NATURAL RESOURCES CONSERVATION SERVICE

VIRGINIA CONSERVATION PRACTICE STANDARD

DIVERSION

(Ft.)

CODE 362

DEFINITION

A channel generally constructed across the slope with a supporting ridge on the lower side.

PURPOSE

This practice may be applied to support one or more of the following purposes.

Break up concentrations of water on long slopes, on undulating land surfaces, and on land that is generally considered too flat or irregular for terracing.

Divert water away from farmsteads, agricultural waste systems, and other improvements.

Collect or direct water for storage, water-spreading or water-harvesting systems.

Protect terrace systems by diverting water from the top terrace where topography, land use, or land ownership prevents terracing the land above.

Intercept surface and shallow subsurface flow.

Reduce runoff damages from upland runoff.

Reduce erosion and runoff on urban or developing areas and at construction or mining sites.

Divert water away from active gullies or critically eroding areas.

Supplement water management on conservation cropping or stripcropping systems.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to all land uses where surface runoff water control and/or management are needed and where soils and topography are such that the diversion can be constructed and a suitable outlet is available or can be provided.

CRITERIA

Capacity. Diversions as temporary measures, with an expected life span of less than 2 years, shall have a minimum capacity for the peak discharge from the 2-year frequency, 24-hour duration storm.

Diversions that protect agricultural land shall have a minimum capacity for the peak discharge from a 10-year frequency, 24-hour duration storm.

Diversions designed to protect areas, such as urban areas, buildings, roads, and animal waste management systems, shall have a minimum capacity for the peak discharge from a storm frequency consistent with the hazard involved but not less than a 25-year frequency, 24-hour duration storm. Freeboard shall be not less than 0.3 ft.

Design depth is the channel storm flow depth plus freeboard.

Cross section. The channel may be parabolic, V-shaped, or trapezoidal. The diversion shall be designed to have stable side slopes.

The ridge shall have a minimum top width of 4 feet at the design depth with the following exception: The ridge top width may be 3 feet at design depth for diversions with less than 10 acres of drainage area above cropland, pastureland, or woodland.

The ridge height shall include an adequate settlement factor.

The top of the constructed ridge at any point shall not be lower than the design depth plus the specified overfill for settlement.

The design depth at culvert crossings shall be the culvert headwater depth for the design storm plus freeboard.

Stability and Capacity. Channel grades may be uniform or variable. Minimum depth and width requirements for channel stability shall be determined using the procedures in the NRCS Engineering Field Handbook (EFH) Part 650, Chapter 9, or Agricultural Research Service (ARS) Agricultural Handbook 667, Stability Design of Grass-Lined Open Channels (Sept. 1987); or other equivalent methods.

When a retardance class method is used to determine capacity by the equation Q =AV, and the velocity (V) is calculated by using Manning's equation, the highest expected value of "n" shall be used.

Location. The outlet conditions, topography, land use, cultural operations, cultural resources, and soil type shall determine the location of the diversion.

Protection against sedimentation. Diversions normally should not be used below high sediment producing areas. When they are, a practice or combination of practices needed to prevent damaging accumulations of sediment in the channel shall be installed. This may include practices such as land treatment erosion control practices, cultural or tillage practices, vegetated filter strip, or structural measures. Install practices in conjunction with or before the diversion construction.

If movement of sediment into the channel is a problem, the design shall include extra capacity for sediment or periodic removal as outlined in the Operation and Maintenance Plan.

Outlets. Each diversion must have a safe and stable outlet with adequate capacity. The outlet may be a grassed waterway, a lined waterway, a vegetated or paved area, a grade stabilization structure, an underground outlet, a stable watercourse, a sediment basin, or a combination of these practices. The outlet must convey runoff to a point where outflow will not cause damage. Vegetative outlets shall be installed and established before diversion construction to ensure establishment of vegetative cover in the outlet channel.

The release rate of an underground outlet, when combined with storage, shall be such that the design storm runoff will not overtop the diversion ridge.

To prevent the diversion from overtopping, the designed outflow capacity of the outlet(s) must be achieved at, or below, the design depth of the diversion at their junction.

Vegetative Establishment. The diversion ridge, channel, and other disturbed areas that are not cultivated shall be vegetated according to Virginia Conservation Practice Standard *Critical Area Planting (Code 342)* upon completion of grading. Species selected shall be suited to the site conditions and intended uses. Selected species will have the capacity to achieve adequate density, height, and vigor within an appropriate time frame to stabilize the diversion.

Use mulch anchoring, nurse crop, rock, straw or hay bale dikes, fabric checks, filter fences, or runoff diversion to protect the vegetation until it is established. Planting of a close growing crop, e.g. small grains or millet, on the contributing watershed prior to construction of the diversion can significantly reduce the flow through the diversion during establishment.

Lining. If the soils or climatic conditions preclude the use of vegetation for erosion protection, non-vegetative linings such as concrete, gravel, rock riprap, cellular block, or other approved manufactured lining systems may be used.

Liners shall be designed in accordance with Virginia Conservation Practice Standard *Lined Waterway or Outlet (Code 468)*.

OTHER CONSTRUCTION REQUIREMENTS

All ditches or gullies shall be filled, and trees and other obstructions shall be removed before construction begins unless planned as part of the diversion construction activities.

If underground conduits are located under diversion ridges, mechanical compaction, water packing, and installation and backfill of conduit trenches shall be made in advance to allow adequate settlement. The materials used for the inlet and conduit shall be suitable for the purpose intended and shall meet the requirements of Virginia Conservation Practice Standards *Subsurface Drain (Code 606)* or *Underground Outlet (620)*.

Diversion ridges constructed across gullies or depressions shall be compacted by machinery or other means sufficient to ensure proper

functioning of the diversion. The surface of the finished diversion shall be reasonably smooth and present a workmanlike appearance.

CONSIDERATIONS

A diversion in a cultivated field should be aligned and spaced from other structures or practices to permit use of modern farming equipment. The side slope lengths should be sized to fit equipment widths when cropped.

For outlets, such as a grassed waterway, the transition section may be susceptible to erosion damage. If vegetation proves inadequate in the transition section, it may be necessary to line this section of the channel.

On large watersheds, runoff flows are usually too large to outlet entirely through underground outlets. A combination of outlet practices may be needed.

The effects on the water budget should be considered in the planning and design of diversions, especially where water is diverted for other uses.

Consideration should be given to the effect on surface water quality from the movement of sediment, pathogens, soluble nutrients and pesticides attached to sediment and carried by runoff. Measures should be taken during design, construction and establishment to minimize erosion and pollution.

At non-cropland sites, consider planting native vegetation in areas disturbed due to construction.

Maximize wetland functions and values with the diversion design. Minimize adverse effects to existing wetland functions and values. Diversion of upland water to prevent entry into a wetland may convert a wetland by changing the hydrology.

Any construction activities should minimize disturbance to wildlife habitat. Opportunities should be explored to restore and improve wildlife habitat, including habitat for threatened, endangered, and other species of concern.

For vegetated diversions, avoid areas where unsuitable subsurface, subsoil, or substratum material may be exposed during implementation of the practice. Where plant growth-limiting areas cannot be avoided, seek recommendations from a soil scientist or consider stockpiling the topsoil, over-cutting the diversion, and replacing the topsoil over the cut area to facilitate vegetative establishment.

PLANS AND SPECIFICATIONS

Prepare plans and specifications for diversions that describe the requirements for applying the practice according to this standard.

Record all required information in an engineer field book, on a plan sheet or design computation sheet, or in another appropriate location.

DESIGN DATA

1. Completed Environmental Evaluation and subsequent requirements.
2. Soils investigation.
3. Survey and plot data:
   a. Typical cross-sections of the diversion(s).
   b. Profile(s) of the diversion(s).
4. Design computations, including purpose of practice and references used.
   a. Watershed area.
   b. Peak runoff.
   c. Permissible velocity.
   d. Channel dimensions.
5. Plan view of the layout of the diversion with existing and planned features, including dimensions, distances, etc.
6. Standard Cover Sheet (VA-SO-100A).
7. Materials and quantities needed. Identify borrow material and/or spoil area, as needed.
8. Vegetation and/or ground cover requirements.
9. Identification of needed Erosion & Sediment Control measures.
10. Supplemental practices required.
11. Virginia Conservation Practice Specifications (700 Series). Include specifications for control of concentrated flow during construction and vegetative establishment.
12. Operation and Maintenance Plan.

CHECK DATA

1. As-built survey.
2. As-built plans including dimensions, types and quantities of materials installed, and variations from design. Include justification for variations.
3. Locations of appurtenant practices.
4. Adequacy of vegetation and/or ground cover.
5. Complete as-built section of Cover Sheet.

OPERATION AND MAINTENANCE

An operation and maintenance plan shall be prepared for use by the client. The plan shall include specific instructions for maintaining diversion capacity, storage, ridge height, and outlets.

The minimum requirements to be addressed in the operation and maintenance plan are:

Provide periodic inspections, especially immediately following significant storms.

Promptly repair or replace damaged components of the diversion as necessary.

Maintain diversion capacity, ridge height, and outlet elevations especially if high sediment yielding areas are in the drainage area above the diversion. Establish necessary clean-out requirements.

Each inlet for underground outlets must be kept clean and sediment buildup redistributed so that the inlet is at the lowest point. Inlets damaged by farm machinery must be replaced or repaired immediately.

Redistribute sediment as necessary to maintain the capacity of the diversion.

Maintain vegetation and trees and control brush by hand, chemical and/or mechanical means. Maintenance of vegetation will be scheduled outside of the primary nesting season for grassland birds.

Control pests that will interfere with the timely establishment of vegetation.

Keep machinery away from steep sloped ridges. Keep equipment operators informed of all potential hazards.

REFERENCES

USDA, ARS. 1987. Stability design of grass-lined open channels. Agriculture Handbook 667.

USDA-Natural Resources Conservation Service. Electronic Field Office Technical Guide (eFOTG), Section IV [Online]. Available at http://www.nrcs.usda.gov/technical/eFOTG

USDA-Natural Resources Conservation Service. National Engineering Handbook, Part 650, Engineering Field Handbook, Chap. 9, Diversions.

USDA-Natural Resources Conservation Service. Virginia 700 Series Construction Specifications. [On-line]. Available at http://www.nrcs.usda.gov/technical/eFOTG

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