

NATURAL RESOURCES CONSERVATION SERVICE
VIRGINIA CONSERVATION PRACTICE STANDARD

IRRIGATION SYSTEM, SURFACE AND SUBSURFACE

(No. and Ac.)

CODE 443

DEFINITION

A system in which all necessary water-control structures have been installed for the efficient distribution of 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 Virginia Conservation Practice Standard *Irrigation System, Microirrigation (Code 441)*.

CRITERIA

General Criteria Applicable to 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 Conservation Practice Standards shall be consistent with sound engineering principles.

Conservation irrigation methods

Design all irrigation systems as an integral part of an overall plan of conservation land use and treatment for the farm that is based on the capabilities of the land and the needs of the irrigated area.

Base all farm irrigation system designs on the use of sound irrigation water application methods that are suited to site conditions (combination of soil and slope) and crops to be grown. Adapted methods are those methods that will provide efficient use of water without destructive soil erosion or degradation of water

Conservation practice standards are reviewed periodically, and updated if needed. To obtain the current version of this standard, contact the Natural Resources Conservation Service.

quality. Follow detailed design criteria from local irrigation guides where available.

Capacity

Design the irrigation system to have adequate capacity to meet the intended purpose(s).

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

Design all structures and water delivery components for maximum flow conditions expected and ensure adequate capacity and/or freeboard. Design all structures and water delivery components according to appropriate Virginia Conservation Practice Standards.

Design application rate

Ensure that the design rate of application is 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

Include structures needed for water control such as measuring devices, division boxes, checks, turnouts, pipelines, lined ditches, valves, and gates to control and regulate water for efficient application.

Irrigation water management

Develop an irrigation water management plan meeting the requirements of Virginia Conservation Practice Standards *Irrigation Water Management (Code 449)* for this practice.

Additional 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, allow for reasonable water losses during application and any leaching requirements.

Water surface elevation

Design all systems for irrigation by surface methods so that the water surface elevation at field takeout points is sufficient to provide the required flow onto the field surface. Provide a head of at least 4 inches.

Location of head ditches or pipelines

Locate head ditches or pipelines used for surface irrigation so that irrigation water can be applied uniformly over the entire field without causing erosion. Space ditches or pipelines so that irrigation run lengths are not longer than the maximums specified in the local irrigation guide or those determined by field evaluation. If more than one crop is to be grown or more than one method of irrigation used, space ditches or pipelines so that they do not exceed the allowable run length determined for the limiting crop or method.

Erosion control

Provide for conveying and distributing irrigation water without causing damaging soil erosion. Ensure that all unlined ditches have nonerosive gradients. If water is conveyed on slopes steep enough to cause excessive flow velocities, design the irrigation system for the installation of such erosion-control structures as drops, chutes, buried pipelines, or erosion-resistant ditch linings.

Seepage control

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

Tailwater and Excess Runoff Removal

Include facilities of adequate capacity as needed for the safe removal of irrigation tailwater and storm water runoff from the field surface. Ensure collection facilities (ditches)

constructed for this purpose are on nonerosive gradients or are 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, provide for the installation of pumping plants and other needed appurtenant structures. Protect ditches from bank erosion. If excess water will be reused for irrigation, provide for collection facilities so that water does not flow directly from furrows or borders into irrigation head ditches. Install tailwater systems according to Virginia Conservation Practice Standard, *Irrigation System, Tailwater Recovery (Code 447)*.

Additional Criteria Applicable to Subsurface Irrigation Systems

Design subsurface irrigation systems to maintain the water table at or between predetermined elevations below the ground surface at all points in the design area.

Space feeder ditches or conduits for subsurface irrigation 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.

Additional Criteria Applicable to Chemical and/or Nutrient Application

Protect surface waters from direct application and runoff.

Apply chemicals, fertilizers, waste water, and liquid manure in accordance with appropriate Virginia Conservation Practice Standards for *Nutrient Management (Code 590)*, *Pest Management (Code 595)*, and/or *Waste Utilization (Code 633)*.

CONSIDERATIONS

When planning this practice, consider the following items, where applicable:

- Effects of nutrients and pesticides and other dissolved substances on surface and ground water quality.
- 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.
- Impact of salt leaching on system management and capacity requirements.
- Effects on the water budget, especially volumes and rates of runoff, infiltration, evaporation, transpiration, deep percolation, and ground water recharge.
- Effects on plant growth and transpiration because of changes in the volume of soil water.
- Effects on downstream flows or aquifers that impact other water uses or users.
- Effects on the volume of downstream flow that could have environmental, social, or economic impacts.
- Effects on field water table in providing a suitable rooting depth for anticipated land uses.
- Effects on erosion and the movement of sediment and soluble and sediment-attached substances carried by runoff.
- Effects on temperature of downstream waters.
- Effects on aquatic and wildlife communities, wetlands or water-related wildlife habitats.
- Effects on the visual quality of water resources.
- Effects on cultural 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.

Record all required information in an engineer field book, on a plan sheet or design computation sheet, or in another appropriate location.

DESIGN DATA

1. Completed Environmental Evaluation (Form VA-EE-1) and subsequent requirements.
2. Soils investigation.
3. Survey and plot data: profile, cross-sections, topography, as needed.
4. Design computations, including purpose of practice and references used.
 - a. All design data required by other Virginia Conservation Practice Standards, such as *Irrigation System*, *Tailwater Recovery (Code 447)*, *Nutrient Management (Code 590)*, *Pest Management (Code 595)*, or *Waste Utilization (Code 633)*, as applicable.
 - b. Irrigation Water Management Plan (Virginia Conservation Practice Standard *Irrigation Water Management (Code 449)*).
5. Plan view of site with existing and planned features, including dimensions, distances, etc.
6. Standard Cover Sheet (VA-SO-100A).
7. Materials and quantities needed. Identify borrow material and/or spoil area, as needed.
8. Vegetation and/or ground cover requirements.
9. Identification of needed Erosion & Sediment Control measures.
10. Supplemental practices required.
11. Virginia Conservation Practice Specifications (700 Series).
12. Operation and Maintenance Plan.

CHECK DATA

1. As-built survey.
2. As-built plans including dimensions, types and quantities of materials installed, and variations from design. Include justification for variations.
3. Locations of appurtenant practices.
4. Adequacy of vegetation and/or ground cover.
5. Complete as-built section of Cover Sheet.

OPERATION AND MAINTENANCE

Prepare an operation and maintenance plan specific to the facilities installed for use by the landowner or operator responsible for operation and maintenance. Provide specific instructions for operating and maintaining facilities to ensure they function properly. 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

1. USDA-Natural Resources Conservation Service. Electronic Field Office Technical Guide (eFOTG), Section IV [Online]. Available at <http://www.nrcs.usda.gov/technical/eFOTG>
2. USDA-Natural Resources Conservation Service. National Engineering Handbook, Sections 5 and 15.
3. USDA-Natural Resources Conservation Service. National Engineering Handbook – Part 650, Engineering Field Handbook.
4. USDA-Natural Resources Conservation Service. National Engineering Handbook – Part 652, Irrigation Guide.

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