



NATURAL RESOURCES CONSERVATION SERVICE CONSERVATION PRACTICE STANDARD

DIVERSION

CODE 362 (AC.)

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 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

Design and install measures according to a site-specific plan in accordance with all local, State, Tribal, and Federal laws and regulations. Apply measures that are compatible with improvements planned or being carried out by others.

Capacity

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

Diversions that protect agricultural land must 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 require 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 minimum depth is 0.3 ft.

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).

Design depth is the channel storm-flow depth plus freeboard.

Cross Section

The channel may be parabolic or trapezoidal. The diversion shall be designed to have stable side slopes, but no slope shall be steeper than two horizontal to one vertical (2:1).

The minimum top width of the supporting ridge is 4 feet **except** for diversions with less than 10 acres of drainage area above cropland, pastureland, or woodland, where the minimum top width of the supporting ridge may be 3 feet.

The top of the constructed ridge at any point must not be lower than the design depth plus the specified overfill for settlement. The minimum additional fill for settlement shall be 10 percent of the fill height.

The diversion design depth at a culvert crossing must equal the headwater depth for the culvert design storm plus freeboard.

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 National Engineering Handbook, Part 650, Engineering Field Handbook, Chapter 9, Diversions; or Agricultural Research Service (ARS) Agricultural Handbook 667, Stability Design of Grass-Lined Open Channels (Sept. 1987); or other equivalent methods (permissible velocity method). The ARS handbook can be found on the USDA National Agricultural Library Digital Collections Web site.

When a retardance class method is used to determine capacity (Q) of the diversion by the relationship

$$Q=AV \text{ (A = flow area),}$$

and, the velocity (V) is calculated by using Manning's Equation; use the highest expected value of Manning's "n", which represents the flow retardance due to the height, density and type of vegetation.

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

Maximum velocities for diversions with linings shall be as specified in the Wisconsin NRCS Conservation Practice Standard (WI NRCS CPS), 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. A Manning's "n" value of 0.03 or less shall be used for determining the velocity in bare soil channels.

Table 1. Vegetated Diversion Velocity

Diversion Slope Range (%)	Permissible 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

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

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

³Soils 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

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

Protection Against Sedimentation

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

If movement of sediment into the channel is a problem, include extra capacity for sediment accumulation in the design and instructions for periodic removal 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, 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. Install vegetative outlets before diversion construction to insure establishment of stable vegetative cover in the outlet channel.

When using an underground outlet, the diversion ridge must contain the design storm runoff combined with an underground outlet release rate to protect from overtopping. 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

Vegetate diversions according to WI NRCS CPS, Critical Area Planting (Code 342). Select species suited to the site conditions and intended uses. Use plant species that exhibit the capacity to achieve adequate density, height, and vigor within an appropriate time frame to stabilize the diversion.

Establish vegetation as soon as conditions permit. 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, nonvegetative linings such as concrete, gravel, rock riprap, cellular block, or other approved manufactured lining systems may be used.

Design diversion channel liners in accordance with WI NRCS CPS, Lined Waterway or Outlet (Code 468).

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.

At noncropland sites, consider planting native vegetation in areas disturbed due to the diversion construction.

Diversion of upland water to prevent entry into a wetland may convert a wetland by changing the hydrology. In analyzing downslope impacts, minimize adverse effects to existing wetland functions and values. Similarly consider how to maximize wetland functions and values with the diversion design.

Provide construction inspection to ensure that the top of the constructed ridge at any point meets the design depth plus the specified overfill for settlement.

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, substratum material that limits plant growth such as 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 condition or, if not feasible, consider stock piling the topsoil, over excavating the diversion and replace the topsoil over the excavated 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. As a minimum, the plans and specifications must include:

- A plan view of the layout of the diversion.
- Typical cross sections of the diversion(s).
- Profile(s) of the diversion(s) that include both the channel bottom and supporting ridge top.
- Disposal requirements for excess soil material.
- Vegetative establishment requirements.

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.

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 regions 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 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, NRCS. National Engineering Handbook, Part 650, Engineering Field Handbook, Chap. 9, Diversions.

In accordance with Federal civil rights law and U.S. Department of Agriculture (USDA) civil rights regulations and policies, the USDA, its Agencies, offices, and employees, and institutions participating in or administering USDA programs are prohibited from discriminating based on race, color, national origin, religion, sex, gender identity (including gender expression), sexual orientation, disability, age, marital status, family/parental status, income derived from a public assistance program, political beliefs, or reprisal or retaliation for prior civil rights activity, in any program or activity conducted or funded by USDA (not all bases apply to all programs). Remedies and complaint filing deadlines vary by program or incident. Persons with disabilities who require alternative means of communication for program information (e.g., Braille, large print, audiotape, American Sign Language, etc.) should contact the responsible Agency or USDA's TARGET Center at (202) 720-2600 (voice and TTY) or contact USDA through the Federal Relay Service at (800) 877-8339. Additionally, program information may be made available in languages other than English. To file a program discrimination complaint, complete the USDA Program Discrimination Complaint Form, AD-3027, found online at [How to File a Program Discrimination Complaint](#) and at any USDA office or write a letter addressed to USDA and provide in the letter all of the information requested in the form. To request a copy of the complaint form, call (866) 632-9992. Submit your completed form or letter to USDA by: (1) mail: U.S. Department of Agriculture, Office of the Assistant Secretary for Civil Rights, 1400 Independence Avenue, SW, Washington, D.C. 20250-9410; (2) fax: (202) 690-7442; or (3) email: program_intake@usda.gov. USDA is an equal opportunity provider, employer, and lender.