NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

DIVERSION

(Ft.)

CODE 362

DEFINITION

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

PURPOSE

This practice may be applied as part of a resource management system 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 water-spreading or water-harvesting systems.
- Increase or decrease the drainage area above ponds.
- 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 strip-cropping systems.
- Other areas where excess water needs diverted.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies:

- On any or all cropland and other land uses where surface runoff water control and/or management is needed.
- Where soils and topography are such that the diversion can be constructed and a suitable outlet is available or can be provided.
- Where the concentration of water on long, cultivated slopes is causing erosion but sheet and rill erosion predictions indicate that soil loss is within the allowable tolerance.

Diversions shall not be substituted for terraces on land requiring treatment to control sheet and rill erosion.

CRITERIA

General Criteria Applicable to All Purposes

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.

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

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 not be less than 0.3 ft.

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 except for diversions with less than 10 acres drainage area above cropland, pastureland, rangeland, or woodland where the ridge top width may be 3 feet at the design depth. 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. Allowance for settlement shall be 5 percent of design height for diversions constructed with a carryall and 10 percent of design height for diversions constructed with a dozer.

Side slopes shall not be steeper than 3 horizontal to 1 vertical. Flatter side slopes may be desirable to facilitate mowing operations in pasture, or farming operations in cropland.

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

Freeboard. Unless otherwise specified in this standard, freeboard shall be 0.5 feet.

All diversions with permanently vegetated channels with design capacity depths up to 3.0 feet shall have a freeboard of 0.5 feet added. Depths of more than 3.0 feet for design capacity shall require 0.3 feet plus 10% of ridge height for freeboard.

Design depth is the channel storm flow depth plus freeboard.

Grade and velocity. Channel grades may be uniform or variable. Channel velocity shall not exceed that considered non-erosive for the soil and planned vegetation or lining. Maximum design velocities for non-vegetated channels are:

2.5 ft/s for erosion-resistant soils;

2.0 ft/s for average soils; and

1.5 ft/s for easily erodible soils.

Velocity shall be computed by Manning's formula, using a maximum "n" value of 0.035.

Maximum channel velocities for permanently vegetated channels shall not exceed those recommended in the NRCS Engineering Field Handbook (EFH) Part 650, Chapter 7, or Agricultural Research Service (ARS) Agricultural Handbook 667, Stability Design of Grass-Lined Open Channels (Sept. 1987).

When the capacity is determined by the formula Q = A * V and the V is calculated by using Manning's equation, the highest expected value of "n" shall be used.

Permanently vegetated diversions shall be designed using dual retardance techniques. When an "n" value of 0.06 is used, the capacity depth includes freeboard and settlement.

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

Spacing. Diversions used for control of ephemeral gully erosion in cropland fields where sheet and rill erosion computations indicate that soil loss is within the allowable tolerance shall have spacing determined by the method below. In no case shall diversions be spaced farther than 700 feet.

Easily Eroded Soils (sl, fsl, vfsl):

$$HI = (xs + y + 1.0)(100/s)$$

Average Soils (l, sil, sicl, scl):

$$HI = (xs + y + 1.5)(100/s)$$

Erosion Resistant Soils (c, sic, sc, cl):

$$HI = (xs + y + 2.0)(100/s)$$

Where:

HI = horizontal interval in feet

x = 0.6 for area of state west of I-35,
0.5 for area of state east of I-35

s = land slope in percent

y = a variable with values from 1.0 to 4.0

Table 1. Values for "y"

	y Values	
CP_f *	T/K $\geq$ 15.2	T/K < 15.2
< 0.22	4.0	3.5
0.22 – 0.35	3.5	3.0
0.36 – 0.43	3.0	2.0
> 0.43	2.0	1.0

* CP_f is calculated from the RUSLE2 Net C factor (C) times P_f. P_f is the Net Contour factor (Pc) times the Net Ridge factor (Pr).

$$CP_f = C \times Pc \times Pr$$

"T" is the soil loss tolerance

"K" is the soil erodibility factor

Refer to RUSLE2 or appropriate soil loss prediction equations/methods to determine soil loss.

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 insure 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. All components of the underground outlet shall be designed according to the Oklahoma Conservation Practice Standard 620 - Underground Outlet.

The design depth of the water surface in the diversion shall not be lower than the design elevation of the water surface in the outlet at their junction when both are operating at design flow.

Vegetation. Disturbed areas that are not to be cultivated shall be vegetated as soon as practicable after construction.

Diversions shall be vegetated according to Oklahoma Conservation Practice Standard 342 - Critical Area Planting.

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

Specific Criteria Applicable to Level Diversions

A level diversion with partial or complete end closures and channel blocks, when specified, may be used on land of good permeability or with an underground outlet system. Drainage of the diversion through soil infiltration and/or an underground outlet system shall permit draining the design storm from the diversion channel within a reasonable period so crops or vegetation are not significantly damaged by standing water. The combined design capacity for storage, pipe outlets and emergency spill, shall be that needed to handle the 10-year, 24-hour frequency storm runoff. Freeboard and addition for settlement shall not be less than that for gradient diversions. Where partial end closures are used, the design detention storage shall be commensurate with the spillway requirements for Oklahoma Conservation Practice Standard 378 - Pond.

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 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 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.

On landforms where archeological sites are likely to occur, use techniques to maximize identification of such sites prior to planning, design, and construction.

PLANS AND SPECIFICATIONS

Plans and specifications for installing diversions shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose.

OPERATION AND MAINTENANCE

A written operation and maintenance plan shall be developed for the client to use. 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:

1. Provide periodic inspections, especially immediately following significant storms.
2. Promptly repair or replace damaged components of the diversion as necessary.
3. 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.
4. 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.
5. Redistribute sediment as necessary to maintain the capacity of the diversion.
6. Vegetation shall be maintained to the desired height and trees and brush controlled by hand, chemical and/or mechanical means.
7. Keep machinery away from steep sloped ridges. Keep equipment operators informed of all potential hazards.

NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE GENERAL SPECIFICATIONS

DIVERSION

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CONSTRUCTION SPECIFICATIONS

All ditches or gullies not filled, and undesirable trees and other obstructions not removed before construction begins shall be part of the diversion construction. The diversion shall be constructed to planned and staked alignment, grade, and cross section.

The banks of all gullies and ditches to be crossed shall be sloped not steeper than 1.5 horizontal to 1 vertical prior to or during construction. All trees, brush, stumps, and other objectionable material that is hazardous to the safe functioning of the diversion shall be removed from within the construction area.

Borrow material shall be taken from the channel unless otherwise specified. The channel shall be constructed to the specified grade lines. The ridge shall have the minimum specified top width at the designed depth. All slopes and fills shall be full-bodied from top to toe. The equipment shall be routed so that the best compaction practical will be obtained.

The outlet end of the gradient diversions shall have an opening equal to or greater than the cross sectional area of the channel.

Partial or complete end closures and channel blocks, when specified, for level diversions shall be in place before the diversion is considered complete.

Any ditch or channel made at the bottom edge of the back slope while moving earth from the back side into the diversion ridge shall be shaped, as necessary, so that drainage from the back slope of the diversion will not flow parallel to it.

Construction tolerances may be allowed within the following limitations:

Gradient diversions

Channel blocks or "highs" of 0.3 feet or 15% of the design depth, whichever is greater, may be allowed in the channel profile for all diversions where such tolerance does not affect the design depth requirements.

A constructed grade of 0.6 feet may be allowed in the last 100 feet of the spill end of the diversion. The constructed grade may be steeper than 0.6 feet if design warrants.

Acceptable average grades for diversions are those within $\pm$ 0.10 feet per 100 feet of the design grade, excluding the first and last 100 feet, as long as there is a positive grade. This average grade shall be figured for the diversion length excluding 100 feet on each end. A tolerance of $\pm$ 0.20 feet per 100 feet may be allowed for not more than 300 feet consecutive length where this does not cause the average grade mentioned above to exceed the specified tolerance from design grade.

Level diversions

The maximum tolerance between high and low points in the constructed flat channel diversion bottom is 0.4 feet over the entire length and width of the channel, except where low areas are a part of the design, where such tolerance does not affect the design detention storage or height requirements.

All Diversions

Acceptable side slopes for the channel and ridge for all diversions shall not steepen the design slopes by more than 0.5 horizontal to 1 vertical.

If underground conduits are located under diversion ridges, the wall of the trench for the conduit shall be sloped to a 1½:1 slope, or soil

around the conduit shall be mechanically compacted or water packed. For new diversions, 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 in Oklahoma Conservation Practice Standard 606 - Subsurface Drain. Diversion ridges constructed across gullies or depressions shall be compacted sufficiently to keep settlement within tolerable limits. The surface of the finished diversion shall be reasonably smooth and present a workmanlike appearance.

Underground outlets shall be installed at locations shown on the drawings or as staked in the field. Refer to the Oklahoma Conservation Practice Standards and Specifications for Underground Outlet (620) for installation requirements.

Topsoil should be stockpiled and spread over excavations and other areas to facilitate revegetation. If vegetation is needed, seedbed preparation, seeding, fertilizing, and mulching shall comply with standards in local technical guides.

VEGETATIVE SPECIFICATIONS

Seedbed preparation; seeding dates, mixtures, and rates; stabilizing measures; mulching; fertilizer; and lime requirements shall be specified for each area using the Critical Area Planting specification as a guide.