

**Natural Resources Conservation Service
Conservation Practice Standard**

**IRRIGATION SYSTEM
SURFACE AND SUBSURFACE
(No. and Ac.)
CODE 443**

DEFINITION

A planned irrigation system in which all necessary water-control structures have been installed for the efficient distribution of irrigation water by surface means, such as furrows, borders, contour levees, or contour ditches, or by subsurface means.

PURPOSE

This practice is applied as part of a conservation management system to achieve one or more of the following:

- Efficiently convey and distribute irrigation water to the surface point of application without causing excessive water loss, erosion, or water quality impairment.
- Efficiently convey and distribute irrigation water to the subsurface point of application without causing excessive water loss or water quality impairment.
- Apply chemicals and/or nutrients as part of an irrigation system.

CONDITIONS WHERE PRACTICE APPLIES

This standard applies to the planning and design of an irrigation water distribution system or a chemical and/or nutrient application system.

Areas must be suitable for irrigation with water of suitable quality for the purpose intended. Water supplies must be sufficient in quantity and quality to make irrigation practical for the crops to be grown and the application methods to be used.

This standard does not apply to detailed design criteria and construction specifications

for individual structures or components of the system.

This standard does not apply to NRCS conservation practice standard, Irrigation System, Microirrigation (441).

CRITERIA

General Criteria Applicable for All Purposes

This practice shall conform to all federal, State, and local laws and regulations. Laws and regulations of particular concern include those involving water rights, land use, pollution control, property easements, wetlands, preservation of cultural resources, and endangered species.

The criteria for the design of components not addressed in NRCS practice standards shall be consistent with sound engineering principles.

Land treatment units. All conservation farm irrigation systems shall be designed to meet the particular needs of the various land treatment units to be served.

Conservation irrigation methods. All farm irrigation systems designs shall be based on the use of conservation water application methods that are suited to the site conditions (combination of soil and slope) and the crops to be grown. Adapted methods are those methods that will provide for efficient use of water without destructive soil erosion or degradation of water quality.

Design Criteria Applicable for All Purposes

Capacity. The capacity of the system and its components shall be adequate to meet the

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peak use requirements of the crops to be grown and the required rate of water delivery for the irrigation methods to be used.

If more than one irrigation method will be used on the same field, the system capacity shall be adequate for the method requiring the highest rate of water delivery.

All structures and water delivery components shall be designed for maximum flow conditions expected and shall have adequate capacity and/or freeboard. All structures and water delivery components shall be designed according to appropriate NRCS conservation practice standards.

Design application rate. The design rate of application shall be within a range established by the minimum practical application rate for local climatic conditions and the maximum rate consistent with the intake rate of the soil and conservation practices used on the land.

Water control. Farm irrigation systems shall include such structures as measuring devices, division boxes, checks, turnouts, pipelines, lined ditches, valves, and gates, as needed, to control and regulate the water for efficient application.

Irrigation water management. An irrigation water management meeting the requirements of Conservation Practice Standards 449 – Irrigation Water Management shall be developed for this practice.

Design Criteria Applicable to Surface Irrigation Systems

Capacity. The system shall have either (1) a design capacity adequate to meet water demands of all crops to be irrigated in the design area or (2) enough capacity to meet the requirements of water application during critical crop growth periods when less than full irrigation is planned. In computing capacity requirements, allowance must be made for reasonable water losses during application and any leaching requirements.

Water surface elevation. All systems for irrigation by surface methods shall be designed so that the water surface elevation at field takeout points is sufficient to provide the

required flow onto the field surface. A head of at least 4 inches shall be provided.

Location of head ditches or pipelines. Head ditches or pipelines used for surface irrigation shall be located so that irrigation water can be applied uniformly over the entire field without causing erosion. Ditch or pipeline spacing shall be of such that irrigation runs are not longer than the maximums specified in local irrigation guides or that determined by adequate field evaluations. If more than one kind of crop is to be grown or more than one method of irrigation is to be used, the ditch or pipeline spacing shall not exceed the allowable length of run determined for the limiting crop or method.

Feeder ditches or conduits for subsurface irrigation shall be spaced so that the variation in depth from the land surface to the water table is not greater than is permissible for adequate irrigation of the limiting crop to be grown.

Erosion control. The design of farm irrigation systems must provide for conveying and distributing irrigation water without causing damaging soil erosion. All unlined ditches shall be located on nonerosive gradients. If water must be conveyed down slopes that are steep enough to cause excessive flow velocities, the irrigation system design shall provide for the installation of such erosion-control structures as drops, chutes, buried pipelines, or erosion-resistant ditch linings. Polyacrylamide may be utilized for erosion control according to NRCS conservation practice standard for Anionic Polyacrylamide (PAM)-Erosion Control (450) in lieu of or in combination with other structural measures.

Seepage control. For surface irrigation systems, ditches shall not traverse highly permeable soils without adequate measures for seepage control. If site conditions require conveyance of water across excessively permeable areas, the irrigation system design shall provide for pipelines, flumes, or lined ditches as needed to prevent excessive seepage losses.

Tailwater and Excess Runoff Removal. Irrigation system designs shall include facilities of adequate capacity as needed for the safe removal of irrigation tailwater and storm water

runoff from the field surface. Collection facilities (ditches) constructed for this purpose shall be on nonerosive gradients or be stabilized by lining or structural measures if erosion is a hazard. If field elevations do not permit the safe disposal of excess water by gravity flow, the design shall provide for installation of pumping plants and other needed appurtenant structures. Ditches shall be protected from bank erosion. If excess water will be reused for irrigation, the irrigation system design shall provide for collection facilities so that water does not flow directly from furrows or borders into irrigation head ditches. Tailwater systems shall be installed according to NRCS conservation practice standard, Irrigation System, Tailwater Recovery (447).

Design Criteria Applicable to Subsurface Irrigation Systems

Subsurface irrigation systems shall be designed to maintain the water table at or between predetermined elevations below the ground surface at all points in the design area.

Feeder ditches or conduits for subsurface irrigation shall be spaced so that the variation in depth from the land surface to the water table is not greater than is permissible for adequate irrigation of the most limiting crop to be grown.

Design Criteria Applicable to Chemical and/or Nutrient Application

The installation and operation of an irrigation system for the purpose of chemical and/or nutrient application shall comply with all federal, state and local laws, rules and regulations. This includes backflow and anti-siphon prevention measures. Additionally, surface waters shall be protected from direct application and runoff.

Nutrient and pest management. Chemicals, fertilizers, waste water, and liquid manure shall be applied in accordance with appropriate NRCS conservation practice standards for Nutrient Management (590), Pest Management (595), and/or Waste Utilization (633).

CONSIDERATIONS

Water quantity

- Effects on the water budget, especially on volumes and rates of runoff, infiltration, evaporation, transpiration, deep percolation, and ground water recharge.
- Potential for changes in plant growth and transpiration because of changes in the volume of soil water.
- Effects on downstream flows or aquifers that would affect other water uses or users.
- Effects on the volume of downstream flow that could have undesirable environmental, social, or economic effects.
- Effect on the water table of the field in providing a suitable rooting depth for anticipated land uses.
- Potential use for irrigation water management.

Water quality

- Effects on erosion and the movement of sediment and soluble and sediment-attached substances carried by runoff.
- Effects of nutrients and pesticides on surface and ground water quality.
- Effects on the movement of dissolved substances below the root zone or to ground water.
- Effects of water level control on the salinity of soils, soil water or downstream water quality.
- Effects of water levels on such soil nutrient processes as plant nitrogen use or denitrification.
- Effects on the temperatures of downstream waters that could cause undesirable effects on aquatic and wildlife communities.
- Effects on wetlands or water-related wildlife habitats.
- Effects on the visual quality of water resources.

PLANS AND SPECIFICATIONS

Plans and specifications for surface and subsurface irrigation systems shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose.

OPERATION AND MAINTENANCE

An operation and maintenance plan specific to the facilities installed shall be prepared for use by the landowner or operator responsible for operation and maintenance. The plan should provide specific instructions for operating and maintaining facilities to ensure they function properly. The plan shall include provisions to address the following, as a minimum:

- Periodic cleaning and regrading of collection facilities to maintain proper flow lines and functionality.
- Periodic checks and removal of debris as necessary from trash racks and structures to assure proper operation.
- Periodic removal and planned placement of sediment from traps and/or storage facilities to maintain design capacity and efficiency.
- Inspection or testing of all pipeline and pumping plant components and appurtenances, as applicable.

- Routine maintenance of all mechanical components in accordance with manufacturer's recommendations.
- Periodic land leveling or grading of surface irrigated fields is required to maintain uniform field grades for application uniformity.

REFERENCES

NEH, Part 623, Chapter 2
NEH, Part 623, Chapter 11
NRCS Conservation Practice Standards:
Irrigation Water Conveyance, Pipeline,
Code 430
Irrigation Water Management, Code 449
Nutrient Management, Code 590
Pest Management, Code 595
Pumping Plant for Water Control, Code 533
Waste Utilization, Code 633