Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

DIVERSION

CODE 362

(ft)

DEFINITION

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

PURPOSE

This practice is used to accomplish one or more of the following purposes:

- Intercept surface and shallow subsurface flow to reduce runoff and erosion.
- Divert water away from sensitive areas, conservation practices, agricultural waste systems, infrastructure, and other improvements.
- Collect or direct water for storage, water spreading, water-harvesting systems, or treatment.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to all land uses where the soils and topography allow construction of a diversion with a suitable outlet.

CRITERIA

General Criteria Applicable to All Purposes

Design and install measures in accordance with all local, State, Tribal, and Federal laws and regulations. Apply measures to be compatible with improvements planned or being carried out by others.

Capacity

Design diversions to be used as temporary measures *(e.g. for construction sites, critical area plantings)* to convey the peak discharge from the 2-year frequency, 24-hour duration storm.

Design diversions to protect agricultural land or surface mine reclamation to convey the peak discharge from a 10-year frequency, 24-hour duration storm.

Design diversions to protect urban areas, buildings, roads, and animal waste management systems to convey the peak discharge from a storm frequency consistent with the hazard involved, but not less than a 25-year frequency, 24-hour duration storm with a minimum freeboard depth of 0.3 feet.

Peak discharges for all storms will be determined by the method outlined in NRCS National Engineering Handbook (NEH) Part 650, Engineering Field Handbook (EFH) Chapter 2 or Technical Release 55 (TR-55).

The diversion design depth is the maximum expected water depth resulting from the design storm plus any required freeboard. The diversion design depth at a culvert crossing or grade stabilization structure must equal the headwater depth for the culvert or structure design storm plus any required freeboard.

Cross section
The channel may be parabolic or trapezoidal. *Design diversions with stable side slopes, but not steeper than two horizontal to one vertical (2:1). Use a minimum of 8:1 slopes for agricultural equipment crossing and 4:1 minimum to facilitate mowing.* Where a supporting ridge is required to contain the design flow plus any required freeboard in the channel, the minimum ridge top width is 3 feet. Design all farmable ridge side slopes no steeper than 5 horizontal to 1 vertical (5:1) to allow safe operation of farming equipment. The top of the constructed ridge at any point must not be lower than the design depth plus the specified overfill for settlement. *Include additional fill for settlement but not less than 10 percent of the fill height.*

Channel stability and capacity
Channel grades may be uniform or variable. Determine minimum depth and width requirements for channel stability by using the procedures in the NRCS National Engineering Handbook (Title 210), Part 650, Chapter 9, "Diversions."

Use the limiting stress or limiting velocity method to determine adequate channel capacity (depth) and stability (erosion resistance) of the channel. The capacity of a vegetated diversion will be based on the densest and longest vegetation resulting in the highest expected retardance.

Channel velocity shall not exceed values as shown in Table 1.

Maximum velocities for diversions with linings shall be as specified in Lined Waterway (Code 468), or as specified by the manufacturer for commercially available lining products.

Maximum velocities for diversions with bare soil channels shall be as shown in Table 2. Use a Manning's "n" value of 0.03 or less to determine flow velocity in bare soil channels.

Table 1. Vegetated Diversion Velocity

Diversion Slope Range (%)	***Permissile Velocity[1]***	
	Erosion Resistant Soils[2] (ft./sec.)	***Easily Eroded Soils[3] (ft./sec.)***
0-5	*7*	*5*
5.1-10	*6*	*4*
Over 10	*5*	*3*

[1]Use velocities exceeding 5 ft./sec. only where good cover and proper maintenance can be obtained.

[2]Cohesive (clayey) fine-grain soils and coarse-grain soils with cohesive fines with a plasticity index of 10 to 40 (CL, CH, SC, and GC)

[3]Soils that do not meet the requirements for erosion-resistant soils.

Table 2. Bare Soil Channel Diversion Velocity

Soil Texture[1]	***Permissible Velocity (ft./sec.)***
Sands, silts, and loams (SW, SP, ML, SM, SM-SC, CL-ML)	*1.5*
Silty clay loams, and sandy clay loams (SC, CL) PI<10	*2.0*
Silts, Clays (MH, CL, CH) PI≥10	*2.5*

[1]General description and Unified Soil Classification System designation. PI is plasticity index.

Protection against sedimentation
Excess sediment accumulation in the diversion channel lessens hydraulic capacity, impedes flow, and inhibits vegetation. For a contributing drainage area that produces a high sediment load, incorporate measures to limit the accumulation of sediment in the channel by—

- Install or apply conservation practices such as land treatment, erosion control, cultural or tillage, or structural measures in conjunction with or before diversion construction.
- Increase the diversion channel size to accommodate the estimated sediment accumulation (e.g., 2-year, 10-year, or 25-year) unless the operation and maintenance plan specifically addresses the periodic removal of sediment. *Refer to the Required Sediment Storage Table in Water and Sediment Control Basin (Code 638).*

Outlets
Each diversion must have a safe and stable outlet with capacity to convey the design storm. 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. To protect the diversion from overtopping, the designed discharge capacity of outlets must be achieved below the design depth of the diversion at their junction. When using an underground outlet, the diversion must contain the design storm runoff, less any reduction creditable to the conduit discharge. The outlet must convey runoff to a point where outflow will not cause erosion. Install vegetated outlets before diversion construction to ensure establishment of stable vegetative cover in the outlet channel, unless additional protective measures are used until the vegetation is established.

Vegetative establishment
For vegetated diversions, use the criteria in Conservation Practice Standard (CPS) Critical Area Planting (Code 342) to establish vegetation. Select species suited to local site conditions and intended uses, and common to the site or location. Use plant species that exhibit the capacity to achieve adequate density, height, and vigor within an appropriate timeframe to stabilize the diversion.

Establish vegetation on noncropped disturbed areas as soon as conditions permit. Use mulch anchoring, nurse crop, rock, straw or hay bale dikes, fabric checks, filter fences, erosion control blankets, 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, nonvegetative linings such as concrete, gravel, rock riprap, cellular block, turf reinforcement mats, or other approved manufactured lining systems may be used. Design any lining in accordance with the criteria in NRCS CPS Lined Waterway or Outlet (Code 468).

CONSIDERATIONS

A diversion in a cultivated field should be in alignment with other structures or practices in the field and spaced in such a way as to facilitate safe and efficient use of farming equipment. The side slope lengths should be sized to fit equipment widths when cropped.

For a diversion protecting an agricultural waste system, infrastructure, or a sensitive area, consider designing a wider ridge top, and consider greater channel freeboard.

Consider providing an increased level of designed treatment for sites with high priority areas for source water protection or are upstream of community drinking water withdrawal sites.

Diversion of storm runoff or subsurface seepage from a wetland may convert the wetland by changing the hydrology. In analyzing downslope impacts, avoid adverse effects to existing wetland functions and values. Consider how to maintain wetland functions and values with the diversion design.

Hillside seeps in a crop field can cause cropping problems. Consider aligning the diversion and installing subsurface drainage to intercept and correct seepage problems. Install the drainage prior to diversion construction in accordance with NRCS CPS Subsurface Drain (Code 606).

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. At noncropland sites, consider planting native vegetation in areas disturbed during diversion construction.

For vegetated diversions, avoid areas where subsurface, subsoil, or substratum material that limits plant growth (such as by salts, acidity, root restrictions, etc.) may be exposed during implementation of the practice. Where these areas cannot be avoided, seek recommendations from a soil scientist for improving the conditions. Consider stripping and stockpiling the topsoil for spreading over the disturbed area to facilitate vegetative establishment.

Consider impacts to water quality when concentrating flows with a diversion and the potential need to treat contaminated water.

PLANS AND SPECIFICATIONS

Prepare plans and specifications for the diversion that describe the requirements for applying the practice according to this standard. As a minimum, the plans and specifications must include—

- A plan view of the layout of the diversion.
- Typical cross sections of the diversion.
- A profile of the diversion that includes both the channel bottom and any supporting ridge top.
- Construction specifications describing any site-specific details of installation such as—
    - Method of quantity measurement.
    - Placement requirements for any earthfill.
    - Disposal requirements for any excess soil material.
    - Seeding requirements for any vegetation to be established.
    - Lining requirements for any liner to be installed.

OPERATION AND MAINTENANCE

Prepare an operation and maintenance plan for use by the client. Include specific instructions for maintaining diversion capacity, storage of runoff water, ridge height, and outlets in the plan.

As a minimum, include—

- Conducting periodic inspections, especially immediately following significant storms.
- Promptly repairing or replacing damaged diversion components as necessary.
- Maintaining diversion capacity, ridge height, and outlet elevations, especially if high sediment-yielding regions are present in the drainage area above the diversion. Establish necessary diversion cleanout requirements.
- Periodically removing accumulated sediment so the outlet remains at the lowest point of the channel.
- Periodically mowing to maintain the desired vegetation height and design parameters.
- Applying supplemental nutrients as needed to maintain the desired composition of vegetative species and stand density in the diversion.
- Controlling trees, brush, and noxious weeds by hand, chemical, and mechanical means as necessary.
- Scheduling maintenance outside of the primary nesting season for grassland birds.
- Controlling pests that interfere with the timely establishment of vegetation.

- Informing operators of potential hazards associated with operating equipment near steep-sloped ridges.

REFERENCES

USDA NRCS. 2009. National Engineering Handbook (Title 210), Part 650, Chapter 9, Diversions. Washington, D.C. https://directives.sc.egov.usda.gov/