NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

SURFACE DRAIN, MAIN OR LATERAL

(Ft.)

CODE 608

DEFINITION

An open drainage ditch constructed to a designed cross section, alignment, and grade.

PURPOSE

This practice is applied as part of a water management system to collect and convey excess surface or subsurface water.

CONDITIONS WHERE PRACTICE APPLIES

This standard applies to ditches for conveyance of surface and subsurface drainage water primarily collected by drainage field ditches and subsurface drains. It provides minimum drainage requirements for channels that provide drainage outlets for agricultural lands.

This standard does not apply to the collection of water from within a field. Conservation Practice Standard 607, Surface Drain, Field Ditch, should be used for that situation.

All lands to be drained shall be suitable for agriculture after installation of required drainage and other conservation practices.

CRITERIA

This practice shall conform to all federal, state, and local laws, rules, and regulations especially those involving water rights, land use, pollution control, property easements, wetlands, preservation of cultural resources, and endangered species. A wetland determination shall be used to document that National Environmental Policy Act (NEPA) and National Food Security Act Manual (NFSAM) provisions concerning wetlands are met for both the excavation and spoil areas. If a certified wetland determination does not exist for the area, one shall be completed as part of the planning process.

The landowner shall be responsible for obtaining and complying with all applicable permits.

Drainage requirements. Mains and laterals shall be located and designed to serve as integral parts of a surface or subsurface drainage system that meets the conservation and land use needs.

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

The required capacity of open ditches for subsurface drainage in irrigated areas shall be determined by evaluating site conditions, 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, the outlet shall be sufficient for the quantity and quality of water conveyed.

Structures constructed under this practice shall not compromise the structural integrity or flow capacity of existing structures within the system (for example, bridges or culverts).

Hydraulic grade line. The hydraulic grade line for drainage ditch design shall be determined from control points, including elevations of significant low areas served by the ditch and hydraulic grade lines of any tributary ditches and the outlet. If control point elevations are estimated rather than computed from survey data, the hydraulic grade line shall be no less than the following:

- 1 foot below fields that will receive normal drainage from ditches draining more than 640 acres (1 square mile).
- 0.5 foot for ditches draining 40 to 640 acres.
- 0.3 foot for ditches draining less than 40 acres.

For lands to be used only for water-tolerant crops such as certain trees and grasses, these requirements may be modified and the hydraulic grade line set at ground level. These provisions do not apply to channels where dikes contain flow.

The effects of hydraulic losses caused by culverts, bridges, or other obstructions in the channel section shall be accounted for in the design. Culverts and bridges shall have sufficient hydraulic capacity and depth to satisfy drainage needs and to minimize obstruction to flow.

Depth. Drainage ditches shall be designed deep enough to allow for normal siltation. Ditches that serve as outlets for subsurface drains shall be designed 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 low flow during the growing season. Where site conditions allow, the invert elevation of the main or lateral shall be at least 1 foot lower than the invert elevation of subsurface drains or field ditches that outlet into the main or lateral.

Cross section. The design ditch cross section shall be set below the design hydraulic grade line and shall meet the combined requirements of capacity, limiting velocity, depth, side slopes, bottom width, and (if needed) allowances for initial sedimentation. Side slopes shall be stable, shall meet maintenance requirements, and shall be designed based on site conditions.

The design side slopes in the main or lateral shall not be steeper than those recommended for ordinary conditions in Section 650.1412(d) in National Engineering Handbook Part 650 (NEH 650), *Engineering Field Handbook*. Stability during rapid drawdown conditions must be considered.

Velocity. The maximum permissible design velocity shall be based on site conditions and shall ensure stability of the ditch bottom and side slopes. Design velocities shall not be less than 1.4 feet per second to avoid excessive sedimentation.

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

Manning's equation shall be used in determining the design velocity. Manning's equation roughness coefficient "*n*" value shall be 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, the appropriate Manning's "*n*" value in Section 650.1412(d) in NEH 650 shall be used to determine the required design capacity.

Berms and spoil banks. Adequate berms at a safe distance from the drain shall be provided and shaped 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. Spoil material shall be spread as soon as practical. Minimum berm widths shall be those recommended in Section 650.1412(d) in NEH 650 except where the spoil is spread according to CPS 572, Spoil Spreading.

Where spoil material is to be placed in banks along the ditch rather than spread over adjacent fields, the spoil banks shall have stable side slopes. Provision must be made to convey water flows through the spoil bank and into the ditch without causing serious erosion.

Related structures and ditch protection. Mains and laterals shall be protected against erosion where surface water or shallow ditches enter deeper ditches. This may be achieved through the use of suitable measures such as chutes, drop structures, pipe drops, grassed

waterways, critical area seeding, filter strips, or specially graded channel entrances.

Grade control structures, bank protection, or other suitable measures shall be used if necessary to reduce velocities and control erosion. Grade control structures shall meet the CPS 410, Grade Stabilization Structure.

Structures shall be protected from washout by flows exceeding design capacity.

Each structure for an open ditch system shall be designed according to Natural Resources Conservation Service conservation practice standards for the kind of structure and type of construction used.

Channel vegetation. Vegetation shall be established according to CPS 322, Channel Bank Vegetation.

CONSIDERATIONS

- The use of a low-flow or 2-stage channel design.
- Impacts of sedimentation downstream.
- Possible damages above or below the point of discharge that might involve legal actions or other off-site impacts.
- Potential impacts on wetlands.
- Impacts on cultural resources.
- Use of riparian buffers, filter strips, and fencing.
- Potential water quality impacts of soluble pollutants and sediment-attached pollutants.
- Impacts to wildlife.
- Impacts of invasive species movement and establishment through the drainage network.

PLANS AND SPECIFICATIONS

Plans and specifications for constructing mains or laterals shall be in keeping with this standard and shall describe the requirements for constructing the practice to achieve its intended purpose.

OPERATION AND MAINTENANCE

A site-specific operation and maintenance plan shall be provided to and reviewed with the landowner(s) before the practice is installed. The plan shall adequately guide the landowner(s) in the routine maintenance and operational needs of the surface main or lateral. The plan shall also include guidance on periodic inspections and post-storm inspections to detect and minimize damage to the drain.

Drainage mains or laterals with drainage areas in excess of 1 square mile shall meet the operation and maintenance requirements specified in CPS 582, Open Channel.

REFERENCES

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