NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

IRRIGATION WATER MANAGEMENT
Code 449
(Acres)

DEFINITION

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

PURPOSE

- 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) as defined in Florida NRCS conservation practice standards (CPS), Irrigation System, Microirrigation, Code 441, Irrigation System, Surface and Subsurface, and Sprinkler System, Code 442.

CRITERIA

Evaluate impacts to cultural resources, wetlands and Federal and state protected species and avoid or minimize to the extent practicable during planning, design and implementation of this conservation practice in accordance with established National and Florida policy, General Manual (GM) Title 420-Part 401; Title 450-Part 401, Title 190-Parts 410.22 and 410.26, National Planning Procedures Handbook (NPPH) Florida Supplements to Parts 600.1 and 600.6, National Cultural Resources Procedures

Handbook (NCRPH), National Food Security Act Manual (NFSAM), and the National Environmental Compliance Handbook (NECH).

GENERAL CRITERIA APPLICABLE TO ALL PURPOSES

Apply irrigation water in accordance with federal, state, and local rules, laws, and regulations. Do not apply water in excess of the needs to meet the intended purpose. Plans to utilize water resources may need to be approved or permitted by the appropriate Water Management District in accordance with Chapter 40-2 Florida Administrative Code (F.A.C.).

Measurement and determination of flow rate is a critical component of irrigation water management and shall be a part of all irrigation water management purposes.

The irrigator or decision-maker must possess the knowledge, skills, and capabilities of management coupled with a properly designed, efficient and functioning irrigation system to reasonably achieve the purposes of irrigation water management.

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

As a minimum, include the items listed in the Plans and Specifications section of this standard in the plan.

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).

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 surface irrigation, apply irrigation water at a rate that achieves an acceptable distribution uniformity (DU) as defined in National Engineering Handbook (NEH), Part 652, Irrigation Guide, Chapter 15, Florida Supplement, Table FL15-1 and that minimizes irrigation induced erosion.

Irrigator Skills and Capabilities. Proper irrigation scheduling, in both timing and amount, control of runoff, minimizing deep percolation, and the uniform application of water are of primary concern. The irrigator or decision-maker shall possess or obtain the knowledge and capability to accomplish the purposes which include:

A. General

1. How to determine when irrigation water should be applied based on the rate of water used by crops and on the stages of plant growth and/or soil moisture monitoring.
2. How to determine the amount of water required for each irrigation, including any leaching needs.
3. How to recognize and control erosion caused by irrigation.
4. How to measure or determine the uniformity of application of an irrigation.
5. How to perform system maintenance to assure efficient operation.
6. The relationship between water application and soil surface and subsurface conditions, soil intake rates and permeability, crop root zones, and available water holding capacity.
7. How to manage salinity and shallow water tables through water management.
8. The capability to control the irrigation delivery.

B. Surface Systems

1. The relationship between advance rate, time of opportunity, intake rate, and other aspects of distribution uniformity and the amount of water infiltrated.
2. How to determine and control the amount of irrigation runoff.
3. How to adjust stream size, adjust irrigation time, or employ techniques such as “surge irrigation” to compensate for seasonal changes in intake rate or to improve efficiency of application.

C. Subsurface Systems

1. How to balance the relationship between water tables, leaching needs, and irrigation water requirements.
2. The relationship between the location of the subsurface system to normal farming operations.
3. How to locate and space the system to achieve uniformity of water application.
4. How to accomplish crop germination during dry periods.

D. Pressurized Systems

1. How to adjust the application rate and/or duration to apply the required amount of water.
2. How to recognize and control runoff.
3. How to identify and improve uniformity of water application.
4. How to account for surface storage due to residue and field slope in situations where sprinkler application rate exceeds soil intake rate.
5. How to identify and manage for weather conditions that adversely impact irrigation efficiency and uniformity of application.

Determine that irrigation water management is being practiced by evaluating the irrigator's knowledge and use of the principles of irrigation water management as described above. Irrigation water management shall be documented in writing.

Document the use of irrigation water management using Florida NRCS Form FL-ENG-449 or industry recognized methods.

Guidance for determining irrigation water requirements is contained in NEH, Part 623, Irrigation, Chapter 2 and NEH, Part 652, Irrigation Guide, Chapter 4.

System Capability. Ensure that the irrigation system is capable of applying water uniformly and efficiently and provides the irrigator with adequate control over water application.

Guidance for determining minimum irrigation system efficiencies is contained in NEH, Part 652, Irrigation Guide, Chapter 15, Florida Supplement, Table FL15-1.

Additional Criteria to Optimize Use of Water Supplies

Manage limited irrigation water supplies to meet critical crop growth stages.

When water supplies are estimated to be insufficient to meet even the critical crop growth stage, the irrigator or decision-maker shall modify plant populations, crop and variety selection, and/or irrigated acres to match available or anticipated water supplies.

On high water table soils, manage the water table at a level that will allow the maximum storage of rainfall and provide the required moisture to the plant.

Additional Criteria to Minimize Irrigation Induced Soil Erosion

Application rates shall be consistent with local field conditions for long-term productivity of the soil. On soils that are susceptible to irrigation induced erosion, the irrigation system should be operated so that the application rate is less than the basic soil infiltration rate.

Reduce soil erosion caused by wheel tracks of center pivot systems by using residue management, cover crops, terraces, diversions, critical area treatment, grassed waterways and/or other conservation practices.

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.

Apply chemigation or fertigation in accordance with all local, state and federal laws.

Do not conduct chemigation or fertigation 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 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 developed in accordance with Florida NRCS CPS, Nutrient Management, Code 590, or Pest Management, Code 595.

Ensure 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 the NEH Part 623, Chapter 2 and NEH, Part 652, 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.

Ensure the irrigation system is capable of uniformly applying the required rate of water application based on the anticipated minimum temperature, maximum wind speed, and relative humidity.

Begin water application when the temperature is above the critical temperature of the crop being protected. Stop water application when the wet bulb temperature is above the critical temperature of the crop being protected. Account for the wind speed’s increase in evaporative cooling when determining application period.

Follow criteria contained in the Water Management District Rule 40-2 F.A.C. in the use of water for freeze protection.

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 items 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. Base timing of irrigation 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.
- Consider the effects that irrigation water has on wetlands, water related wildlife habitats, riparian areas, cultural resources, and recreation opportunities. Irrigation may affect the temperature of water resources that could cause undesirable effects on aquatic and wildlife communities.
- Management of nutrients and pesticides.
- Schedule salt leaching events to coincide with low 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 on the electrical load control/interruptible power schedules, repair and maintenance downtime, and harvest downtime may change the IWM Plan.
- The improvement of the irrigation system to increase distribution uniformity or application efficiency of irrigation water applications. An irrigation system evaluation should be performed to determine if the irrigation system meets the minimum uniformity as specified in the applicable NRCS conservation practice standard for irrigation. Procedures for evaluating irrigation systems are contained in the NEH, Part 652, Irrigation Guide and the NEH, Part 623, Irrigation. Where the irrigation system does not meet the minimum uniformity, it should be modified to meet or exceed the minimum specified uniformity.
- The effects irrigation water use may have on downstream flows or aquifers and the amount of water available for other water uses.
- The effect irrigation may have on the salinity of soils, soil water and downstream water resources.

PLANS AND SPECIFICATIONS

An IWM plan will be developed site specifically for each irrigated field. Specifications for this practice shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose. Specifications for this practice will be prepared for each field according to the criteria, considerations, and operation and maintenance described in this standard.

Record specifications using approved specification sheets, job sheets, narrative statements in the conservation plans, or other acceptable documentation specifying the applicable requirements, system operations, and components necessary for applying and maintaining the practice to achieve its intended purpose(s).

As a minimum, include the following in the plans and specifications for each field where IWM is applied:

- An irrigation system layout map showing the main pipeline(s) and irrigated area.
- Method to determine flow rate of total volume of water required for each irrigation event.
- Document scientific method used for scheduling and timing of irrigation applications.
- Soil series and available water holding capacity.
- 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.
- The specific soil moisture monitoring objectives, if soil moisture sensors are used. Indicate how data from soil moisture sensor locations and depths will be considered to make field-wide irrigation decisions.
- Method for measuring soil moisture. If soil moisture sensors are used, show locations on the irrigation system map and record depths.
- Method for adjusting irrigation to compensate for changes in the soil infiltration rate.
- An estimate of the irrigation system distribution uniformity, based on testing, evaluation or observation.
- Method for measuring irrigation system application rate.
- Method for evaluating irrigation induced soil erosion and how to mitigate it.
- Method for adjusting the irrigation schedule(s) for chemical application.
- Method to determine if irrigation system is operating correctly.
- Method for recognizing excess runoff.
- Recordkeeping documents for the irrigator documents to use during operation and maintenance.

OPERATION AND MAINTENANCE

Prepare an operation and maintenance (O&M) plan that provides the necessary information to implement the practice. As a minimum, the O&M Plan shall include, but not limited to the following:

- Procedure to document all irrigation water management activities with adequate records including, but not limited to, the following:
    - Record each irrigation event, including the amount or depth of water applied and the date of application,
    - Record the data from the methods(s) used for determining the timing and amount of irrigation event.
- A site specific maintenance checklist to ensure the irrigation system performance is optimum.

- Ensure necessary O&M items are addressed in the physical components of conservation practices that are considered companions to this standard.

REFERENCES

Florida NRCS CPS,
Irrigation System, Microirrigation, Code 441
Irrigation System, Surface and Subsurface, Code 443
Nutrient Management, Code 590
Pest Management, Code 595
Sprinkler System, Code 442

Florida Water Management District, Chapter 40-2 F.A.C.

NEH Part 623, Chapter 2, Irrigation Water Requirements

NEH Part 623, Chapter 9, Water Measurement Manual

NEH Part 652, Irrigation Guide

NEH Part 652, Irrigation Guide, Florida Supplement

NRCS Form FL-ENG-449