measures.

REFERENCES

Related Practices

- Practice 902 Bridges.
- Practice 903 Fords/Low Water Crossings.
- Activity 5.10 Outlet Protection.

Other Sources of Information

- HERPICC Stormwater Drainage Manual.
- BPR Hydraulic Engineering Circular 5.
- North Carolina Erosion Control Manual

Last Print/Revision Date: October 13, 1996

PRACTICE 902
BRIDGES

DESCRIPTION

- Structure carrying a path or road over a channel.

Exhibit 902a: A typical bridge (Source: NRCS Files)

PURPOSE

- To provide cross channel access.

WHERE APPLICABLE

- Any stream or ditch.

ADVANTAGES

- Allows channel crossing with minimal environmental impact.

CONSTRAINTS

- Expensive.
- Requires professional engineering.

DESIGN AND CONSTRUCTION GUIDELINES

Materials

- Varies with the type of project.

Installation

- Varies dramatically with each project.

Special Considerations

Practicality

- It is usually cheaper to install a culvert, pipe, or detour rather than a bridge. A bridge should be absolutely necessary.

Aesthetics

- Generally, bridges with long spans, shallow structure depth, and high columns are aesthetically pleasing. However, they are also expensive. Therefore: make spans as long as they need to be, use minimum vertical clearance, use open abutments, make structures as shallow as practical, and use single column supports if possible.

Preliminary Design

- Normal, skewed, or curved crossings will be dictated by the connections to other facilities. Normal crossings are cheapest and easiest to install.
- Approximate spans will be determined by the terrain, obstructions, required clearances, and assumed width of support.
- Wingwalls optimize bridge length.
- Vertical alignment will be determined on the basis of required clearance, depth for falsework, depth for structure and maximum allowable grades on approaches.
- Type selection is usually based upon required spans, available depth, permissibility of falsework use, length of construction season, and economy.
- Bridge opening size should be calculated based on appropriate hydraulic analysis to avoid upstream floodwater surcharge.

Economy

- In selecting for economy, consider short spans, low columns, liberal allowance for depth, open abutments, continuous spans, reinforced concrete, as well as simplicity of layout, structural concept and execution.

MAINTENANCE

- Erosion and scouring may occur around bridge abutments. See Exhibit 902b for plans for bridge scour protection.

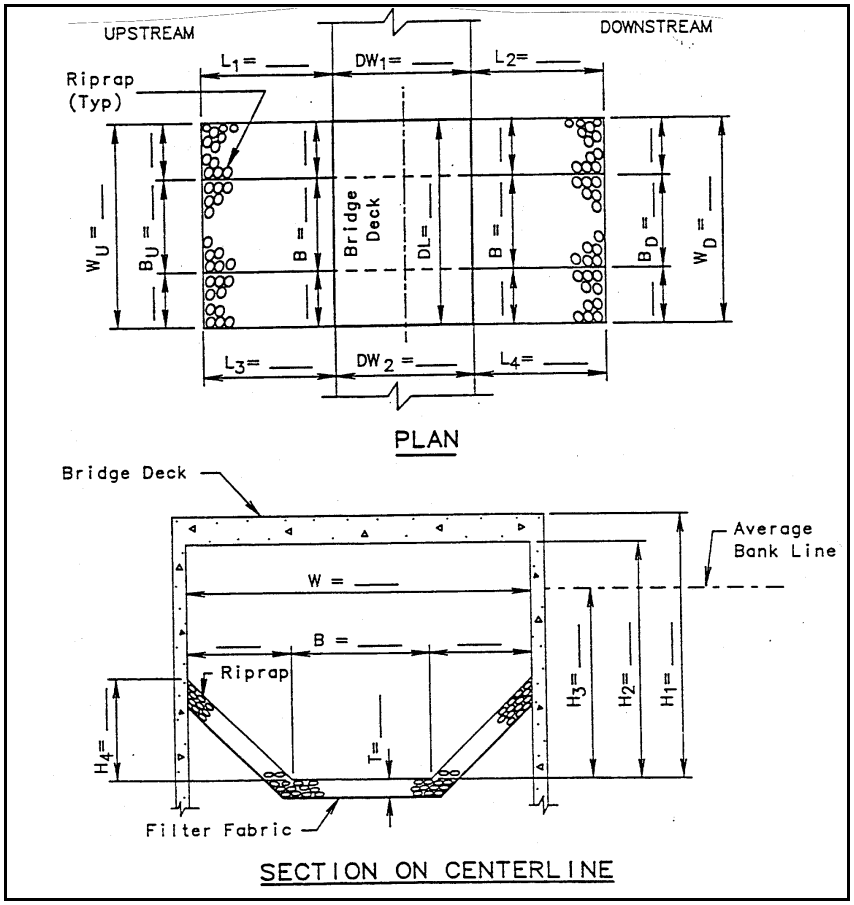

Exhibit 902b: Bridge scour protection plan (Source: NRCS Standard Specifications)

REFERENCES

Related Practices

- Practice 103 Temporary Wetland Crossing.
- Practice 104 Temporary Diversion.
- Practice 801 In-Channel Sediment Basin.

Other Sources of Information

- Indiana Erosion Control Handbook.
- Aesthetics of Bridges.
- Manual of Bridge Design.
- NRCS Standard Specifications.

Last Print/Revision Date: October 13, 1996

PRACTICE 903
FORDS/LOW WATER CROSSINGS

DESCRIPTION

- A ford or temporary structure installed across a stream or watercourse for short-term use by construction vehicles or heavy equipment (Note: this practice is also included in the Indiana Erosion Control Handbook).

Exhibit 903a: Fords/Low Water Crossings (Source: NRCS Files)

PURPOSE

- To provide a simple means for construction vehicles to cross channels.

WHERE APPLICABLE

- Where heavy equipment must be moved across a channel.

ADVANTAGES

- Allows channel crossing with minimal environmental impact.

CONSTRAINTS

- Drainage area should be less than 1 square mile.
- Anticipated life of crossing usually 1 year or less.
- Temporary diversions may be needed during construction.
- May temporarily increase erosion and flooding, if not installed properly.
- May be expensive to install.

- Source of a continuous downstream sediment movement.

DESIGN AND CONSTRUCTION GUIDELINES

Materials

- Riprap and geotextile fabric, culvert, or bridge abutments.

Installation

- Preconstruction
  1. Construct crossing when stream is low.
  2. Install crossing at right angle to the stream.
  3. Limit surface runoff by installing temporary diversion (Practice 104).
- Installing a Ford
  1. If necessary, install an in-channel sediment basin (practice 801) before preparing the approaches to the ford.
  2. Install temporary diversions in the road approach sections to divert surface runoff (Practice 104).
  3. Excavate and grade the approaches.
  4. Lay geotextile fabric for stabilization.
  5. Apply weather resistant stone over the fabric to a minimum depth of twice the specified D_{50}.

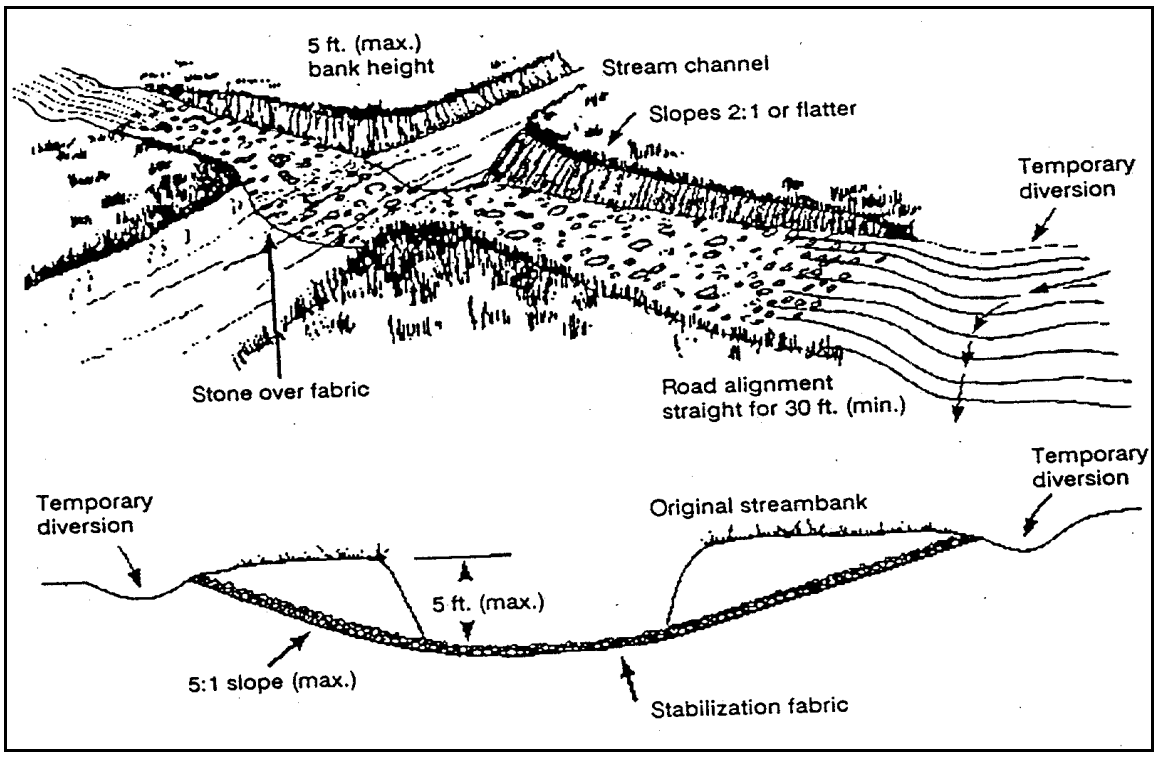

Exhibit 903b: A temporary ford of stone over geotextile fabric (Source: Indiana Erosion Control Handbook)

- Installing a Temporary Bridge or Culvert
  1. Elevate bridge abutments or culvert at least 1' above the adjoining streambank to allow storm overflow to bypass the structure without damage.
  2. Extend the culvert pipe beyond fill side slopes.
  3. Stabilize disturbed streambanks, fill slopes, and overflow and other disturbed areas.

Special Considerations

- Try to avoid stream crossings whenever possible.
- Bridges usually cause the least disturbance.
- Culverts may be the least expensive crossing to install.
- Fords are well suited for wide, shallow crossings.

MAINTENANCE

- Inspect periodically after storm events throughout the life the structure.
- All deficiencies should be repaired immediately.

REFERENCES

Related Practices

- Practice 103 Temporary Wetland Crossing.
- Practice 104 Temporary Diversion.
- Practice 801 In-Channel Sediment Basin.

Other Sources of Information

- Indiana Erosion Control Handbook.
- North Carolina Erosion Control Manual.
- NRCS Standard Specifications.

Last Print/Revision Date: October 13, 1996