

**USDA  
 NATURAL RESOURCES  
 CONSERVATION SERVICE**  
  
**MARYLAND CONSERVATION  
 PRACTICE STANDARD**  
  
**STREAM CROSSING**  
  
**CODE 728  
 (Reported by No.)**

**DEFINITION**

A stabilized area to provide access across a stream for livestock, people, and/or equipment.

**PURPOSES**

This practice may be applied for one or more of the following purposes:

1. To reduce streambank and streambed erosion by providing a stable area to cross;
2. To improve and/or protect water quality from sediment, nutrients and organic wastes by exclusion of animals from the stream channel and providing a controlled crossing (access) for livestock and/or equipment;
3. Protect the stream from adverse hydrologic and hydraulic impacts.

**CONDITIONS WHERE PRACTICE  
 APPLIES**

This practice may be applied on all land uses where an intermittent or perennial watercourse exists, and a permanent or temporary crossing is needed for livestock, people, and/or equipment. This practice is applicable on sites where the soil, vegetation, water, or other natural resources need to be protected from uncontrolled access to the watercourse by livestock or human activities.

This practice may be applied as part of a grazing land resource management system, where access is needed from one grazing area to another graz-

ing area, and where movement of equipment between areas is necessary for pasture maintenance.

**CONSIDERATIONS**

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 - All types of crossings can be suitable for providing a stable access across a stream channel. When crossings will be frequently used by large numbers of livestock or vehicles, or when livestock are expected to congregate in the stream, use culverts or bridges to provide a dry and stable access and protect water quality.

Crossings planned for equipment only can usually be of any type. Livestock crossings require further evaluation. Consider the type and number of livestock, 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 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.

Identify and evaluate other constraints such as management options, economic feasibility, ac

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cess, state and federal regulations, or cost-share program requirements. If permits or approvals are required before construction of the crossing, consider the amount of time that will be needed to complete the process.

Consider the need for additional conservation practices to protect the resource base in and adjacent to the stream corridor. Supporting practices may include riparian forest buffers, filter strips, fences, spring developments, watering facilities, critical area plantings, and streambank and shoreline protection measures.

### **CRITERIA**

#### **General**

**Site Selection** - Design stream crossings to serve the planned land use with the expected livestock and/or vehicular traffic. When planning a stream crossing for livestock use, inventory the grazing land to determine present and planned livestock travel patterns.

Construct crossings at right angles to stream flow and in areas where the streambed is stable. Where practical, locate crossings just upstream of any natural barrier such as a rock seam or large boulder. Avoid sites where channel grade or alignment changes abruptly, where there is instability, or where overfalls exist.

**Water Quality** - When water quality protection/improvement is a purpose of the stream crossing, select the appropriate type of crossing and supporting practices to achieve this purpose.

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

If natural barriers such as steep banks, hedge-rows, etc. do not exist, provide fencing, gates, and other measures to keep livestock out of the stream and off the stream banks, and to direct them to the crossing. 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.

Sites containing sacrifice areas, feedlots, or other areas that concentrate pollutants shall have crossings located 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.

The use of fords shall be limited because fords do not completely exclude stream access, and may result in continued water quality impacts. The use of bridges and culverts is preferred for water quality protection, unless these types of crossings are not feasible due to constraints of the channel's shallow depth and/or large width, or because of other significant constraints.

For livestock such as cattle that tend to loaf in the water, only a small number of animals shall be allowed to have unrestricted access to a ford. 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.

**Site Evaluation** - As part of the planning process, a written site evaluation is required to determine possible alternatives for the type of stream crossing to be used.

The following factors shall be addressed 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 Engi

neers. Obtain all applicable permits and authorizations before constructing a stream crossing.

**Minimum Width** - The minimum width of the crossing is eight (8) feet. When the crossing is planned to be utilized as an access road for maintenance equipment and other vehicles, the minimum width is twelve (12) feet.

**Structural Backfill** - 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.

**Outlets** - Protect outlets to the extent that design flows will not result in erosion downstream of the structure. This protection may include a riprap apron below concrete ford or pipe crossings.

**Vegetation** - Seed or sod areas disturbed during installation of stream crossings as necessary to prevent erosion. Seedbed preparation, seeding, sodding, fertilization, and mulching of disturbed areas must comply 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 such as Enkamat, Geoweb, etc. 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 exceed the natural cross sectional area.

**Structural** - The bottom of the ford shall have a width equal to the bottom width of the channel, but not less than 4.0 feet. Provide a low flow channel in the bottom of the ford by sloping the bottom of the crossing 4 inches towards the center of the channel so that the surface of the ford at the center of the channel shall be depressed 4 inches below stream bottom. Other types of open low flow channels may be considered. Design the entrance and exit ramps to 8:1 slope or flatter.

Concrete fords shall consist of 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. Gravel must meet the requirements of MSHA No. 57 (1-inch maximum size).

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.

Provide riprap or other suitable materials to protect roadway and/or fill against overflow from storms exceeding structure capacity. The maximum slope of riprap stabilized banks is 2 horizontal to 1 vertical.

**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, requires 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.

The minimum length for culverts is twenty (20) feet. Extend the pipe a minimum of 1 foot beyond the toe of slope on both ends. 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 discharge. Provide riprap or other suitable materials to protect roadway and/or fill against overflow from storms exceeding structure capacity. The maximum slope of riprap stabilized banks is 2 horizontal to 1 vertical.

**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 by design guide, concrete shall meet the requirements of Maryland Department of Transportation, State Highway Administration

Standard Specifications for Construction and Materials, Section 414, Mix No. 3 (3,500 psi), Type IA cement.

### **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. Documentation shall meet the requirements found in section "Supporting Data and Documentation" in this standard.

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. Survey data shall be plotted on 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*.