United States Department of Agriculture

Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

IRRIGATION WATER MANAGEMENT

CODE 449

(ac)

DEFINITION

The process of determining and controlling the volume, frequency, and application rate of irrigation water.

PURPOSE

This practice is used to accomplish one or more of the following purposes–

- Improve irrigation water use efficiency
- Minimize irrigation induced soil erosion
- Decrease degradation of surface and groundwater resources
- Manage salts in the crop root zone
- Manage air, soil, or plant micro-climate
- Reduce energy use

CONDITIONS WHERE PRACTICE APPLIES

This practice is applicable to all irrigated lands.

An irrigation system adapted for site conditions (soil, slope, crop grown, climate, water quantity and quality, air quality, etc.) must be in place and capable of efficiently applying water to meet the intended purpose(s).

CRITERIA

General Criteria Applicable to All Purposes

Develop an Irrigation Water Management (IWM) Plan that will guide the irrigator or decision-maker in the proper management and application of irrigation water.

When irrigation water is limited, develop an IWM Plan that will meet critical crop growth stages.

Include in the IWM plan the method for determining the flow rate or total volume of irrigation water required for each irrigation event.

Include in the IWM plan the method for determining the timing and amount of each irrigation event using at least one of the following methods:

- Evapo-transpiration of the crop, using appropriate crop coefficients and reference evapo-transpiration data,
- Soil moisture monitoring, and/or
- Scientific plant monitoring (e.g. leaf water potential or leaf/canopy temperature measurements).

NRCS reviews and periodically updates conservation practice standards. To obtain the current version of this standard, contact your Natural Resources Conservation Service State office or visit the Field Office Technical Guide online by going to the NRCS website at https://www.nrcs.usda.gov/ and type FOTG in the search field.

USDA is an equal opportunity provider, employer, and lender.

When irrigation water is not available on demand, such as when provided by an irrigation district, use the planned availability to determine the timing of the irrigation event. In this case, adjust irrigations amounts appropriately.

In locations where rain is expected during the growing season, and where a soil water balance is calculated, include measurements from a rain gauge (or other accurate method of determining local rainfall) that represent the managed field(s).

Base the volume of water needed for each irrigation event on:

- the available water-holding capacity of the soil for the crop rooting depth,
- the management allowed soil water depletion,
- the current soil moisture status,
- the current crop/forage growth stage,
- the distribution uniformity of the irrigation event, and
- the water table contribution.

For adjustable rate systems (e.g variable rate irrigation center pivots), base the application rate of irrigation water on:

- the volume of water to be applied,
- the frequency of irrigation applications, soil infiltration and permeability characteristics, and
- the capacity of the irrigation system.

For surface irrigation, apply irrigation water at a rate that achieves an acceptable distribution uniformity (DU) and that minimizes irrigation induced erosion.

Additional Criteria to Decrease Degradation of Surface and Groundwater Resources

Plan irrigation water application rates and volumes that minimize transport of sediment, nutrients and chemicals to surface waters and groundwater.

Schedule the application of nutrients and chemicals to avoid excess leaching below the root zone to the groundwater and excess runoff to surface waters.

Do not conduct fertigation or chemigation operations if rainfall that may produce runoff or deep percolation is imminent. Limit application of chemicals or nutrients to the minimum length of time required to deliver them and flush the pipelines. Limit the irrigation application amount to the amount necessary to apply the chemicals or nutrients to the soil depth recommended by the manufacturer. Base the timing and rate of application on the NRCS approved pest, herbicide, or nutrient management plan.

Ensure that the irrigation and delivery system is equipped with properly designed and operating valves and components to prevent backflows into the water source(s) and/or contamination of groundwater, surface water, or the soil.

Additional Criteria to Manage Salts in the Crop Root Zone

Ensure the irrigation application volume provides an appropriate salt balance in the soil profile.

Base the water requirement on the leaching procedure contained in NRCS National Engineering Handbook (NEH), Part 623, Chapter 2, Irrigation Water Requirements, and NEH, Part 652, National Irrigation Guide, Chapters 3 and 13.

Additional Criteria to Manage Air, Soil or Plant Micro-Climate

The irrigation system must have the capacity to apply the required rate of water for cold or heat protection as determined by the methodology contained in NEH, Part 623, Chapter 2, Irrigation Water Requirements.

Additional Criteria Applicable to Reduce Energy Use

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

Calculate the reduction of energy use as the average annual or seasonal energy reduction compared to previous operating conditions.

CONSIDERATIONS

Consider the following when planning irrigation water management:

Crop residue and soil surface storage can increase effective precipitation and reduce soil surface evaporation.

There is a potential for spray drift and odors when applying agricultural and municipal waste waters. Timing of irrigation should be based on prevailing winds to reduce odor. In areas of high visibility, irrigating at night should be considered.

Overspray from end guns should not reach public roads.

Modify equipment and/or soil amendments such as polyacrylamides and mulches to decrease erosion.

The water quality can impact the crop quality and plant development.

The water quality can impact the soil's physical and chemical properties, such as soil crusting, pH, permeability, salinity, and structure.

Avoid traffic on wet soils to minimize soil compaction.

Schedule salt leaching events to coincide with low levels of residual soil nutrients and pesticides.

Manage water so it does not drift or come in direct contact with surrounding electrical lines, supplies, devices, controls, or components that would cause shorts in the same or the creation of an electrical safety hazard to humans or animals.

The effect of the electrical load control/interruptible power schedules, repair and maintenance downtime, and harvest downtime may change the IWM Plan.

Improvements to the irrigation system may increase the distribution uniformity or application efficiency of irrigation water applications.

PLANS AND SPECIFICATIONS

Application of this standard may include job sheets or similar documents that specify the applicable requirements, system operations, and components necessary for applying and maintaining the practice to achieve its intended purpose(s).

The Irrigation Water Management (IWM) Plan will contain, at a minimum:

- An irrigation system layout map showing the main pipeline(s), irrigated area, soil moisture sensor locations and depths (if used), and soils.
- The methods used to measure or determine the flow rate or volume of the irrigation applications.
- Documentation of the scientific method used for scheduling the timing and amount of irrigation applications.
- The seasonal or annual planned water application volumes by crop.
- The management allowable depletion (MAD) and depth of the managed crop root zone for each crop.
- An estimate of the irrigation system distribution uniformity, based on testing, evaluation, or

observation.

- The specific soil moisture monitoring objectives, if soil moisture sensors are used. Indicate how data from the soil moisture sensor locations and depths will be considered to make field-wide irrigation decisions.
- Information on how to recognize irrigation induced erosion and how to mitigate it.
- Recordkeeping documents for the irrigator to use during operation and management.

OPERATION AND MAINTENANCE

Include a maintenance checklist to ensure the system performance is optimum.

The irrigator will document all irrigation water management activities with adequate records. At a minimum:

- Record each irrigation event, including the amount or depth of water applied and the date of application, and
- Record the data from the method(s) used for determining the timing and amount of the irrigation event.

Other necessary O&M items are addressed in the physical component standards considered companions to this standard.

REFERENCES

USDA-NRCS, National Engineering Handbook, Part 623, Chapter 2, Irrigation Water Requirements.

USDA-NRCS, National Engineering Handbook, Part 623, Chapter 9, Water Measurement Manual.

USDA-NRCS, National Engineering Handbook, Part 652, National Irrigation Guide.