NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

SURFACE DRAINAGE

MAIN OR LATERAL

(ft)

CODE 608

DEFINITION

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

SCOPE

This standard applies to ditches for disposal 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 must meet the stability and maintenance requirements of the standard for Open Channels (582). Field Ditch (607), for the disposal of surface water is not applicable.

PURPOSE

To dispose of excess surface of subsurface water, intercept ground water, control ground water levels, provide for leaching of saline or alkali soils, or a combination of these objectives.

CONDITIONS WHERE PRACTICE APPLIES

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

In areas where an outlet for the drainage system will be available, either by gravity flow or by pumping. The outlet shall provide for the quantity and quality of water to be disposed of. Consideration shall be given to possible damages above or below the point of discharge that might involve legal actions.

PLANNING CONSIDERATIONS

Water Quantity

1. Effects on the water budget components, especially with regard to effect on runoff, soil water, and water tables.
2. Potential changes in soil moisture that will affect the growth of desirable vegetation.
3. Effect on ground water recharge.

Water Quality

1. Effects on the detachment and transport of sediment and chemicals and dissolved and sediment-attached substances into water courses.
2. Effects on the salinity of drained soils and downstream water courses.
3. Effects on wetlands.
4. Effect on the quality of ground water.
5. Potential for changes in downstream water temperatures.
6. Effects on downstream visual quality.

DESIGN CRITERIA

The design and installation shall be based on adequate surveys and investigations.

Investigations. A detailed site investigation shall be made for each surface drain prior to design. This investigation should include, but not be limited to evaluations of utilities in the construction area, wetlands, soil, and other environmental factors.

If wetlands appear to be involved, a wetland determination/delineation shall be made by Corp of Engineers (COE) and/or NRCS. If wetlands are involved, a 401 State water quality certification and a COE 404 permit may be needed.

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. The degree of drainage required by the crops shall be determined and expressed in terms of drainage coefficients or depth and spacing of drains.

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 coefficient curves.

The drainage curves 45M $^{5}/_{6}$ for cultivated land, 30M $^{5}/_{6}$ for pastureland and 10M $^{5}/_{6}$ for forest in the Engineering Field Handbook, Chapter 14, Exhibit 14-3 are to be used to determine the flow capacity of mains and laterals.

The required capacity of open ditches for subsurface drainage in western 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 ft. below fields that will receive normal drainage from ditches draining more than 1 mi^2.
2. 0.5 ft for ditches draining 40 to 640 acres.
3. 0.3 ft for ditches draining less than 40 acres.

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

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 siltation. If needed, the design depth and capacity may be increased to provide adequate subsurface drainage or for normal flow. The increase shall be based on an

evaluation of site conditions. 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 clearance between a drain invert and the ditch bottom shall be least 1 ft. for ditches that fill with sediment at a normal rate, except where lower valves are specified for a job because of unusual site conditions. The normal water surface is the elevation of the usual low flow during the growing season.

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.

Velocity. The maximum permissible design velocity shall be based on site conditions and shall insure stability of the ditch bottom and side slopes. (Refer to Table 14-2, Engineering Field Handbook, Chapter 14). A desirable minimum velocity is 1.5 ft/s. On flat grades, a channel cross section shall be selected on the basis of the depth and maintenance requirements, which will result in the desirable minimum velocity if possible.

The velocity for newly constructed channels with drainage areas in excess of 1 mi^2 shall meet the stability requirements specified for Open Channels (582).

Capacity design. Manning's Formula shall be used in determining the design velocity, and the value of *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 following values of *n*, based on the hydraulic radius of the channel and assuming an aged channel with good maintenance and good alignment, shall be used in solving the Manning Formula for mains and laterals when determining the design for required capacity.

Hydraulic radius	*n*
Less than 2.5	.040 — .045
2.5 to 4.0	.035 — .040
4.1 to 5.0	.030 — .035
More than 5.0	.025 — .030

Berms and spoil banks. Adequate berms 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 spoilbank 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 following minimum berm widths shall be provided, except where spoil is spread according to the engineering standard for spoilbank spreading:

Ditch depth	Minimum berm width
ft	*ft*
2 — 6	8
6 — 8	10
More than 8	15

If spoil material is to be placed in banks along the ditch rather than spread over adjacent fields, the spoilbanks shall have stable side slopes.

Provision must be made to channel water through the spoil and into the ditch without causing serious erosion.

Operation and maintenance. Requirements for operating and maintaining all drainage mains and laterals having drainage areas in excess of 1 mi^2 shall be according to the standard for Open Channels (582).

Related structures and ditch protection. Mains and laterals shall be protected against erosion by chutes, drop structures, pipe drops, other suitable structures or grassed waterway, or specially graded channel entrances where surface water or shallow ditches enter deeper ditches.

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 enough hydraulic capacity and depth for drainage needs and to minimize obstruction to flow.

Capacities of pipe or drop structures generally shall be determined by use of the applicable drainage coefficients with the "island-type" of construction used to protect the structure from washout.

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

Channel vegetation. Vegetation shall be established according to the standard for Channel Vegetation, Code 322, or Critical Area Planting, Code 342.

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.

REFERENCES

Engineering Field Handbook, Chapter 14
NRCS Conservation Practice Standards
Code 342 - Critical Area Planting
Code 582 - Open Channel
Code 322 - Channel Vegetation
Code 607 - Surface Drainage, Field Ditch

SURFACE DRAINAGE
MAIN OR LATERAL

Specification Guide

CLEARING

The channel area shall be cleared of trees, logs, stumps, and other materials necessary for construction. Care must be taken to protect all trees to be saved for environmental purposes. All material shall be disposed of by an acceptable method as shown on the plans.

EXCAVATION

Channels shall be excavated to line and grade as shown on the plans or as staked in the field. The excavated surface shall be reasonably smooth. Construction activities shall be carried on in a manner that will not restrict flow from upstream channels. Care must be taken to reduce and prevent pollution of water.

SPOIL

Spoil shall be disposed of as shown on the plans or as marked in the field. The spoil shall be graded so that runoff is directed away from the main or lateral.

STRUCTURES

All structures and other related protection devices shall be installed as the work progresses to permit proper functioning of the ditch and to prevent environmental damage during the installation period.

VEGETATION

Vegetation shall be planted at times and rates shown in the plans or in the specifications for each job.

SURFACE DRAINAGE, MAIN OR LATERAL

ENGINEERING NOTEKEEPING

Design Survey, Design and Plans

A. A plan-profile drawing will be prepared for all class II and larger jobs and all jobs involving underground public utilities. Drawings will be prepared on standard sheets or state approved forms. When plan profiles are not required, information to support design will be recorded in the engineering field book or case file as appropriate. The following will be included either on the drawings or in the engineering field book as appropriate:

1. Location map.
2. Profile of main.
3. Design grades.
4. Typical cross section showing side slopes, berm width, bottom width, and method of spoil disposal.
5. Drainage area.
6. Group jobs require a drainage area map showing the location of ditches, apparent property lines and ownership along the works of improvement.
7. Structures where applicable.
8. Soil borings where applicable.
9. Yardage calculations when needed for performance certification.
10. Outlet conditions.
11. Cross reference to appropriate engineering field books will be made on drawings and plans.
12. Recommendations for channel vegetation.

Construction Check

A. A sampling process may be used in obtaining supporting data for a job consisting of a number of similar ditches. The sample should be taken from segments or parts that appear least likely to meet specifications. In such cases the person doing the checking should be satisfied that the entire job meets specifications and record adequate supporting data for the selected sample.

Supporting data and a signed certification may be accepted from qualified contractors. The certification shall include appropriate information and measurements to show that standards and specifications have been met. These backup data need not necessarily follow the format used by NRCS but must be understandable and legible. Each year an NRCS Construction Check shall be made, recorded, and filed on 5% of the jobs installed by each contractor making his own certifications.

B. The following information shall be recorded as supporting data when the job is completed.

1. At least one ditch cross section and others as necessary are to be taken to show that side slopes, depth, bottom width, spoil disposal, and berm widths meet specifications.
2. Show grade of completed ditch. The horizontal interval between profile shots will depend upon the uniformity of the topography and the quality of construction. Generally, readings should be taken at least once every 400 feet. Where layout hubs are still in place, the check may be made from them.
3. Length of all ditches installed.
4. Data on all structures installed.
5. Adequacy of outlet.
6. Certification that practice meets standards and specifications. Note any exceptions.
7. Date and signature of persons making the construction check.

C. When construction checks are made of a system of parallel shaped bucket ditches, check out notes need to be recorded for only one representative ditch. A minimum of one cross section will be taken. Grade checks shall be made as determined necessary by the individual approving the design. Visual inspection may be used as construction checks for all the remaining ditches in the system unless the responsible employee determines that more construction checks are needed. Documentation of this visual check will be made as part of the construction check.

Recording Data

All field survey notes and construction check data will be recorded in a standard engineering field book or other approved forms in accordance with Technical Release 62 and Chapter 1, Engineering Field Handbook.