Surface Drainage, Main or Lateral (Ft.) 608

DEFINITION

An open drainage ditch constructed to a designed size and grade.

PURPOSE

This practice may be 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 multiple-purpose channels that provide drainage outlets for agricultural lands. Mains or laterals having a drainage area of more than 1 mi^2 (2.6 km^2) must meet the stability and maintenance requirements of the NRCS conservation practice standard Open Channel (582). This standard does not apply to collection of water with a drainage field ditch. NRCS conservation practice standard Surface Drainage, Field Ditch (607) 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.

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

CRITERIA

General Criteria Applicable to All Purposes

Surface Drainage Mains or Laterals shall be planned, designed, and installed to meet all federal, state, local and tribal laws and regulations.

Surface Drainage Mains or Laterals shall be designed according to the principles set forth in the National Engineering Handbook, Part 650, Engineering Field Handbook, Chapter 14, Water Management (Drainage), or other applicable publications and reports.

The design and installation shall be based on adequate surveys and investigations. The landowner(s) 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 and the degree of drainage required by the crops.

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 required capacity shall be obtained by determining the watershed area; the required topographic, soil, and land use information; and use of the appropriate drainage curves in National Engineering Handbook, Part 650, Engineering Field Handbook, Chapter 14, Water Management (Drainage), Section 650.1410.

The required capacity of open ditches for subsurface drainage in irrigated areas shall be determined by evaluating site conditions, including 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.

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

1. 1 foot (300 mm) below fields that will receive normal drainage from ditches draining more than 1 mi^2 (2.6 km^2).
2. 0.5 feet (150 mm) for ditches draining 40 to 640 acres (16 to 260 ha).
3. 0.3 ft. (90 mm) for ditches draining less than 40 acres (16 ha).

For lands to be used only for water-tolerant crops, such as certain trees and grasses, these requirements may be modified and the hydraulic gradeline 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 considered.

Depth. Drainage ditches shall be designed deep enough to allow for normal sediment accumulation. 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 clearance between a subsurface drain outlet invert or a field ditch invert shall be at least 1 foot (300 mm) to account for sediment accumulation in the main or lateral.

Cross section. The design ditch cross section shall be set below the design hydraulic gradeline 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 on the basis of on-site conditions. The design side slopes in the main or lateral shall not be steeper than those shown in National Engineering Handbook, Part 650, Engineering Field Handbook, Chapter 14, Water Management (Drainage), Section 650.1412 (d). 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 ft/sec (0.4 m/sec) to avoid excessive sedimentation.

The velocity for newly constructed channels with drainage areas in excess of 1 mi^2 (2.6 km^2) shall meet the stability requirements specified for NRCS conservation practice standard Open Channel (582).

Capacity design. Manning's equation shall be used in determining the design velocity, and the value of the retardance factor "*n*" shall be based on alignment, probable vegetative growth expected with normal maintenance, other roughness factors, and the hydraulic radius. Unless special site studies are available to justify other values, the values of *n* in National Engineering Handbook, Part 650, Engineering Field Handbook, Chapter 14, Water Management (Drainage), Section 650.1412 (d), shall be used in solving Manning's equation for mains and laterals when determining the design for required 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, to eliminate the need for moving spoil banks in future operations, to provide for work areas and facilitate spoil bank spreading, to prevent excavated material from washing or rolling back into ditches, and to lessen sloughing of ditchbanks caused by heavy loads too near the edge of the ditchbanks. The spoil shall be spread as soon as practical. Minimum berm widths shall be those recommended in National Engineering Handbook, Part 650, Engineering Field Handbook, Chapter 14, Water Management (Drainage), Section 650.1412 (d).

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. In areas where spoil spreading is specified on the design, the slope of the spoil after spreading shall not be steeper than 4:1 on the land side and 3:1 on the channel side when a berm is established. Provision must be made to convey runoff water through the spoil bank and into the ditch without causing 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 chutes, drop structures, pipe drops, other suitable structures or 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.

Culverts and bridges shall have sufficient hydraulic capacity and depth to satisfy drainage needs and to minimize obstruction to flow.

Capacities of pipe or drop structures shall be determined by use of the applicable drainage coefficients. The "island-type" method of construction shall be used to protect the structure from washout by flows exceeding design capacity.

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

Outlet. The surface drainage main or lateral shall have a stable outlet with adequate capacity to discharge the degree of drainage from the site.

Channel vegetation. Vegetation shall be established according to NRCS conservation practice standard Critical Area Planting (342).

Use vegetation adapted to the site that will accomplish the desired purpose. Preference shall be given to native species in order to reduce the introduction of invasive plant species; provide management of existing invasive species; and minimize the economic, ecological, and human health impacts that invasive species may cause. If native plant materials are not adaptable or proven effective for the planned use, then non-native species may be used. Refer to the Field Office Technical Guide, Section II, Invasive Plant Species, for plant materials identified as invasive species.

CONSIDERATIONS

Consider the potential effects of installation and operation of surface drainage mains or laterals on the cultural, archeological, historic and economic resources.

Consider possible damages above or below the point of discharge that might involve legal actions or other offsite impacts.

Consider potential impacts on wetlands.

Consider use of riparian buffers, filter strips and fencing.

Consider potential water quality impacts for soluble pollutants and attached sediment pollutants.

PLANS AND SPECIFICATIONS

Plans and specifications shall be prepared in accordance with the criteria of this standard and shall describe the requirements for applying the practice to achieve its intended use.

Support data documentation requirements are as follows:

- Inventory and evaluation records
  - Assistance notes or special report
- Survey notes, where applicable
  - Design survey
  - Construction layout survey
  - Construction check survey
- Design records
  - Physical data, functional requirements and site constraints, where applicable
  - Soils/subsurface investigation report, where applicable
- Design and quantity calculations
- Construction drawings/specifications with:
  - Location map
  - "Designed by" and "Checked by" names or initials
  - Approval signature
  - Job class designation
  - Initials from preconstruction conference
  - As-built notes
- Construction inspection records
  - Assistance notes or separate inspection records
  - Construction approval signature
- Record of any variances approved, where applicable.
- Record of approvals of in-field changes affecting function and/or job class, where applicable.

OPERATION AND MAINTENANCE

An Operation and Maintenance (O&M) plan shall be developed for this practice. The O&M plan shall be consistent with the purposes of the practice, its intended life, safety requirements, and the criteria for the design.