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

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

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to all land uses where an intermittent or perennial watercourse exists and a ford, bridge, or culvert type crossing is needed.

CRITERIA

General Criteria Applicable to All Purposes

Treatments shall be in accordance with all applicable local, state and federal laws and regulations governing activities in or along streams, pollution abatement, health, and safety.

Federal, State and Local Laws and Permits

Permits may be required from the following agencies:

- ***U.S. Army Corps of Engineers (USACE).***
- ***WV Department of Natural Resources (WVDNR) – Public Land Corporation (PLC) – Stream Access Application***
- ***West Virginia Department of Environmental Protection (WVDEP) – Division of Water and Waste Management (DWWM)***
  - ***Dam Safety (Non-Coal)***
  - ***Stormwater Program***
- ***WV Department of Agriculture (WVDA)***
- ***WV Public Lands Corporation (WVPLC)***
- ***US Fish and Wildlife Service (USFWS)***
- ***WV Division of Forestry (WVDOF)***
- ***Local, state and county ordinances***

If applicable, proposed projects must comply with the West Virginia State Water Quality Standards including the Antidegradation Implementation Rule. Permits or licenses issued by a federal agency (such as the USACE) may require a WVDEP Section 401 Water Quality Certification to ensure that projects will not violate the state's water quality standards or stream designated uses.

Work in waters where there is a presence or possible presence of threatened/endangered species requires notification and collaboration with the USFWS.

The owner or operator is responsible for securing all permits or approvals and for performing in accordance with such laws and regulations. NRCS employees do not procure permits, rights, or approvals, or enforce laws and regulations. NRCS may provide the landowner or operator with

Conservation practice standards are reviewed periodically and updated if needed. To obtain the current version of this standard, contact your Natural Resources Conservation Service State Office or visit the Field Office Technical Guide.
Note: Text in bold italics indicates information added or changed by WV.

technical information needed to obtain the required rights (or approvals) to construct, operate, and maintain the practice.

Obtain all required permits before starting construction.

Apply this standard in accordance with all local, State, Tribal, and Federal regulations, including flood plain regulations and flowage easements.

Identify significant cultural resources or threatened or endangered species that could be affected by the implementation of the practice.

Location. Locate stream crossings in areas where the streambed is stable or where it can be stabilized (see NRCS Conservation Practice Standard, Channel Bed Stabilization, Code 584). Do not place crossings where channel grade or alignment changes abruptly, excessive seepage or instability is evident, overfalls exist (evidence of incision and bed instability), where large tributaries enter the stream, or within 300 feet of known spawning areas of listed species. ***Do not place stream crossings in meander bend pools.*** Avoid wetland areas.

Discourage livestock loafing in the stream by locating crossings, where possible, out of shady riparian areas or by including gates in the design.

Install stream crossings perpendicular to the direction of stream flow where possible. Fully consider the natural lateral migration pattern of the stream in the design. Avoid skews on all but the smallest streams.

Access Roads. Where the stream crossing is installed as part of a roadway, size the crossing according to NRCS Conservation Practice Standard, Access Road, Code 560.

Width. Provide an adequate travel-way width for the intended use. Make “livestock- only” crossings no less than 6 feet wide and no more than 30 feet wide, as measured from the upstream end to the downstream end of the stream crossing, not including the side slopes.

Side Slopes. Make all side slope cuts and fills stable for the channel materials involved. Make the side slopes of cuts or fills in soil materials no steeper than 2 horizontal to 1 vertical (2:1). Make rock cuts or fills no steeper than 1.5 horizontal to 1 vertical (1.5:1).

Stream Approaches. Blend approaches to the stream crossing with existing site conditions, where possible. Use streambank soil bioengineering practices ***and/or natural stream design techniques*** as appropriate and feasible. Make the approaches stable, with gradual ascent and descent grades which are not steeper than 4 horizontal to 1 vertical (4:1), and of suitable material to withstand repeated and long term use. Make the minimum width of the approaches equal to the width of the crossing surface.

Divert surface runoff around the approaches to prevent erosion. Direct roadside ditches into a diversion or away from the crossing surface.

Configure the crossing approaches (gradient and curves) to properly accommodate the length and turning radii of vehicles using the crossing.

Rock. All rock must be able to withstand exposure to air, water, freezing, and thawing. Use rock of sufficient size and density to resist mobilization by design flood flows.

Use appropriate rock sizes to accommodate the intended traffic without damage to the livestock, people, or vehicles using the crossing.

Fencing. Exclude livestock access to the crossing through the use of fence and gates, as needed.

Install cross-stream fencing at fords, with breakaway wire, swinging floodgates, hanging electrified chain, or other devices to allow the passage of floodwater and large woody material during high flows.

Design and construct all fencing in accordance with NRCS Conservation Practice Standard, Fence, Code 382.

Vegetation. Plant all areas to be vegetated as soon as practical after construction. If completion does not coincide with appropriate planting dates for permanent cover, use a cover of temporary vegetation to protect the site until permanent cover can be established. Native or functioning-as-native plant species are preferred. Use NRCS Conservation Practice Standard, Critical Area Planting, Code 342, where vegetation is unlikely to become established by natural regeneration, or where acceleration of the recovery of vegetation is desired.

In areas where the vegetation may not survive, use NRCS Conservation Practice Standard, Heavy Use Area Protection, Code 561.

Bridge Crossings

Design bridges in a manner that is consistent with sound engineering principles and adequate for the use, type of road, or class of vehicle. Design bridges with sufficient capacity to convey the design flow and transported material without appreciably altering the stream flow characteristics. Design bridges to fully span the stream, passing at least the bankfull flow where the design flow is not dictated by regulation.

Bankfull flow is the discharge that fills a stream channel up to the elevation at which flow begins to spill onto the floodplain.

Adequately protect bridges protected so that out-of-bank flows safely bypass without damaging the ***bridge*** ~~culvert~~ or eroding the banks.

Vehicle and pedestrian bridges must be designed in accordance with the current American Association of State Highway and Transportation Officials Load and Resistance Factor Design (LRFD) bridge design specifications (AASHTO, 2010).

Evaluate the need for safety measures such as guardrails and reflectors at bridge crossings.

Acceptable bridge materials include concrete, steel, and wood.

Culvert Crossings

Design culverts in a manner that is consistent with sound engineering principles and adequate for the use, type of road, or class of vehicle. For culverts associated with a road, culvert design flow shall meet the criteria in NRCS Conservation Practice Standard, Access Road, Code 560. The design flow for culverts not associated with a road will be the 2-year, 24-hour storm discharge, or bankfull flow, whichever is less. Design culverts with sufficient capacity to convey the design flow and transported material without appreciably altering the stream flow characteristics. ***The minimum diameter of culvert shall be 18 inches.***

Design culverts to minimize habitat fragmentation and to minimize barriers to aquatic organism movement.

Do not use culverts where large flows of sediment or large woody material are expected, or where the channel gradient exceeds 6 percent (100 horizontal to 6 vertical).

Evaluate the need for safety measures such as guardrails at culvert crossings.

Crossings shall be adequately protected so that out-of-bank flows safely bypass without damaging the structure or eroding the streambanks or the crossing fill.

At least one culvert pipe shall be placed with its entire length set six inches below the existing stream bottom. Additional culverts may be used at various elevations to maintain terrace or floodplain hydraulics and water surface elevations.

Make the barrel length of the culvert adequate to extend the full width of the crossing, including side slopes, and inlet or outlet extensions.

Acceptable culvert materials include concrete, corrugated metal, corrugated plastic, new or used high quality steel, and any other materials that meet the requirements of NRCS Conservation Practice Standard, Structure for Water Control, Code 587.

Ford Crossings

The following criteria apply to all ford crossings:

Make the cross-sectional area of the crossing equal to or greater than the natural channel cross-sectional area. Make a portion of the crossing depressed at or below the average stream bottom elevation ~~when needed~~ to keep base flows or low flows concentrated.

Match ford shape to the channel cross-section to the extent possible.

Provide cutoff walls at the upstream and downstream edges of ford-type stream crossings when needed to protect against undercutting.

Evaluate the need for water depth signage at ford crossings.

To the extent possible, the top surface of the ford crossing shall follow the contours of the stream bottom but in no case shall the top surface of the ford crossing be higher than 0.5 foot above the original stream bottom at the upstream edge of the ford crossing.

Make the downstream edge of the ford crossing with a low-flow hydraulic drop less than 0.5 foot above the original stream bottom.

Concrete Fords

Use concrete ford crossings only where the foundation of the stream crossing is determined to have adequate bearing strength.

Use concrete with a minimum compressive strength of 3,000 psi at 28 days, with a ratio of water to cementitious materials of 0.50 or less. Use coarse aggregate of 0.75 to 1 inch nominal size. If designed for freezing conditions, use concrete with 4 to 8 percent air-entrainment.

Use a minimum thickness of 5 inches of placed concrete. Pour the concrete slab on a minimum 4-inch thick gravel base, unless the foundation is otherwise acceptable.

Construct toe-walls at the upstream and downstream ends of the crossing. Make the toe-walls a minimum of 6 inches thick and 18 inches deep. Extend the toe-walls in the stream approaches to the bankfull flow elevation.

Precast concrete panels may be used in lieu of cast-in-place concrete slabs. To the extent possible, the panels shall follow the contours of the stream bottom in order to avoid potential problems with sediment accumulation. Use concrete units that have adequate reinforcement for transportation and placement.

Dewatering of the site and toe-walls is required during placement of the concrete to maintain the proper water/cement ratio. Flowing water will erode concrete that is not sufficiently hardened. The stream must be diverted or retained from flowing over the concrete for at least 12 hours after placement of the concrete.

During construction, aquatic species must be removed from the construction area according to State protocols.

Rock Fords and the Use of Geosynthetics

Coarse aggregate or crushed rock ford crossings are often used in steep areas subject to flash flooding and where normal flow is shallow or intermittent. When the site has a soft or unstable subgrade, use geotextiles in the design of rock ford crossings.

Dewater and excavate the bed of the channel to the necessary depth and width and cover with geotextile material. Install the geotextile material on the excavated surface of the ford and extend it across the bottom of the stream and at least up to the bankfull flow elevation.

Cover the geotextile material with at least 6 inches of crushed rock. Use minimum 6-inch deep geocells, if geocells are used. Use durable geosynthetic materials and install them according to the manufacturer's recommendations, including the use of staples, clips, and anchor pins.

Design all rock ford stream crossings to remain stable for the bankfull flow. Compute channel velocities and choose rock size using procedures in NEH630; NEH654 TS14N; and EFH Chapter 16 (NEH650), Appendix 16A, or other procedures approved by the State Conservation Engineer.

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

CONSIDERATIONS

Avoid or minimize the use of or number of stream crossings, when possible, through evaluation of alternative trail or travel-way locations. Assess landuser operations to consolidate and minimize the number of crossings. Where feasible, use existing roads.

Evaluate proposed crossing sites for variations in stage and discharge, tidal influence, hydraulics, fluvial geomorphic impacts, sediment transport and flow continuity, groundwater conditions, and movement of woody and organic material. Increase crossing width or span to accommodate transport of large woody material in the flow. Design passage features to account for the known range of variation.

For culvert crossings, consider incorporating natural streambed substrates throughout the culvert length for passage of aquatic organisms (see Bunt and Abt, 2001, for sampling procedures). Natural streambeds provide passage and habitat benefits to many life stage requirements for aquatic organisms and may reduce maintenance costs.

Consider all life stages of aquatic organisms in the stream crossing design to accommodate their passage, in accordance with the species'

requirements. Design criteria are available in NEH Part 654, Technical Supplement 14N, Fish Passage and Screening Design; U.S Forest Service low-water design guidance (USFS, 2006); and stream simulation guidance (USFS,2008). Each State also has specific design criteria for culverts and stream crossings (e.g., MassDOT, 2010). See also Harrelson, et al. 1994, for stream reference site descriptions.

Where a stream crossing is installed to remove an existing barrier to the passage of aquatic organisms, consider using NRCS Conservation Practice Standard, Aquatic Organism Passage, Code 396.

Consider relevant aquatic organisms in the design and location of crossings to improve or provide passage for as many different aquatic species and age classes as possible.

Consider the habitat requirements of other aquatic or terrestrial species that may be affected by construction of a stream crossing. For example, a crossing may be designed with features that also promote safe crossing by terrestrial vertebrates.

Ford crossings have the least detrimental impact on water quality when their use is infrequent. Ford crossings are adapted for crossing wide, shallow watercourses with firm streambeds. If the stream crossing is to be used frequently, or daily, as in a dairy operation, a culvert crossing or curbed bridge should be used, rather than a ford crossing.

Locate stream crossings to avoid adverse environmental impacts and consider the following:

- Effects on upstream and downstream flow conditions that could result in increases in erosion, deposition, or flooding. Consider habitat upstream and downstream of the crossing to avoid fragmentation of aquatic and riparian habitats.
- Short-term and construction-related effects on water quality.
- Overall effect on erosion and sedimentation that will be caused by the installation of the crossing and any necessary stream diversion.
- Effects of large woody material on the operation and overall design of the crossing.
- Consider adding a well-graded rock riprap apron on the downstream edge of concrete crossings to dissipate flow energy.
- Ford crossings should not be placed immediately downstream from a pipe or culvert because of potential damage from localized high velocity flows.

PLANS AND SPECIFICATIONS

Prepare plans and specifications for stream crossings in keeping with this standard. The plans and specifications must clearly describe the requirements for applying the practice to achieve its intended purpose.

As a minimum, include the following in plans and specifications:

- Location of stream crossing.
- Stream crossing width and length with profile and typical cross sections.
- Design grades or slopes of stream approaches.
- Design flow calculations.
- Thickness, gradation, quantities, and type of rock or stone.
- Type, dimensions, and anchoring requirements of geotextile.
- Thickness, compressive strength, reinforcement and other special requirements for concrete, if used.
- Vegetative requirements that include seed and plant materials to be used, establishment rates, and season of planting.
- Location, type, and extent of fencing required.
- Method of surface water diversion and dewatering during construction.
- Location of utilities and notification requirements.

OPERATION AND MAINTENANCE

Develop an operation and maintenance plan ***for use by the owner or others responsible for operating and maintaining the stream***

crossing. The plan shall provide specific instructions that the operator can implement for the life of the practice ***to insure that it functions properly***.

Include the following items in the operation and maintenance plan, as a minimum:

- Inspect the stream crossing, appurtenances, and associated fence after each major storm event and make repairs if needed.
- Remove any accumulation of organic material, woody material, or excess sediment.
- Replace surfacing stone used for livestock crossing as needed.

REFERENCES

AASHTO, 2010. American Association of State Highway and Transportation Officials Load and Resistance Factor Design (LRFD) Bridge Design Specifications, Customary U.S. Units, 5th Edition, with 2010 edits; ISBN Number: 1-56051-451-0

Bunte, Kristin; Abt, Steven R. 2001. Sampling surface and subsurface particle-size distributions in wadable gravel-and cobble-bed streams for analyses in sediment transport, hydraulics, and streambed monitoring. Gen. Tech. Rep. RMRS-GTR-74. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 428 p
http://www.fs.fed.us/rm/pubs/rmrs_gtr74.html

Harrelson, Cheryl C; Rawlins, C. L.; Potyondy, John P, 1994. Stream channel reference sites: an illustrated guide to field technique. Gen. Tech. Rep. RM-245. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station. 61 p.
http://www.stream.fs.fed.us/publications/PDFs/RM245E.PDF

MassDOT, 2010. Design of Bridges and Culverts for Wildlife Passage at Freshwater Streams. Massachusetts Department of Transportation, Highway Division. (http://www.mhd.state.ma.us/downloads/projDev/Design_Bridges_Culverts_Wildlife_Passage_122710.pdf)

Messinger, Terence, 2009, Regional Curves for Bankfull Channel Characteristics in the Appalachian Plateaus, West Virginia: USGS Scientific Investigations Report 2009-5242, 43 p.
http://pubs.usgs.gov/sir/2009/5242/

Keaton, Jefferson N., Messinger, T., Doheny, E.J., 2005, Development and Analysis of Regional Curves for Streams in the Non-Urban Valley and Ridge Physiographic Province, Maryland, Virginia, and West Virginia: USGS, Scientific Investigations Report 2005-5076, 109 p.
http://pubs.usgs.gov/sir/2005/5076/

Wiley, J.B., and Atkins, J.T., 2010, Estimation of Flood-Frequency Discharges for Rural, Unregulated Streams in West Virginia: USGS, Scientific Investigations Report 2010-5033, 78 p.
http://pubs.usgs.gov/sir/2010/5033/

USDA Forest Service, October 2006. Low-Water Crossings: Geomorphic, Biological, and Engineering Design Considerations. USDA Forest Service, National Technology and Development Program, 0625 1808-SDTDC.
http://www.fs.fed.us/eng/pubs/pdf/LowWaterCrossings/index.shtml

USDA Forest Service, May 2008. Stream Simulation: An Ecological Approach to Providing Passage for Aquatic Organisms at Road-Stream Crossings. USDA Forest Service, National Technology and Development Program, 0877 1801-SDTDC.
http://www.stream.fs.fed.us/fishxing/aop_pdfs.html