STANDARD FOR STREAM CROSSING

Definition

A structural span installed across a watercourse to provide a travel way for vehicles or pedestrians. Temporary structures will be in place for no more than one year and shall be removed prior to completion of construction.

Purpose

A stream crossing is designed to provide access across a watercourse while reducing sediment delivery into the stream, minimizing damages to the streambed or channel, and avoiding flood damages.

Condition Where Practice Applies

This standard applies to temporary and permanent stream crossings. The temporary stream crossing shall be used to cross streams with drainage areas less than one square mile. Structures which must handle flow from larger drainage areas should be designed as permanent structures using generally accepted engineering practice. Complex sites requiring bridge scour studies are beyond the scope of this standard.

Water Quality Enhancement

Flow restrictions caused by stream crossings can increase velocity through the structure causing stream bed erosion and scour. Reducing flow velocity or protecting the stream bed can minimize erosion and sediment production. Crossings can minimize or prevent oils, greases and diesel fuels which become mixed with sediment during construction and after or which could wash off vehicles, from entering the watercourse. In addition, temporary crossings help to minimizing sediments which can be tracked into the stream during construction.

I. Temporary Crossings

Planning

Temporary stream crossings are necessary to prevent construction vehicles from damaging streambanks and tracking sediment and other pollutants into the watercourse. These structures are, however, undesirable in that they represent a channel restriction which can increase flooding upstream or washout during periods of high flow. Therefore, the temporary nature of the structure is stressed. The structure should be planned to be in service for the shortest practical period of time and to be removed as soon as their function has been completed.

This standard pertains primarily to flow capacity and resistance to washout of the structure. From a safety and utility standpoint, the designer must also be sure that the span is capable of withstanding the expected loadings from heavy construction equipment.

The preferred method for temporarily crossing a stream is a bridge made of wood, metal or other material which can provide access across the stream. A bridge causes the least amount of disturbance to the stream bed and banks. They can also be quickly removed and reused. In addition, temporary bridges pose the least chance for interference with fish passage and migration. The other method of temporarily crossing a stream is a culvert crossing consisting of stone and a section(s) of pipe. Temporary culverts are used where the channel is too wide for normal bridge construction or the anticipated loading of construction vehicles may prove unsafe for single span bridges. There is some disturbance to the stream bed and banks during construction and removal of the temporary culvert crossing. The stone, along with the temporary culverts, can be salvaged and reused.

Design Criteria

1. **Temporary Bridge**

a. Structures may be designed in various configurations and out of various materials. However, the bridge must be able to withstand the anticipated loading of the construction traffic. An example of a typical bridge crossing is shown in figure 31-1.

b. Crossing Alignment - The temporary stream crossing shall be at right angles to the stream. Where approach conditions dictate, the crossing may vary 15 degrees from a line drawn perpendicular to the center line of the stream at the intended crossing location.

c. The centerline of the roadway approaches on both sides of the crossing shall coincide with the crossing alignment centerline for a minimum of 50 feet from each bank of the stream crossed. If physical right-of-way restraints preclude the 50 feet minimum, a shorter distance may be provided.

d. A water diversion such as a dike or swale shall be constructed (across the roadway on both roadway approaches) 50 feet (maximum) on either side of the stream crossing. This will prevent roadway surface runoff from directly entering the stream. The 50 feet is measured from the top of the stream bank. If the roadway approach is constructed with a reverse grade away from the stream, a diverting structure is not required. See the Standard for Diversions, pg. 15-1, for roadbed diversions.

e. Perimeter soil erosion controls, such as a silt fence, must be employed, when necessary, along and parallel to the banks of stream.

f. All crossings shall have one traffic lane. The minimum width shall be 12 feet.

2. Temporary Culvert

a. Where culverts are installed, Use ASTM C-33, size No. 2 (2 ½ to 1 ½ in) Coarse Aggregate or larger will be used to form the crossing. The depth of stone cover over the culvert shall be a minimum of 12 inches or as recommended by the pipe manufacturer for the design loading. Rip-rap shall be used to protect the sides of the stone from erosion. Typical culvert details are presented in figure 31-2.

b. As a minimum, the culvert shall be designed to pass the flow from a 2-year frequency, 24 hour duration storm without overtopping. In addition the culvert shall be designed to ensure that no erosion will result from the 10-year peak storm.

c. Multiple culverts may be used in place of one large culvert if they have the equivalent capacity of the larger one. The minimum-sized culvert that may be used is 18 inches.

d. All culverts shall be strong enough to support their cross-sectioned area under maximum expected loads.

e. The length of the culvert shall be adequate to extend the full width of the crossing, including side slopes.

f. The slope of the culvert shall be at least 0.25 inch per foot.

g. Crossing Alignment - The temporary culvert crossing shall be at right angles to the stream. Where approach conditions dictate, the crossing may vary 15◦ from a line drawn perpendicular to the center line of the stream at the intended crossing location.

h. The centerline of the roadway approaches on both sides of the crossing shall coincide with the crossing alignment centerline for a minimum of 50 feet from each bank of the stream crossed. If physical right-of-way restraints preclude the 50 feet minimum, a shorter distance may be provided.

i. The approaches to the structure shall consist of stone pads meeting the following specifications:

- Stone: ASTM C-33, size No. 2 (2 ½ to 1 ½ in)
- Minimum thickness: 6 inches
- Minimum Width: equal to the width of the structure

j. A water diverting structure such as a dike or swale shall be constructed (across the roadway on both roadway approaches) 50 feet (maximum) on either side of the stream crossing. This will prevent roadway surface runoff from directly entering the stream. The 50 feet is measured from the top of the stream bank. If the roadway approach is constructed with a reverse grade away from the stream, a diverting structure is not required. See the Standard for Diversions, pg. 5-1 for roadbed diversions.

Construction Specifications

1. Temporary Bridge

a. Clearing and excavation of the stream bed and banks shall be kept to a minimum.

b. The temporary bridge structure shall be constructed at or above bank elevation to prevent the entrapment of floating materials and debris.

Abutments shall be placed parallel to and on stable banks.

c. Bridges shall be constructed to span the entire channel. If the channel width exceeds 8 feet (as measured from top-of-bank to top-of-bank), then a footing, pier or bridge support may be constructed within the waterway. One additional footing, pier or bridge support will be permitted for each additional 8-foot width of the channel. No footing, pier or bridge support, however, will be permitted within the channel for waterways which are less than 8 feet wide.

d. Stringers shall either be logs, sawn timber, prestressed concrete beams, metal beams, or other approved materials.

e. Decking materials shall be of sufficient strength to support the anticipated load. All decking members shall be placed perpendicular to the stringers, butted tightly. and securely fastened to the stringers. Decking materials must be butted tightly to prevent any soil material tracked onto the bridge from falling into the waterway below.

f. Run planking (optional) shall be securely fastened to the length of the span. One run plank shall be provided for each track of the equipment wheels. Although run planks are optional, they may be necessary to properly distribute loads.

g. Curbs or fenders may be installed along the outer sides of the deck. Curbs or fenders are an option which will provide additional safety.

h. Bridges shall be securely anchored at only one end using steel cable or chain. Anchoring at only one end will prevent channel obstruction in the event that floodwaters float the bridge. Acceptable anchors are large trees, large boulders, or driven steel anchors. Anchoring shall be sufficient to prevent the bridge from floating downstream and possibly causing an obstruction to the flow.

i. All areas disturbed during installation shall be stabilized within 7 calendar days of that disturbance.

j. When the temporary bridge is no longer needed, all structures including abutments and other bridging materials should be removed immediately.

k. Final clean-up shall consist of removal of the temporary bridge from the waterway, protection of banks from erosion, and removal of all construction materials. All removed materials shall be stored outside flood plain of the stream. Removal of the bridge and clean-up of the area shall be accomplished without construction equipment working in the waterway channel.

2. Temporary Culvert

a. Clearing and excavation of the stream bed and banks shall be kept to a minimum.

b. The invert elevation of the culvert shall be installed on the natural streambed grade to minimize interference with fish migration. In addition, no construction or removal of a temporary access culvert will be permitted during the following periods critical to spawning along such waters as identified in the Department of Environmental Protection's report entitled "Classification of New Jersey Waters as related to Their Suitability for Trout":

check updated trout production dates.

i. Brook Trout/Brown Trout Production Watercourses: September 15 through March 15 inclusive

ii. Rainbow Trout Production Watercourses: February 1 through April 30, inclusive

iii. Trout Production Watercourses: September 15 through March 15 inclusive

iv. Trout Stocked Watercourses, or within one mile upstream of Trout Stocked Watercourses and Trout Maintenance Watecourses: March 15 through June 15 inclusive.

Waivers of the timing restrictions may be granted if approved, in writing, by the Department of Environmental Protection's Division of Fish Game and Wildlife.

c. Filter cloth shall be placed on the streambed and streambanks prior to placement of the pipe culvert(s) and aggregate. The filter cloth shall cover the streambed and extend a minimum of six inches and a maximum of one foot beyond the end of the culvert and bedding material. Filter cloth reduces settlement and improves crossing stability. This requirement should not be confused with the installation of conduit outlet protection (item f. below).

d. The culvert(s) shall extend a minimum of one foot beyond the upstream and downstream toe of the aggregate placed around the culvert. In no case shall the culvert exceed 40 feet in length.

e. The culvert(s) shall be covered with a minimum of one foot of aggregate. If multiple culverts are used, they shall be separated by at least 12 inches of compacted aggregate fill. At a minimum, the bedding and fill material used in the construction of the temporary access culvert crossings shall conform with the aggregate requirements cited in part "i" under "Temporary Culvert Crossing."

f. The Standard for Conduit Outlet Protection (pg. 12-1) shall be addressed for the temporary culvert. The 10 year design storm peak flow shall be used for apron and stone sizing.

g. When the crossing has served its purpose, all structures including culverts, bedding and filter cloth materials shall be removed. Removal of the structure and clean-up of the area shall be accomplished without construction equipment working in the waterway channel.

h. Upon removal of the structure, the stream shall immediately be shaped to its original cross-section and properly stabilized. Restoration may include the application of Soil Bioengineering techniques where applicable. See the standard for Soil Bioengineering, pg. 28-1.

II. Permanent Crossings

Planning

This standard pertains primarily to flow capacity and resistance to washout of the structure. Planning, alignment, structural design and other considerations shall be in conformance with the appropriate municipal, county, state or federal requirements and regulations.

Where a natural stream bed is to be provided through the structure to benefit aquatic species, consideration shall be given to flow velocity and potential for bed erosion and scour. Where velocity exceeds the threshold for a stable condition, the need for lining of the stream bed, or use of conduits or box culverts, shall be evaluated.

Design

1. Permanent Culvert

a. Design criteria shall be as prescribed by the appropriate authority.

b. For natural stream bed designs:

Three (3) areas of concern should be must be considered for natural stream bed or three (3) sided "bottomless culvert" designs:

1. The corners and abutments of the Inlet section of the culvert
2. The barrel section of the culvert
3. The outlet or discharge section of the culvert

The Corners and Abutments of the Inlet Section of the Culvert:

Designs should avoid significant reductions in flow width transition from the approach channel to the inlet of the structure, which could cause abutment or contraction scour at the inlet. When it is determined that the potential for abutment or contraction scour exists at the inlet, the areas of concern shall be provided with a structural lining, such as riprap. See the Standard for Riprap and the Standard for Channel Stabilization.

The Barrel Section of the Culvert:

The potential for erosion through the structure shall be evaluated by comparing expected flow velocity against the allowable velocity for the soil texture found in the stream bed, see Standard for Channel Stabilization.

When the allowable velocity is exceeded, use of a channel lining, designed to withstand the expected velocity shall be incorporated, or the use of a conduit or box culvert, shall be considered.

Designs shall avoid abrupt changes in the flow profile through the barrel section of the culvert, which would cause a transition in the water surface profile from Super-Critical Flow to Sub-Critical Flow, creating a Hydraulic Jump.

The Outlet Section or the Discharge end of the Culvert:

If the structure causes a reduction in the design flow top width within the channel, and the outlet velocity exceeds the allowable velocity for the soil the culvert is discharging onto, as referenced in Table 12-1, the discharge end of the structure shall meet the Standard for Conduit Outlet Protection.

The upmost consideration shall be give to the protection of the structure.

Transition area riprap for areas disturbed adjacent to the culvert may be required as referenced within the Standard for Conduit Outlet Protection.

Measures to protect intrusion into the areas of the natural stream bed that are proposed to remain undisturbed, during construction shall be provided.

Construction Specifications

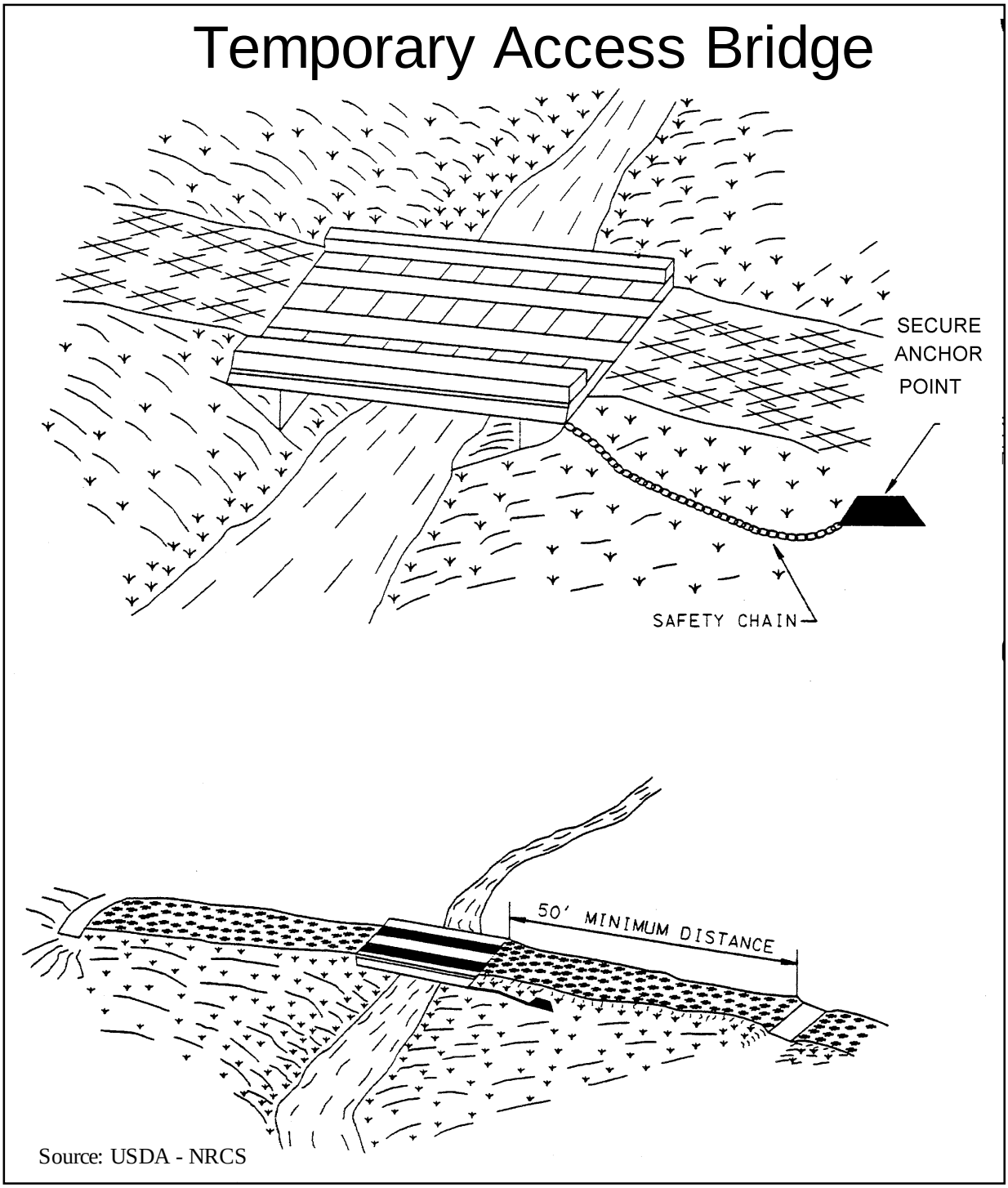
Permanent Crossings

Construction specifications for permanent crossings shall be as prescribed by the appropriate authority and shall be in compliance with all federal, state, and local regulations. All applicable standards, such as permanent vegetation, sediment barriers, land grading etc. shall be addressed when designing permanent crossings.

Maintenance

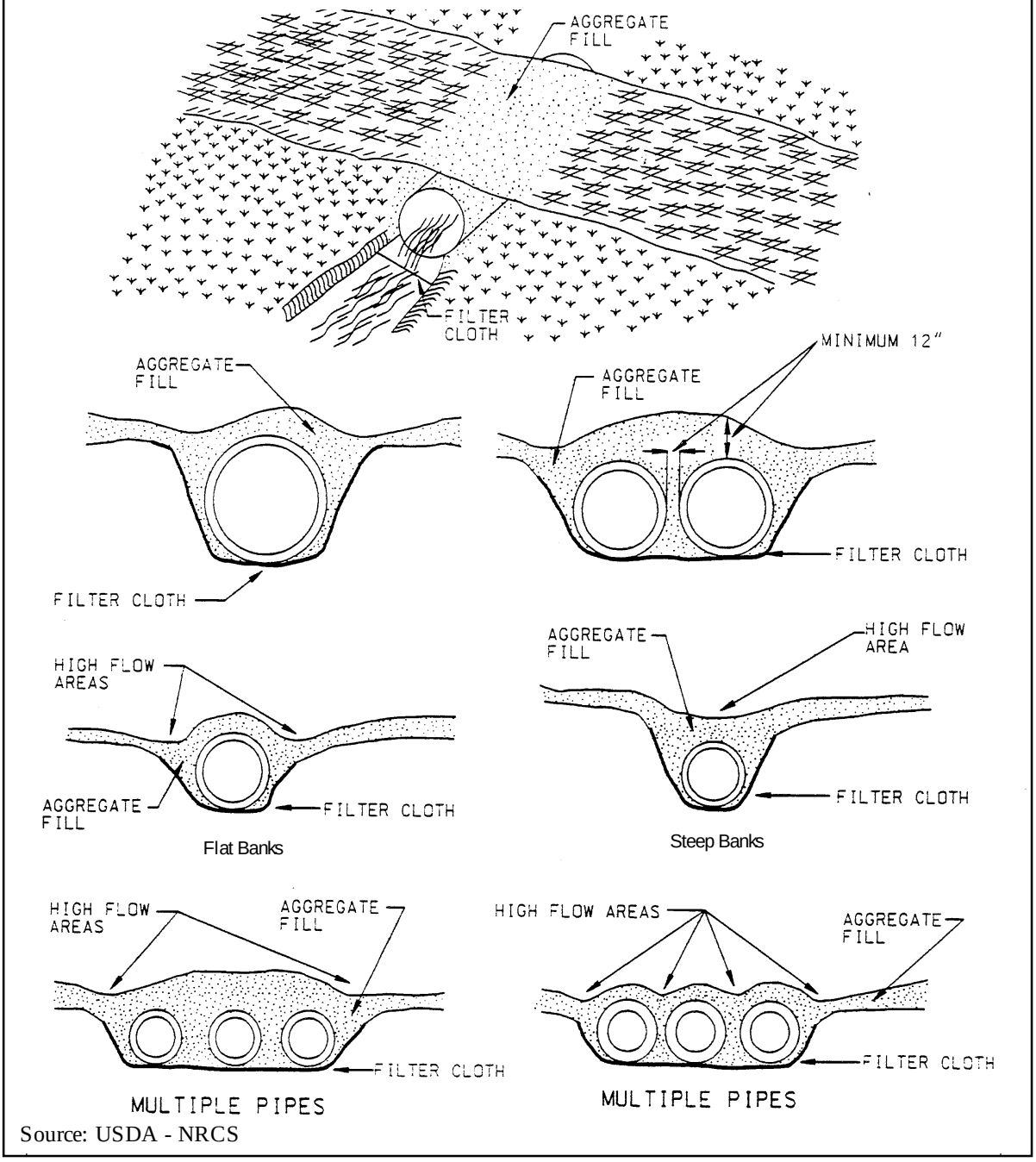
Temporary and permanent installations shall be inspected after every rainfall and at least once a week, whether it has rained or not, and all damages repaired immediately.

1Figure 31-1: Stream Crossing - Temporary Bridge



2Figure 31-2: Stream Crossing - Culvert Installation

Temporary Culvert Crossing



Source: USDA - NRCS