USDA
NATURAL RESOURCES
CONSERVATION SERVICE

MARYLAND CONSERVATION
PRACTICE STANDARD

STREAM CROSSING

CODE 578
(Reported by No.)

DEFINITION

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

PURPOSES

1. Improve water quality by reducing sediment, nutrient, organic, and inorganic loading of the stream.
2. Reduce streambank and streambed erosion.
3. 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, bridge, or culvert type crossing is desired for livestock, people, and /or equipment.

CONSIDERATIONS

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

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

Evaluate the need for safety measures such as guardrails at culvert or bridge crossing, or water depth signage at ford crossings.

Environmental

Locate stream crossings where adverse environmental impacts will be minimized and considering the following:

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

Type of Crossing

Consider the type of stream crossing to be used. Stream crossings can be fords, culverts or bridges. Factors to consider when selecting the type of crossing are:

1. Purpose and planned use of the crossing - Crossings planned for equipment only can usually be of any type. Livestock crossings require further evaluation. Consider the type and number of livestock, frequency of use, and the distance between pastures and water sources when locating crossings. Also consider animal health and safety issues. Livestock may avoid bridge crossings that are narrow and high above the stream bottom. Livestock may slip on snow covered or icy fords;
2. Channel geometry - Deep and/or narrow channels are well suited for bridge or culvert crossings. Where a channel has a shallow depth and/or large width, a ford crossing may be more suitable;
3. Size of watershed - Large watersheds with high runoff are better suited for fords, bridges or large culverts where reduction in the channel size is minimized;
4. Type of watershed - Watersheds prone to debris blockages require large openings to pass

Conservation practice standards are reviewed periodically, and updated if needed. To obtain the current version of this standard, contact the Natural Resources Conservation Service.

sediment and debris. Bridges, fords or large culverts are suitable for these conditions. Small culverts or multiple culvert crossings may block and cause damage to the crossing and surrounding areas.

CRITERIA

General

Livestock crossings shall be a planned component of a grazing land management system to control grazing distribution, provide for better vegetative cover, and reduce runoff from pasture land.

Limit the use of fords for livestock use due to water quality concerns. The use of bridges and culverts is preferred, when possible.

For livestock such as cattle that tend to loaf in the water, allow only a small number of animals unrestricted access to a ford crossing. Otherwise, large numbers of cattle shall have access to a ford only when moving from pasture to pasture, with the use of fencing and gates to restrict access. Livestock such as sheep, goats, and horses, which generally do not loaf in the water, may be allowed unrestricted access to a ford crossing.

Protect the crossing, from damage, from flows resulting from the 25-year, 24-hour storm. This protection may include riprap aprons, side slopes and/or streambanks, escape channel (i.e. emergency spillway) around the crossing, or by other means. The maximum slope of riprap is 2 horizontal to 1 vertical, unless imbricated riprap techniques are used.

Location – Locate stream crossings 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. Avoid wetland areas if at all possible.

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

Provide a way on all stream crossings for normal passage of water, fish and other aquatic animals within the channel during all seasons of the year.

When used for livestock locate the stream crossing in such a way as to avoid creating a direct conduit for pollutants to reach the stream. Access lanes to crossings shall include measures to divert contaminated runoff into vegetated areas before the runoff reaches the stream.

Site Evaluation - A written site evaluation is required to determine the appropriate type of crossing and supporting practices alternatives for the type of stream crossing to be used. Use the following factors in the written evaluation:

1. Purpose and planned use of the crossing;
2. Depth, width, and alignment of the channel;
3. Size of the watershed;
4. Type of watershed.

Refer to the "Considerations" section of this standard for an explanation of these factors.

Permits - Any construction activities that change course, current or cross section of streams or affect wetlands may require permits or authorizations from the Maryland Department of the Environment and/or the U.S. Army Corps of Engineers. Obtain all applicable permits and authorizations before constructing a stream crossing.

Stream Approaches - Approaches to the stream crossing shall blend with existing site conditions where possible, with slopes not 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. Use a minimum width of the approaches equal to the width of the stream crossing.

Minimum Width - The minimum width of livestock only crossings is six (6) feet. The minimum width of multi-use crossings is ten (10) feet. In all cases the width of the crossing shall be adequate for the intended use.

Fencing - Areas adjacent to the stream crossing shall be permanently fenced or otherwise excluded as needed to manage livestock access to the crossing. Natural barriers such as steep banks, hedgerows, etc. may be used for livestock exclusion.

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.

Design and install fences in accordance with the NRCS Maryland conservation practice standard for Fence, Code 382. Other exclusion measures shall be designed in accordance with the NRCS Maryland conservation practice standard for Use Exclusion, Code 472.

Vegetation – Stabilize disturbed areas in accordance with the Maryland conservation practice standard for Critical Area Planting, Code 342.

In areas where vegetation may not survive, non-vegetative materials such as mulches, gravel, or synthetic linings may be used to protect soil from erosion.

Ford Crossings

Capacity - When fords are used, size the crossing so that the cross sectional area of the crossing is equal to or exceeds the natural cross sectional area.

Structural - The bottom of the ford shall have a width equal to the bottom width of the channel. Depress a portion of the crossing 4 inches below the stream bottom to keep base flows and low flow concentrated. Design the entrance and exit ramps to 8:1 slope or flatter.

For concrete fords use a minimum thickness of concrete of 5 inches with minimum reinforcement of 6-inch x 6-inch, 6 gage woven wire fabric. Provide a minimum 18-inch deep concrete cutoff wall at the downstream side of the crossing. Place 4 inches of gravel as a base for the 5-inch thick concrete slab.

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 approved by the NRCS Engineer providing assistance to the area.

Gravel fords shall consist of 12 inches of 4-inch to 8-inch riprap, capped with 3 inches of AASHTO-M43 No. 2 stone.

Gravel fords with geotextile shall be used when the site has a soft or unstable subgrade. These fords shall consist of geotextile installed in accordance with this standard with 6 inches of AASHTO specification No. M43 specification No. 2 stone cover.

Geocell fords shall be a minimum of 6 inches deep. Install geotextile under the geocell material. Install the geocell in accordance with the manufacturer's recommendations. Fill the geocell with AASHTO specification M43 No. 2 stone.

For livestock comfort, a 1 to 3 inch layer of smaller surfacing stone maybe added to all stone crossings. It is expected that this layer will be replaced by the landowner as needed.

The use of other types of crossing materials or configurations not shown above shall be reviewed and approved by the NRCS Engineer providing assistance to the area.

Culvert Crossings

Capacity - Size culverts in accordance with NRCS – Maryland Design Guide MD-5, Culvert Stream Crossings, hydraulic nomographs from Engineering Field Handbook part 650, Chapter 3; USDOT, Federal Highway Administration, Hydraulic Design of Highway Culverts series No. 5; or other sources which compare inlet and outlet control conditions.

Culvert crossings must have at a minimum one 30-inch diameter pipe. Use an equivalent area when using squash or arch pipe or size in accordance with manufacturer flow data. Multiple pipes may be used in wide channels with low banks. When using multiple pipes the additional pipes may be less than 30 inches in diameter but not less than 18 inches in diameter.

Size culverts in natural stream channels to carry the lesser of the channel capacity at low bank elevation or the 2-year, 24-hour peak discharge. Size culverts located in man-made channels or ditches to safely pass the design discharge of the channel or ditch.

Structural - Install culvert pipe with both upstream and downstream inverts submerged below channel grade one foot. When using multiple pipes only one pipe, the largest of the series, re-

quires submergence. Open bottom culverts do not require submergence.

Bed pipes firmly and uniformly throughout its entire length. Remove rock, soft, spongy, or other unstable soil and replace with suitable earth compacted to provide adequate support. Provide a minimum of 12 inches of cover over all culvert pipes.

Bridges

Capacity - Size bridges across natural stream channels to handle the discharge of channel capacity at low bank elevation or 2-year 24- hour peak discharge, whichever is less. Size bridges located across channels or ditches, which are sized to a particular storm event, to safely pass this required design discharge.

Structural - Design in accordance with designs by others to meet industry standards, certified by a Maryland Registered Professional engineer or in accordance with NRCS Maryland Design Guide MD-3, Bridges for Livestock and Agricultural Equipment.

Materials

Corrugated Metal Pipe and its appurtenances shall be galvanized and fully bituminous coated and must meet the requirements of AASHTO Specification M-190 type with watertight coupling bands. Metal culvert pipes require a minimum 16 gage.

Aluminum Pipe and its appurtenances shall meet the requirements of AASHTO Specification M-196 or M-211 with watertight coupling bands or flanges. Metal culvert pipes require a minimum 16 gage.

Aluminum Coated Steel Pipe and its appurtenances shall meet the requirements of AASHTO Specification M-274-79I. Coupling bands must be composed of the same material as the pipe and be watertight. Metal culvert pipes require a minimum 16 gage.

Reinforced Concrete Pipe shall meet the requirements of ASTM specification C-76. Joints shall have a rubber gasket.

Plastic Pipe Materials - PVC pipe shall be PVC 1120 or PVC 1220 conforming to ASTM D-1785 or ASTM D-2241. Corrugated High Density Polyethylene (HDPE) pipe, couplings and fittings must meet the requirements of AASHTO M294 Type S with watertight joints.

Rock - Gravel (aggregates) and rock riprap shall meet the requirements of Maryland Department of Transportation, State Highway Administration Standard Specifications for Construction and Materials, Sections 901.01 and 901.02 respectively.

Geotextile - Geotextile may be woven or non-woven, and shall meet the requirements of Maryland Department of Transportation, State Highway Administration Standard specifications for Construction and Materials, Section 921.09, Class SE.

Concrete - Unless otherwise specified on standard drawings or on design guides, use a minimum compressive strength of 4,000 psi at 28 days, type I cement and have 5% air entrainment.

SPECIFICATIONS

Prepare plans and specifications for stream crossings for specific field sites, according to the Considerations, Criteria, and Operation and Maintenance described in this standard. Include construction plans, drawings, job sheets, construction specifications, and other similar documents, as appropriate. Prepare documentation according to the requirements found in section "Supporting Data and Documentation" in this standard.

Place fill material in horizontal layers not to exceed four inches in thickness and compacted by hand tampers or other compaction equipment. Do not operate equipment within 4 feet measured horizontally to pipes and over pipes unless there is a minimum of 12 inches of compacted fill over the pipe.

Carry out all work in areas free from water. Construct and maintain all temporary dikes, levees, cofferdams, drainage channels, and stream diversions necessary to protect the areas to be occupied by the permanent works. Furnish, install, operate, and maintain all necessary pumping and other equipment required for removal of water from the various parts of the work and for maintaining the excavations, foundation, and other parts of the work free from water as required or directed by the engineer for constructing each part of the work

OPERATION AND MAINTENANCE

Prepare a written operation and maintenance plan for each stream crossing or management unit, and provide the plan to the client. Address as a minimum the following items.

1. Inspect the stream crossing and channel at least twice annually. Provide maintenance or repairs as needed. Inspect stone approaches and add stone as needed to maintain access areas;

2. Inspect stone approaches to the crossing. Add stone as needed to maintain access areas and protect soil from erosion;

3. Inspect fencing, gates, and other practices as associated with the crossing. Maintain and repair fencing on the crossing and surrounding areas as needed to protect the user and prevent livestock from entering excluded areas.

SUPPORTING DATA AND DOCUMENTATION

Planning Information, Field Data, and Survey Notes

Record on survey note paper, SCS-ENG-28 & 29, and/or in the conservation plan folder, as appropriate. The following is a list of the minimum data and documentation to be recorded in the case file:

1. Field location of the project, and CPA-6 assistance notes. Also note the location of the project on the conservation plan map;

2. Profile along centerline of stream (100 feet upstream and downstream);

3. Cross-sections (3) – 100 feet upstream and downstream and at crossing perpendicular to flow, extending 25 feet beyond the top of each bank;

4. Sketch of area, to indicate stream meandering and limits of stream protection (if needed);

5. Soil investigation, auger logs to determine any special construction needs;

6. Written site evaluation for the project that addresses the following factors: purpose and planned use of the crossing, depth and width of the channel, size of the watershed, and type of watershed.

Design Data

Record on appropriate engineering paper. For guidance on the preparation of engineering plans see Chapter 5 of the EFH, Part 650. The following is a list of the minimum required design data:

1. Determine peak runoff from the contributing drainage area for the required design storm in accordance with Chapter 2, Engineering Field Handbook, Part 650 or by other approved method;

2. Determine stream channel stability using appropriate methods;

3. Construction drawing including the following: location map, plan view, profiles, cross sections, system components details, material and construction specifications;

4. Construction sequence to include stream channel diversion and other sediment control measures as needed;

5. Show job class on plan;

6. Quantities estimate;

7. Planting plan. This must meet the criteria, specifications, and documentation requirements of the Maryland conservation practice standard for Critical Area Planting, Code 342. Show on plan.

Construction Check Data/ As-Built

Record on survey notepaper, SCS-ENG-28, or other appropriate engineering paper. Plot final survey data on the plans in red. The following is a list of minimum data needed for As-builts:

1. Documentation of all site visits on CPA-6. Include the date, who performed the inspection, specifics as to what was inspected, all alternatives discussed, and decisions made and by whom;

2. Check notes recorded during or after completion of construction showing cross sections, profiles of constructed components, lengths widths and elevations of all components;

3. Statement on seeding and fencing (when required);

4. Final quantities and documentation for quantity changes, and materials certification;

5. Sign and date check notes and plans by someone with appropriate approval authority. Include statement that practice meets or exceeds plans and NRCS practice standards.

REFERENCES

1. Department of the Army, Corps of Engineers. *Permits for Discharges of Dredged or Fill Material into Waters of the United States.* 33 CFR 323 - 330.

2. Maryland Department of the Environment. *Construction on Nontidal Waters and Floodplains.* Code of Maryland Regulations (COMAR) 26.17.04.

3. Maryland Department of the Environment. *Nontidal Wetlands.* Code of Maryland Regulations (COMAR) 26.23.01 - 26.23.06.

4. Maryland Department of the Environment. *Tidal Wetlands.* Code of Maryland Regulations (COMAR) 26.24.01 - 26.24.04.

5. Maryland Department of the Environment. *1994 Maryland Standard and Specifications for Soil Erosion and Sediment Control*.

6. Maryland Department of the Environment, Water Management Administration, November, 2000. *Maryland's Waterway Construction Guidelines*.

7. Maryland Department of Transportation, State Highway Administration, January 2001. *Standard Specifications for Construction and Materials*. Baltimore, Maryland.

8. USDA, Natural Resources Conservation Service. *Conservation Practice Standards. Maryland* Field Office Technical Guide, Section IV.

9. USDA, Natural Resources Conservation Service. *MD #3, Bridges for Livestock and Agricultural Equipment*. Maryland Design Guides Field Handbook.

10. USDA, Natural Resources Conservation Service. *MD #5, Culvert Stream Crossings*. Maryland Design Guides Field Handbook.

11. USDA Natural Resources Conservation Service, *National Engineering Handbook, Part 650, Chapters 2, and 3*.

12. USDA Natural Resources Conservation Service. *National Handbook of Conservation Practices*.