Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

SURFACE DRAIN, MAIN OR LATERAL

Code 608

(Ft.)

DEFINITION

An open drainage ditch for moving the excess water collected by a field ditch or subsurface drain to a safe outlet.

PURPOSE

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

- To convey excess surface or shallow subsurface water from a field ditch to a safe outlet.
- To convey excess subsurface water from a subsurface drain to a safe outlet.

CONDITIONS WHERE PRACTICE APPLIES

This standard applies to ditches that receive and convey drainage water from surface and subsurface drains.

This standard does not apply to collection of water from the surface or subsurface of the field. Use Conservation Practice Standard (CPS) Code 607, Surface Drain, or Code 606, Subsurface Drain, for that function.

CRITERIA

General Criteria Applicable to All Purposes

If wetlands are present then complete an appropriate wetland determination per established procedures.

Drainage Requirements. Locate and design mains and laterals to serve as integral parts of a surface or subsurface drainage system that meets the conservation and land use needs.

Capacity. Size the ditch capacity to provide for the removal of excess water, based on climatic and soil conditions and the needs of crops. Base the design capacity of the ditch on the watershed area; the topographic, soil, and land use information; and use of the appropriate drainage curves or coefficients.

In irrigated areas, the capacity analysis will include the effect of irrigation water deliveries, irrigation canal or ditch losses, soil stratification and permeability, deep percolation losses, field irrigation losses, subsurface drain discharge, and quantity of surface water to be carried by the drainage ditch.

Whether the outlet is by gravity flow or by pumping, design the outlet to be sufficient for the quantity and quality of water conveyed.

Protect the structural integrity and flow capacity of existing structures such as bridges or culverts within the system.

Hydraulic Grade Line. Determine the hydraulic grade line for drainage ditch design from control points, including elevations of significant low areas served by the ditch and hydraulic grade lines of any tributary ditches and the outlet. Set the hydraulic grade line of the ditch low enough to provide positive drainage into the ditch during the design flow event, plus calculated freeboard, or a minimum of 0.5 feet.

Account for the effects of hydraulic losses caused by culverts, bridges, or other obstructions in the channel section in the design. Design culverts and bridges with sufficient hydraulic capacity and depth to satisfy drainage needs and to minimize obstruction to flow. Use CPS Code 578, Stream Crossing.

Depth. Design the drainage ditch deep enough to allow for normal siltation. For a ditch that serves as an outlet for subsurface drains, design for a normal water surface at or below the invert of the outlet end of the drain. The normal water surface is the elevation of the usual base flow during the growing season. Where site conditions allow, design the flow line elevation of the main or lateral to be at least 1 foot lower than the invert elevations of subsurface drains or field ditches that outlet into the main or lateral.

Cross Section. Design the ditch cross section to meet the combined requirements of capacity, limiting velocity, depth, side slopes, bottom width, and, if needed, allowances for initial sedimentation, all below the design hydraulic grade line. Design side slopes based on site conditions to be stable and meet maintenance requirements.

Where a low-flow or two-stage channel is planned, use the design process in NRCS National Engineering Handbook (NEH), Part 654.1005.

Use the drainage guide or other local information to determine side slope limits for specific soils and/or geologic materials. If such information is not available, set the design side slopes in the main or lateral no steeper than those recommended for ordinary conditions in NRCS NEH, Part 650, Engineering Field Handbook, Chapter 14, Section 650.1412 (d). Account for side-slope stability during rapid drawdown conditions in the design.

Velocity. Ensure stability of the ditch bottom and side slopes. Base the maximum permissible design velocity, or maximum permissible stress, on site conditions. Avoid potential for excessive sedimentation accounting for the soils and sediment delivery amount for the particular location. Without site specific information, the minimum design velocity is 1.4 feet per second.

The velocity for newly constructed channels with drainage areas in excess of 1 square mile must meet the stability requirements specified for the CPS Code 582, Open Channel.

Use Manning's equation to determine the design velocity. Select Manning's n value based on channel hydraulic radius, channel alignment, an aged channel condition, and probable vegetative growth expected under normal maintenance. Unless special site studies are available to justify other values, use the appropriate Manning's n factor in NRCS NEH, Part 650, Engineering Field Handbook, Chapter 14, Section 650.1412 (d), or in the local drainage guide, to determine the required design capacity.

Berms and Spoil Banks. Locate adjacent berms at a safe distance from the drain and shape berm-side slopes as required to:

- Provide access for maintenance equipment; eliminate the need for moving spoil banks in the future;
- Provide for work areas and facilitate spoil bank spreading; prevent excavated material from washing or rolling back into ditches; and
- Lessen sloughing of ditch banks caused by heavy loads near the edge of the ditch banks.

Spread spoil material as soon as practical in accordance with NRCS CPS Code 572, Spoil Spreading.

Where spoil material is placed along the ditch rather than spread over adjacent fields, ensure that the spoil banks have stable side slopes. Make provision to convey water flows through the spoil bank and into the ditch without causing serious erosion Maximum berm height is 3 feet above original ground. Minimum berm width is shown in table 1.

Table 1 - Minimum berm width as a function of ditch depth

Ditch depth (ft)	Minimum berm width (ft)
<6	8
6–8	10
>8	15

Related Structures and Ditch Protection. Protect drainage mains and laterals against erosion where surface water or shallow ditches enter deeper ditches. Use suitable measures such as chutes, drop structures, pipe drops, grassed waterways, critical area planting, filter strips, or specially graded channel entrances to minimize side inlet erosion. Use grade control structures, bank protection, or other suitable measures if necessary to reduce velocities and control erosion. Grade control structures must meet the criteria in NRCS CPS Code 410, Grade Stabilization Structure.

Protect structures from washout by flows exceeding design capacity.

Design each structure for an open-ditch system according to NRCS standards for the kind of structure and type of construction used.

Provide a travel way if needed for movement and operation of equipment required for maintenance of the channel.

Channel vegetation. Establish vegetation according to CPS Code 342, Critical Area Planting. If natural revegetation will adequately control erosion, provide documentation regarding the time for establishment of protection and needed efforts to control invasive species.

CONSIDERATIONS

When planning this practice consider—

- The use of a low-flow or two-stage channel design.
- Impacts of sedimentation downstream.
- Possible damages above or below the point of discharge that might involve legal actions or other offsite impacts.
- Potential impacts on wetlands.
- Impacts on cultural resources.
- Use of riparian buffers, filter strips, and fencing.
- Potential water quality effects of soluble pollutants and sediment-attached pollutants.
- Impacts to wildlife.
- Impacts of invasive species movement and establishment through the drainage network.

PLANS AND SPECIFICATIONS

Prepare plans and specifications for constructing the drainage main or lateral in keeping with this standard and describing the requirements for constructing the practice to achieve its intended purpose.

The owner or operator is responsible for securing all required permits or approvals and for performing in accordance with such laws and regulations. The landowner and/or contractor is responsible for locating all buried utilities in the project area, including drainage tile and other structural measures.

Plans and specification shall include, but not limited to—

- Typical cross sections of the lateral.
- Grade of drains.
- Spacing of drains.
- Location of drains.
- Detail of structures.
- Vegetative requirements, if applicable.
- Outlet protection if needed.

OPERATION AND MAINTENANCE

Provide a site-specific operation and maintenance plan to the landowner or operator before the practice is installed.

Include guidance in the plan for the routine maintenance and operational needs of the drainage ditch. Include guidance on periodic inspections and post-storm inspections to detect and minimize damage to the drain.

REFERENCES

USDA NRCS National Engineering Handbook, Part 650, Engineering Field Handbook, Chapter 14, Water Management (Drainage).

USDA NRCS National Engineering Handbook, Part 654, Stream Restoration Design, Chapter 10, Two-Stage Channel Design.