NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

IRRIGATION FIELD DITCH

(Ft.)

CODE 388

DEFINITION

A permanent irrigation ditch constructed in or with earth materials, to convey water from the source of supply to a field or fields in an irrigation system.

PURPOSE

This practice may be applied as part of an irrigation water management system to efficiently convey and distribute irrigation waters.

CONDITIONS WHERE PRACTICE APPLIES

This standard is limited to open channels and elevated ditches of 25 cubic feet per second (cfs) or less in capacity and constructed of earth materials.

This standard applies where field ditches are needed as an integral part of an irrigation water distribution system design to facilitate the conservation use of soil and water resources.

CRITERIA

All planned work shall comply with all federal, state and local laws and regulations.

Water supplies and irrigation deliveries for the area served shall be sufficient to make irrigation practical for the crops to be grown and the irrigation water application methods to be used.

Field ditches shall be constructed in earth material that contains enough fines to prevent excessive seepage losses and where shrinkage cracks will not endanger the ditch, or cause down gradient water quality problems. The sealing effect of sediment carried in the irrigation water may be considered.

Capacity requirements. Field ditches shall have adequate capacity to deliver:

1. The design peak consumptive use of the crop(s) to be grown in the field, with proper provisions for the expected field irrigation efficiency.
2. The largest irrigation stream required for the irrigation method(s) planned for the field.

The design capacity shall include additional flow required to compensate for the ditch seepage loss and to safely carry surface runoff from adjacent lands that must be transported to waterways or overflow points.

For capacity design, the value of Manning's "n" shall be selected according to the materials in which the ditch is constructed, the alignment and hydraulic radius, and the additional retardance due to vegetation.

Velocities. Field ditches shall be designed for flows that are non-erosive for the soil materials in which they are constructed. Local information, such as the Louisiana Drainage Guide, on the velocity limit for specific soils shall be used if available. If such information is not available, the maximum design velocity shall not exceed those shown in Table 1 below.

For checking designs to see that velocities do not exceed permissible values, a Manning's "n" no greater than 0.025 shall be used, and applicable criteria in NRCS conservation practice standard for Open Channels (582) shall be followed.

Table 1. Permissible Design Velocities

Soil Texture & Unified Soil Classification Symbol	Maximum Velocity (ft/sec)
Silts and very fine sandy loams (ML, CL-ML, SP)	1.0
Silty clay loams, fine sandy loams, sandy loams, and Loams (CL, SM)	2.0
Silty clays, sandy clay loams, clay loams and sandy Clays (CL, CH, SC)	3.0
Stiff clays and high plastic soils (CH, MH)	4.0

Water surface elevations. The design water surface elevation for field ditches shall be determined from control points including significant high areas served by the ditches, hydraulic gradients of any lateral ditches, and the elevation of the irrigation water source. All field ditches shall be designed so that the water surface elevations at field takeout points are high enough to provide the required flow onto the field surface. If ditch checks or other control structures are to be used to provide the necessary head, the backwater effect must be considered in computing freeboard requirements.

The required water surface elevation above the field surface will vary with the type of takeout structure or device used and the amount of water to be delivered through each. A minimum head of 4 inches shall be provided.

The effects of hydraulic losses caused by culverts, bridges, irrigation structures and other obstructions in the channel sections shall be considered.

Where minimum cross section required by the construction equipment will exceed the design cross-section, the grade of the hydraulic gradient shall be checked and adjusted to approximate that which will actually exist when the ditch is carrying the design flow.

Cross section. Freeboard in field ditches shall be not less than one-third of the maximum design depth of water, to a maximum freeboard of 0.5 feet. Side slopes shall be stable, meet maintenance requirements, and be designed to meet site conditions. Local information, such as the Louisiana Drainage Guide, on the side slope limit for specific soils shall be used if available. The top width of banks as measured at the elevation providing the required freeboard shall be not less than 12 inches and shall equal or exceed one-half the flow depth.

The design ditch cross section shall be set below the hydraulic gradient and shall meet the combined requirements of capacity, limiting velocity, depth, side slopes, bottom width, and allowance for sedimentation.

Minimum design side slopes of ditches excavated below normal ground (forebays for irrigation pumps, relifts, slips, etc.) shall be 1 horizontal to 1 vertical.

A berm is not required on ditches constructed below normal ground when spoil spreading is to be done at the time the ditch is constructed. Where spoil is not to be spread at this time, the minimum design berm width between the slope edge of the ditch and the toe of the spoil shall not be less than the values shown in Table 2.

Table 2. Minimum Berm Widths

Average Ditch Depth (feet)	Berm Width (feet)
4.0 or less	4
4.1 to 6	6
Over 6	10

Elevated Ditch Cross Section Criteria. The following cross section criteria shall apply to irrigation field ditches constructed above normal ground.

If a field ditch is to be constructed on a fill section, side slopes of the fill shall not be steeper than the values shown in Table 3.

Table 3. Minimum Side Slopes[1/]

Height of fill to water surface on centerline of fill (feet)	Steepest allowable side-slope of fill (horizontal to vertical)
< 3	1½:1
3 – 6	2:1
> 6	2½:1

1/Measured from hydraulic gradient to normal ground.

Minimum design side slopes of borrow areas adjacent to levees shall be 1½ horizontal to 1 vertical.

Levees constructed with blade equipment. Levees with design heights of 4 feet or less may have 0 (zero) top widths provided side slopes are 2½:1 or flatter.

Levees with settled heights greater than 4 feet, or with side slopes steeper than 2½:1 shall have a minimum design top width as shown in Table 4.

The design freeboard shall not be less than one-third of the maximum design depth of water, and in no case less than 0.5 foot.

The allowance for levee settlement shall not be less than 20 percent of the design levee height for clay and silty soils, and 10 percent for other soils.

Levees constructed with excavation type equipment. The minimum design top width of levees shall not be less than the values shown in Table 4. The minimum design berm width of levees, measured between the edge of the borrow and the toe of the levee, shall not be less than the values shown in Table 4.

The criteria in Table 4 shall apply when old levees are leveled and new ones constructed.

The berm may be eliminated where the side slopes of the levee and the borrow are 2½:1 or flatter. Where old levees are to be enlarged, the berm may be eliminated if, in the opinion of the designer, neither the levee nor the borrow will slough.

Table 4. Minimum Levee Top and Berm Widths

Levee Height (feet)	Levee Top Width (feet)	Berm Width (feet)
3.0 or less	2	2
3.1 – 5.9	3	3
6.0 – 8.0	4	4
Over 8.0	½ settled levee height	½ settled levee height

The design freeboard of levee fill above water level when the ditch is carrying design flow shall not be less than one third of the maximum design depth of water, and in no case less than 1.0 foot.

The allowance for levee settlement shall not be less than 30 percent of the design levee height for clay and silty soils, and 20 percent for other soils.

Related structures. Plans for ditches shall provide for adequate turnouts, checks, crossings, and other appurtenant structures as needed for the successful operation of an irrigation distribution system. Erosion control or water control structures, culverts, diversions, or other related structures needed to supplement the field ditch shall be designed and installed to meet NRCS standards for the particular structure and type of construction.

Where existing bridges are to be left without modification, the channel cross section under the bridge shall be excavated to the same cross section as the ditch immediately above.

Where new bridges are installed, they shall not obstruct flow below the hydraulic gradient, except for piling.

Erosion and water control structures, culverts, and bridges shall be installed to the sizes, lines, and grades shown in the plans.

Culverts and other conduits which will be under fills shall be designed to carry the channel capacity without causing erosion or increases in the water surface profile above that used in the channel design.

Where applicable, provision should be made for drainage of irrigation ditches when not in use. This can usually be done by providing a capped pipe in the lower end of the ditch.

CONSIDERATIONS

When planning this practice, the following items should be considered, where applicable:

1. Potential impacts on downstream flows or aquifers that would affect other water uses or users.
2. Potential water quality impacts for soluble pollutants and attached sediment pollutants.
3. Potential for uncovering or redistributing toxic material.
4. Impacts on cultural resources.
5. Effects on wetlands or water-related wildlife habitats.
6. Effects of water level control on salinity of soils, soil water or downstream water.

PLANS AND SPECIFICATIONS

Plans and specifications for constructing irrigation field ditches shall describe the requirements for applying the practice to achieve its intended purposes.

OPERATION AND MAINTENANCE

An Operation and Maintenance plan shall be prepared for use by the landowner or operator. The plan shall provide specific instructions for operating and maintaining the irrigation field ditches to insure it functions properly. The plan shall include the following provisions:

- Perform prompt repair or replacement of damaged components.
- Remove debris and foreign material that hinder system operation from field ditches and other components.
- Maintain recommended vegetative cover on all slopes and watercourses.