NATURAL RESOURCES CONSERVATION SERVICE

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.
- Reduce Energy Use.

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 Oregon NRCS Conservation Practice Standard 441 – Irrigation System, Microirrigation.

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 practice standards shall be consistent with sound engineering principles.

Conservation irrigation methods. All irrigation systems must be designed 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.

All farm irrigation system designs shall be based 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 quality. Detailed design criteria from local irrigation guides shall be followed where available.

Capacity. The irrigation system shall have adequate capacity to meet the intended purpose(s).

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 the conveyance and/or control of the maximum flow conditions expected and shall have adequate capacity and/or freeboard. All structures and water delivery components shall be designed according to appropriate Oregon 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 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. An irrigation water management plan meeting the requirements of Oregon Conservation Practice Standard 449 – Irrigation Water Management shall be developed 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) sufficient 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 such that irrigation run lengths are not longer than the maximums specified in the local irrigation guide or those determined by field evaluation or by computerized field simulation using WinSRFR or a comparable model. If more than one crop is to be grown or more than one method of irrigation used, the ditch or pipeline spacing shall not exceed the allowable run length determined for the limiting crop or method.

Erosion control. The design of farm irrigation systems shall provide for conveying and distributing irrigation water without causing damaging soil erosion. All unlined ditches shall have nonerosive gradients. If water is conveyed on slopes steep enough to cause excessive flow velocities, the irrigation system design shall provide for the installation of erosion-control structures such as drops, chutes, buried pipelines, or erosion-resistant ditch linings. Polyacrylamide may be utilized for erosion control according to Oregon NRCS Conservation Practice Standard 450 – Anionic Polyacrylamide (PAM)-Erosion Control in lieu of or in combination with 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 include installation of pumping plants and other required 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 Oregon NRCS Conservation Practice Standard 447 – Irrigation System, Tailwater Recovery.

Additional 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.

Additional 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. Appurtenances include 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 Oregon NRCS Conservation Practice Standard 590 – Nutrient Management, 595 – Pest Management, and/or 633 – Waste Utilization.

Additional Criteria Applicable to Reduce Energy Use

Provide analysis to demonstrate reduction of energy use from practice implementation.

Reduction of energy use is calculated as average annual or seasonal energy reduction compared to previous operating conditions.

CONSIDERATIONS

When planning this practice the following items should be considered, 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 and/or downstream water quality.

Effects of water levels on such soil nutrient processes as plant nitrogen use or denitrification.

Effects of the use of PAM on system operation and erosion control.

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.
- plant growth and transpiration because of changes in the volume of soil water.
- downstream flows or aquifers that impact other water uses or users.
- the volume of downstream flow that could have environmental, social, or economic impacts.
- field water table in providing a suitable rooting depth for anticipated land uses.
- erosion and the movement of sediment and soluble and sediment-attached substances carried by runoff.
- temperature of downstream waters.
- aquatic and wildlife communities, wetlands or water-related wildlife habitats.
- the visual quality of water resources.
- 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.

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:

- Effects of management practices including cropping and tillage practices on effective system operation.
- 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 652**,** NRCS, Irrigation Guide.

NEH Part 623, Irrigation.

Engineering Field Handbook, Section 15, Irrigation.

Oregon NRCS Conservation Practice Standards:
Irrigation Water Conveyance (430).
Irrigation Water Management (449).
Irrigation System Tailwater Recovery (447).
Pumping Plant (533).
Anionic Polyacrylamide (PAM) Erosion Control (450)
Structure for Water Control (587).
Nutrient Management (590).
Pest Management (595).
Waste Utilization (633).

USDA Agricultural Research Service Arid-Land Agricultural Research Center, WinSRFR 1.0 Help & Manual.