NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

STREAM CROSSING

(No.)

CODE 578

DEFINITION

A stabilized area or structure constructed across a stream to provide a travel way for people, livestock, equipment, or vehicles.

PURPOSE

- Improve water quality by reducing sediment, nutrient, organic, and inorganic loading of the stream.
- Reduce streambank and streambed erosion.
- Provide crossing for access to another land unit.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to all land uses where an intermittent or perennial watercourse exists and a ford ***(low water crossing),*** bridge, or culvert type crossing is desired for livestock, people, and /or equipment.

Where the concentration of livestock entering a stream is such that a structure is needed to protect the stream channel from degradation by controlling bank erosion, reducing sedimentation and application of animal manures this practice applies.

Relocation of existing crossings may be necessary to improve the stream water quality and/or access location.

FEDERAL, STATE and Local Laws

Design and construction activities shall comply with all federal, state, and local laws, rules, and regulations governing activities in or along streams, pollution abatement, health, and safety.

The owner or operator shall be responsible for securing all required permits or approvals and for performing all planned work in accordance with such laws and regulations. NRCS employees are not to assume responsibility for procuring these permits, rights, or approvals, or for enforcing laws and regulations. NRCS may provide the landowner or operator with technical information needed to obtain the required rights or approvals to construct, operate, and maintain the practice.

Permits may be required from the following agencies:

1. U.S. Army Corps of Engineers

2. WV Department of Natural Resources

3. WV Public Lands Corporation

4. US Fish and Wildlife Service

All contemplated projects and plans involving changes or alterations in any high quality stream and/or as defined in the current publication of "West Virginia High Quality Streams" shall be submitted to the Division of Natural Resources for review.

Work in "Waters of Special Concern" will require individual approval from WVDEP and/or WVDNR. Work in waters where

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there is a present or possible presence of endangered/threatened species require notification and collaboration with the USFWS.

CRITERIA

Location. Stream crossings shall be located in areas where the streambed is stable or where grade control can be provided to create a stable condition. Avoid sites where channel grade or alignment changes abruptly, excessive seepage or instability is evident, overfalls exist, or large tributaries enter the stream. Wetland areas shall be avoided if at all possible.

Locate crossings, where possible, out of shady riparian areas to discourage cattle loafing time in the stream.

Stream crossings shall provide a way for normal passage of water, fish and other aquatic animals within the channel during all seasons of the year.

The site selection for stream crossings shall be

- ***evaluated and designed to serve the planned land use.***
- ***stable for the expected livestock and/or vehicular traffic.***
- ***located at observed natural and/or most active crossing locations.***
- ***designed for a full bank crossing flow velocity.***
- ***installed preferably perpendicular to the stream centerline but in no case exceed 15 degrees angle from the perpendicular.***
- ***be installed away from and preferably downstream of culverts, water supply intakes, bridge piers or other obstructions.***
- ***selected so that the area surrounding the entrance ramps will be stable for the anticipated livestock or vehicular traffic and if this is not possible than additional stabilization material will be installed to assure stabilization of the banks and surrounding area.***

Type of Crossings

Stream Crossings may be either submerged crossings "fords", "low water culvert" crossings, culvert crossings or bridges. The primary factors in selecting the type are depth of channel and the need to provide access for livestock water. Ford crossings will be installed whenever site conditions will permit and when livestock water access is not needed. Narrow deep channels, greater than 4.0 feet in depth should be considered for culvert installation

Access Roads. Where high rates of erosion of the adjacent roadways that slope towards the crossing threaten to deliver an excessive amount of sediment to the drainage, install measures to minimize erosion of the roadside ditch, road surface, and/or cut slopes. Where the stream crossing is installed as part of a roadway, the crossing shall be in accordance with NRCS Conservation Practice Standard, Access Road (560).

Width. The stream crossing shall provide an adequate travel-way width for the intended use. A multi-use stream crossing shall have a travel-way no less than 10 feet wide. "Livestock only" crossings shall be no less than 6 feet wide. Width shall be measured from the upstream end to the downstream end of the stream crossing and shall not include the side slopes.

Side Slopes. All cuts and fills for the stream crossing shall have side slopes that are stable for the soil involved. Side slopes of earth cuts or fills shall be no steeper than 2 horizontal to 1 vertical. Rock cuts or fills shall be no steeper than 1.5 horizontal to 1 vertical.

Stream Approaches. Approaches to the stream crossing shall blend with existing site conditions where possible, and shall not be steeper than 4 horizontal to 1 vertical. Unless the foundation geology is otherwise acceptable, the approaches shall be stable, have a gradual ascent or descent grade, and be underlain with suitable material, as necessary, to withstand repeated and long term use. The minimum width of the approaches shall be equal to the width of the crossing surface.

Surface runoff shall be diverted around the approaches to prevent erosion of the

approaches. Roadside ditches shall be directed into a diversion or away from the crossing surface.

Rock. All rock shall be chosen to withstand exposure to air, water, freezing and thawing. When rock is used, it shall be sufficiently large and dense so that it is not mobilized by design flood flows.

Fencing. Areas adjacent to the stream crossing shall be permanently fenced or otherwise excluded as needed to manage livestock access to the crossing.

Cross-stream fencing at fords shall be accomplished with breakaway wire, swinging floodgates, hanging electrified chain or other devices to allow the passage of floodwater debris during high flows.

All fencing shall be designed and constructed in accordance with NRCS Conservation Practice Standard Fence (382).

Vegetation. All areas to be vegetated shall be planted as soon as practical after construction. When necessary, use of NRCS Conservation Practice Standard, Critical Area Planting (342) shall be considered where vegetation is unlikely to become established by natural regeneration, or acceleration of the recovery of vegetation is desired.

Crossings.

All crossings will be protected from undercutting. Provide a channel lining upstream and downstream of the structure or construct cutoff walls along the upstream and downstream edges of the crossing. Cutoff walls will extend a minimum of two feet or to bedrock, if less, below the stream bottom and laterally a minimum of 10 feet beyond both edges of the stream bottom. Cut off walls will be at least 12 inches wide for rock riprap and 8 inches wide for concrete.

Criteria for Culvert and Bridge Crossings

Design of culverts and bridges shall be consistent with sound engineering principles and shall be adequate for the use, type of road, or class of vehicle. Culverts and bridges shall have sufficient capacity to convey the design flow without appreciably altering the stream flow characteristics.

Culverts may be any of the types listed for principal spillway pipes in WV CPS Ponds (378). Culverts may be installed with a minimum of one foot of cover over the pipe. The downstream face of the fill and the stream channel, for a minimum length of 10 feet will be protected from erosion by installation of riprap or other protective measures.

Culverts shall be sized to handle at least the bankfull flow or the peak runoff from the 2-year, 24-hour peak discharge, whichever is less. Crossings shall be adequately protected so that out-of-bank flows safely bypass without structure or streambank damage, or erosion of the crossing fill. Additional culverts may be used at various elevations to maintain terrace or floodplain hydraulics.

The length of the culvert shall be adequate to extend the full width of the crossing, including side slopes. At least one culvert pipe shall be placed on or below grade with the existing stream bottom.

Acceptable culvert materials include concrete, corrugated metal, corrugated plastic, new or used high quality steel and other materials approved by the engineer.

Acceptable bridge materials include concrete, steel, and wood.

Addition Criteria for Low Water Culvert Crossings

Low water culvert crossings may be installed on 3000 acre watersheds or less if the following conditions are met.

- ***No potential damage to upstream or downstream areas may occur.***
- ***The minimum "low water crossing culvert" size for will be 18 inches in diameter, however, larger culverts should be considered as a means of reducing maintenance caused by debris collection.***
- ***The "low water culvert crossings" shall be sized to carry the lesser peak runoff, without overtopping the crossing, according to***
    - ***the 5-year, 24-hour peak discharge or***

- o ***drainage curve "A" in Exhibit 14 2.1 NEH Part 650, Engineering Field Handbook.***

- ***In some cases widening the stream may be necessary at the location of the culverts in order to install several culverts and maintain the water surface at acceptable levels.***
- ***The low water culvert crossing top and embankment surface shall be designed to remain stable during the 10-year, 24-hour peak discharge.***

Criteria for Ford Crossings

When ford crossings are used, the cross-sectional area of the crossing shall not be less than the natural channel cross-sectional area. A portion of the crossing shall be depressed at or below the average stream bottom elevation when needed to keep base flows or low flows concentrated.

Cutoff walls ***(footer)*** shall be provided at the upstream and downstream edges of ford-type stream crossings when needed to protect against undercutting.

The finished top surface of the ford type stream crossing in the bottom of the watercourse shall be no higher than the original stream bottom at the upstream edge of the ford crossing. ***The bottom of crossings shall have a length equal to the bottom width of the stream, but no less than four feet.***

If the downstream edge of the ford crossing is above the original stream bottom, the ford crossing shall be stabilized in accordance with NRCS Conservation Practice Standard Stream Channel Stabilization (584).

Where rock is used for-ford type stream crossings for livestock, use a hoof contact zone or alternative surfacing method over the surfacing rock.

Concrete Fords

Concrete ford crossings shall be used only where the foundation of the stream crossing is determined to have adequate bearing strength. Concrete shall have a minimum compressive strength of 3,000 psi at 28 days, type 1 or 1A cement and aggregates meeting the requirements of ASTM C33. Concrete ford crossings shall have a minimum thickness of placed concrete of 5 inches with minimum reinforcement of 6-inch by 6-inch, 6 gauge welded wire fabric ***and be designed to have the flexibility and strength to resist the pressures created by freezing and thawing.*** The concrete slab shall be poured on a minimum 4-inch thick rock base ***(#57 or #67 ASTM 33 aggregate)***, unless the foundation is otherwise acceptable. ***Geotextile fabric will be a pervious sheet of woven or non-woven fabric meeting the requirements of Class IV fabric in NEH 20 Specification, 95 Geotextile or WV 700 series specification 746, Geotextiles. The perimeter of the fabric will be anchored in trenches at least 6 inches deep and 6 inches wide.***

Precast concrete panels may be used in lieu of cast-in-place concrete slabs. Precast concrete units shall comply with ACI 525 or 533, or as otherwise acceptable for local conditions.

When heavy equipment loads are anticipated, the concrete slab shall be designed using an appropriate procedure as described in American Concrete Institute, ACI 360, Design of Slabs on Grade.

On streams with bank full flow velocities of 5 feet per second or greater, or where a portion of the finished surface of the ford crossing will be above the stream bed the State Conservation Engineer shall approve the final design. The surface crossing will be covered with a stable material like concrete, pre-cast paving units, or cellular matrix confinement grids filled with gravel or concrete.

Waste concrete from pavement repair is not a suitable material.

Geocell and/or Rock Ford Crossings

Rock ford crossings with geotextile shall be used when the site has a soft or unstable subgrade. Ford crossings made of stabilizing material such as rock riprap are often used in steep areas subject to flash flooding, where normal flow is shallow or intermittent.

The bed of the channel shall be excavated to the necessary depth and width and covered with geotextile material. The geotextile material shall be installed on the excavated surface of the ford and shall extend across the bottom of the stream and at least up to the 10-year, 24-hour peak discharge elevation. ***Geotextile fabric will be a pervious sheet of woven or non-woven fabric meeting the requirements of Class IV fabric in NEH 20 Specification, 95 Geotextile or WV 700 series specification 746, Geotextiles. The perimeter of the fabric will be anchored in trenches at least 6 inches deep and 6 inches wide.***

The geotextile material shall be covered with at least 6 inches of crushed rock. The perimeter of the fabric will be anchored in trenches at least six inches deep and six inches wide.

If using geocells, the cells shall be at least 6 inches deep. All geosynthetic material shall be suitably durable and shall be installed in accordance with the manufacturer's recommendations, including the use of staples, clips and anchor pins.

At minimum, all rock ford stream crossings shall be designed to remain stable during the 10-year, 24-hour peak discharge.

On streams with bank full flow velocities of 5 feet per second or less and where the finished surface of the crossing will be flush with the stream bed, the crossing can be topped with coarse aggregate (ASTM C33 or D448). The specific gradation will be such that the maximum size stone will be the diameter determined from 210-vi-EFH-Dec. '96, Appendix 16A, Fig. 16 A-1 "Rock size based on Isbash Curve". The thickness for the coarse aggregate layer will be two inches or equal to the maximum stone size, whichever is greater. When very coarse aggregates (size 1, 2, 3, 4 or 24) are required, the top one inch to one and one-half inch of the layer may be mixed with a finer aggregate (size 6, 7, 67, or 68) to create a smoother waking surface for livestock and to prevent the gravel from "rolling" under wheel traffic.

When crossings are designed with coarse aggregate topping, the O&M Plan will address the possible need to replace some or all of the aggregate after high flows.

CONSIDERATIONS

Avoid or minimize stream crossings, when possible, through evaluation of alternative trail or travel-way locations.

Ford crossings have the least detrimental impact on water quality when crossing is infrequent. Ford crossings are adapted for crossing wide, shallow watercourses with firm streambeds.

Stream crossings should be located where adverse environmental impacts will be minimized and considering the following:

- Effects on up-stream and down-stream flow conditions that could result in increases in erosion, deposition, or flooding.
- Short term and construction-related effects on water quality.
- Effects on fish passage and wildlife habitats.
- Effects on cultural resources.
- Overall effect on erosion and sedimentation that will be caused by the installation of the crossing and any necessary stream diversion.

Where stream crossings are used, evaluate the need for safety measures such as guardrails at culvert or bridge crossing, or water depth signage at ford crossings.

PLANS AND SPECIFICATIONS

Plans and specifications for stream crossings shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose.

REFERENCES

- NRCS National Engineering Manual (NEM).
- NRCS National Environmental Compliance Handbook
- NRCS Cultural Resources Handbook

- ***210-VI-EFH Amend. 45, WV5 Preparation of Engineering Plans***
- ***210-V-NEM Part 505 – Non-NRCS Engineering Services***
- ***WV Engineering Field Handbook***
- ***FOTG Section II and IV***
- ***"West Virginia High Quality Streams"***

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OPERATION AND MAINTENANCE

An operation and maintenance plan shall be developed and implemented for the life of the practice.

The stream crossing, appurtenances, and associated fence should be inspected after each major storm event, with repairs made as needed.

NRCS, NHCP
December, 2003

NRCS, WV
May, 2006

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Stream Crossing

Instructions for Use of Construction Specification 578

Minimum items to be included in the Construction Specification and Drawings:

1. **Plan View**
2. **Typical cross sections; before and after**
3. **Drainage Area**
4. **Benchmarks, baselines, stations, north arrow, horizontal and vertical datum**
5. **Logs of Soils (as needed)**
6. **Profile(s) of stream; before and after**
7. **Size, type and location of each treatment**
8. **Natural features, structural details, source or manufacturer of all materials, including vegetation and erosion control measures.**
9. **Details of concrete, riprap, etc. in inlet and outlet structure**
10. **Apparent property lines, utility information and owners**
11. **Method and location of debris removal (e.g. burn, spread, spoil)**
12. **Access**
13. **Temporary realignment location**
14. **Location of existing natural or cultural features**
15. **Permits**
16. **Miss Utility- Call Before you Dig 1-800-245-4848**

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Stream Crossing

General Design and Construction Checklist

Survey

_____ **Set benchmark**

_____ **Profile of stream**

_____ **Cross sections of stream**

_____ **random shots necessary for plan view map**

Design Data

_____ **Soil type at installation**

_____ **Plan view:**

- _____ **Location of treatment/s, including planting areas**
- _____ **Location of borrow areas/s if onsite or note otherwise**
- _____ **Location of disposal area/s**
- _____ **Location of 100 yr. and/or 25 yr. flood elevation**
- _____ **Apparent property lines**

_____ **Cross-sections; before and after construction**

_____ **Determine type and size of each structural and vegetative treatment**

_____ **Velocities, water surface profiles, and other geomorphic parameters as required**

_____ **Determine quantities and cost estimate**

_____ **Specifications**

_____ **Comply with Miss Utility**

_____ **Provide data and permit validation**

Construction Checks

_____ **Final cross-sections**

_____ **Structural treatments as specified**

_____ **Plant material certifications and installations**

_____ **Final quantities**

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CONSTRUCTION SPECIFICATIONS
WEST VIRGINIA
STREAM CROSSING

The crossing or access will be installed at the location and in the manner shown on the drawings and described in this specification.

Construction shall be done in such a way that chemicals, fuels, lubricants, and waste materials will not enter the flow area. Erosion, air pollution, and water pollution will be minimized and held within legal limits.

Measures and construction methods that enhance fish and wildlife values and those for erosion and sediment control shall be incorporated as shown on the drawings. In addition, the following methods or practices will be utilized to the degree possible in the construction of the crossing or access, to reduce the potential for sedimentation of the stream:

1. Divert the stream flow to one side of the channel while construction is done on the opposite side. Or, where possible, temporarily dam the channel and pipe or pump the stream flow past the construction area.

2. Perform construction activities from the bank as much as possible. Use backhoes or excavators instead of dozers and use rubber tired equipment when construction activity must be conducted in the water.

3. Build the crossing or access during the time of year when high flows are not expected and do not build the crossing or access during fish spawning season.

4. Haul all excavated material to the appropriate disposal area, grade, and seed and mulch the material as soon as possible.

When required, all trees, shrubs, brush, and debris within the construction limits will be cleared and grubbed to a depth that will permit installation of the crossing or access ramp. All materials will be burned, buried, or piled in designated disposal areas. The clearing operation will be conducted in a manner to avoid damage to vegetation or property outside the work area and to prevent disturbance within the stream. Special attention will be given to protecting and maintaining key shade , food, and den trees when their removal is not necessary.

Excavation of the crossing or access will be completed to the line and grade shown on the drawings. All excavated material will be removed from the limits of the channel and hauled to designated waste disposal areas. If no disposal areas are designated, the excavated material will be utilized to shape the entrance areas to the crossing or ramp to provide free drainage and stability to the areas.

The bottom of excavations will be smoothed to prevent damage to the geotextile fabric. All large rocks, depressions or protruding items will be removed or filled with gravel. Geotextile fabric, of the type and grade shown on the drawings, will be laid on the finished surface in a loose fashion to allow for some movement during placement of riprap and during settlement after construction. When laps are needed in the geotextile, the two pieces of material will overlap by at least three feet. Laps will be such that the upstream or upslope panel of material is over top of the downstream or downslope panel. Repair of damaged fabric can be made by placing another piece of fabric over the damaged area. The repair panel will extend at least three ft. outside of the damaged area in all directions. The geotextile fabric will be anchored with 6 in. wire staples, on 3 ft. minimum centers, at the edges and at all laps to prevent displacement during riprap installation.

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Geotextile fabric will be protected from damage or deterioration from ultraviolet sun rays. Fabric that is damaged or shows signs of deterioration because of improper storage and protection from the sun will not be used. Fabric that is brought on site will be stored in a safe, dry, shaded location. The manufacturers protective cover will be left in place until the fabric is to be used. If the manufacturers cover is not available then the fabric will be protected by covering with dark plastic or a tarp. Fabric installed in the crossing or access will be covered with riprap and gravel within 24 hours of installation.

Rock riprap shall be limestone or sandstone and will be well graded within the limits shown on the drawings. It will be dense, sound, and free from, cracks, seams, and other defects conducive to accelerated weathering. The rock fragments shall be angular to sub-rounded in shape. The least dimension of an individual rock fragment shall be not less than one-third the greatest dimension of the fragment.

The riprap shall be placed to the required thickness in one operation. Riprap will be dumped on the geotextile with a drop of no more than three ft. and will not be pushed or rolled across the fabric. The rock will be delivered and placed in a manner that will insure the riprap in place will be reasonably homogeneous with the larger rocks uniformly distributed and firmly in contact one to another with the smaller rocks filling the voids between the larger rocks.

Coarse aggregate surfacing material will be hard, durable limestone or sandstone aggregates meeting the grading limits shown on the drawings. It will be placed to the required thickness in one operation and in such a manner that segregation of the particle sizes will not occur. After placement the aggregate will be consolidated by traversing the entire surface of the crossing or ramp with four passes of the construction equipment.