NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

IRRIGATION SYSTEM, SPRINKLER

(No. and Ac.)

CODE 442

DEFINITION

An irrigation system in which all necessary equipment and facilities are installed for efficiently applying water by means of nozzles operated under pressure.

PURPOSE

Apply this practice as part of a conservation management system to achieve one or more of the following:

- Efficiently and uniformly apply irrigation water to maintain adequate soil water for the desired level of plant growth and production without causing excessive water loss, erosion, or water quality impairment.
- Climate control and/or modification.
- Applying chemicals, nutrients, and/or waste water.
- Leaching for control or reclamation of saline or sodic soils.
- Reduction in particulate matter emissions to improve air quality.

CONDITIONS WHERE PRACTICE APPLIES

The sprinkler method of water application is suited to most crops, irrigable lands, and climatic conditions where irrigated agriculture is feasible. Select areas that are suitable for irrigation or sprinkler water application and that have an adequate supply of suitable quality water available for the intended purpose(s).

This standard applies to the planning and design of the overall water application through sprinkler discharge systems. This standard pertains to the planning and functional design of all sprinkler components except for special structures, such as permanently installed main and lateral pipelines or pumping plants. Design other components in accordance with appropriate NRCS Conservation Practice Standards.

This standard does not include criteria for mini- or micro-sprinkler systems, which are covered by NRCS Conservation Practice Standard 441 – Irrigation System, Microirrigation.

CRITERIA

General Criteria Applicable to All Purposes

Plan all work to comply with all Federal, State, and local laws and regulations. Plans to withdraw water in excess of state mandated limits need to be approved and permitted by the Georgia Department of Natural Resources.

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

Design each sprinkler discharge system as an integral part of an overall plan of conservation land use and treatment for the intended purpose(s) based on the capabilities of the land and the needs of the operator. Base the selected system on a site evaluation, expected operating conditions and verification that soils and topography are suitable for the intended purpose(s).

Depth of Application. Plan the net depth of application to meet the criteria for the intended purpose, not exceeding the available soil water holding capacity and meeting the land user's management plan for the intended purpose. Determine the gross depth of application by

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using field application efficiencies (E_a) that do not exceed the values in Table 1.

Table 1 – Application Efficiency (E_a) of Sprinkler Irrigation Systems

Type	**E_a %**
Periodic Move Lateral	75
Periodic Move (gun or boom)	60
Fixed Laterals (solid set)	75
Traveling Sprinklers (gun or boom)	65
Center Pivot – Standard	85
Linear (lateral) Move	87
LEPA – Center Pivot and Linear Move	95

Capacity. Design the sprinkler irrigation system to provide adequate capacity to accomplish the primary purpose(s) of the system.

Design Application Rate. Select application rates such that runoff, translocation, and unplanned deep percolation are minimized.

Apply additional conservation measures, such as furrow diking, dammer diking, in-furrow chiseling, conservation tillage or residue management as needed and appropriate.

Use a minimum application rate of 0.10 inches per hour. Use a maximum application rate consistent with the intake rate of the soil and the conservation practices used on the irrigated land. If two or more sets of conditions are in the design area, use the lowest maximum application rate for areas of significant size as the maximum application rate for the entire design area.

Distribution Patterns, Nozzle Spacing and Height. Select a combination of sprinkler spacing, nozzle size, and operating pressure that provides the design application rate and distribution.

Use coefficient of uniformity (CU) data or distribution uniformity (DU) in selecting sprinkler spacing, nozzle size, and operating pressure. Definitions of each of these uniformity values can be found in the NRCS National Engineering Handbook, Part 652, Irrigation Guide.

Pipelines. When designing main lines, submains, and supply lines insure that required water quantities can be conveyed to all operating lateral lines at required pressures. For detailed criteria, see NRCS Conservation Practice Standard 430 – Irrigation Pipeline.

Pump and Power Unit. Where required, use pump and power units with adequate capacity to efficiently operate the sprinkler system at design capacity and total dynamic head. For detailed criteria, see NRCS Conservation Practice Standard 533 – Pumping Plant.

Management Plan. Develop an Irrigation Water Management plan, meeting NRCS Conservation Practice Standard 449 – Irrigation Water Management, for this practice, unless the purpose of the practice is waste water application. Where implemented for waste application, as a component of a Comprehensive Nutrient Management Plan (CNMP), develop a waste utilization plan and/or nutrient management plan that meets the requirements of NRCS Conservation Practice Standard 633 – Waste Utilization and 590 - Nutrient Management, as appropriate.

Additional Criteria Applicable to Center Pivot or Linear-Move Sprinkler Systems

Design Capacity. Design sprinkler systems to have the capacity to meet the primary purpose. For the purpose of crop irrigation, design sprinkler irrigation systems to have either (1) a design capacity adequate to meet peak water demands of all irrigated crops in the design area, or (2) adequate capacity to meet requirements of selected irrigations during critical crop growth periods when less than full irrigation is planned. NEH Part 623, Chapter 2, Irrigation Water Requirements, or the Georgia Irrigation Guide may be used to determine crop irrigation requirements.

In computing capacity requirements, allow for reasonable application water losses.

Distribution Patterns, Nozzle Spacing and Height. Design pivot systems (Heermann-Hein) or Linear systems (Christensen) so that the CU is no less than 85% (76% DU), except as noted in criteria for a Low Energy Precision Application (LEPA) system. In lieu of the manufacturer's CU information, use

Agricultural Research Service model Center Pivot Evaluation and Design (CPED) or similar modeling software in simulation modeling. Manufacturer's information on nozzle packaging, allowing exclusion of the end gun and the first 12 percent of pivot length, not to exceed 250 feet, is acceptable documentation of system CU.

In the absence of CU data, use sprinkler performance tables provided by the manufacturer in selecting nozzle size, operating pressure, and wetted diameter for the required sprinkler discharge. To the extent possible, locate low pressure spray nozzles at uniform heights along the length of the lateral, with the exception of height adjustment to increase wetted diameter for runoff control. From a point midway between the first and second tower to the distal end of a center pivot, plan spray nozzle spacing along lateral lines to be less than or equal to 25% of the effective wetted diameter and impact sprinkler spacing to be less than or equal to 50 percent of the effective wetted diameter. Determine the effective wetted diameter from manufacturer's information for the nozzle height.

Design lower elevation nozzle application systems, typically less than 7 feet from ground surface, that discharge water in the crop canopy for a considerable length of time during the growing season to comply with the criteria of a Low Pressure in Canopy (LPIC) system as defined in this standard.

Additional Criteria Applicable to LEPA and Low Elevation Spray Application (LESA) Center Pivot or Linear-Move Sprinkler Systems

Distribution Patterns. For center pivot systems, use nozzle discharge CU, determined by using the Heermann-Hein weighted area, in selecting sprinkler spacing, nozzle size, and operating pressure. Use nozzle discharge CU greater than 94% of the calculated design flow rate needed at the discharge point. For linear systems, base discharge on equivalent unit areas.

Nozzle Spacing. Select nozzle spacing that is greater than two times the row spacing of the crop, not to exceed 80 inches.

Specific Additional Criteria for LEPA

Discharge Height. Design the system so that water discharges through a drag sock or hose on the ground surface, or through a nozzle equipped with a bubble shield or pad at a uniform height not to exceed 18 inches.

Row Arrangement and Storage. LEPA systems are only applicable on crops planted with furrows or beds. Design LEPA systems with row patterns that match the lateral line movement (i.e., circular for center pivots). Do not apply water in the tower wheel track of a LEPA system. Eliminate runoff and translocation under LEPA systems by providing surface basin storage such as furrow dikes, dammer dikes, or implanted reservoirs.

Slope. Do not install a LEPA system in fields where the slope exceeds 1.0 percent on more than 50 percent of the field.

Design systems that utilize bubble pads or shields, or drag hoses for a portion of the crop year and then spray nozzles at uniform height not exceeding 18 inches for a portion of the crop year to meet LESA criteria.

Specific Additional Criteria for LESA

Discharge Height. Design LESA Systems to discharge water through a spray nozzle at uniform heights not to exceed 18 inches.

Row Arrangement and Storage. LESA Systems are applicable on crops flat planted, drilled, or planted with furrows or beds. Design LESA Systems with some method of providing surface basin storage such as furrow dikes, dammer dikes, or implanted reservoirs, or farming practices such as conservation tillage, in-furrow chiseling, and/or residue management to prevent runoff.

Land Slope. Do not install a LESA systems in fields where the slope exceeds 3.0 percent on more than 50 percent of the field.

Additional Criteria Applicable to LPIC and Mid Elevation Spray Application (MESA) Center Pivot or Linear-Move Sprinkler Systems

Design systems that utilize bubble pads or shields or drag hoses for a portion of the crop year and spray nozzles for a portion of the crop year that do not meet all of the LEPA or LESA criteria to meet LPIC criteria.

Distribution Patterns, Nozzle Spacing and Height. For row crops, when nozzles operate in canopy for 50 percent or more of the growing season, design nozzle spacing to not exceed every other crop row. Design in-canopy heights so that areas of high leaf concentration are avoided (i.e., corn near the ear height (approximately 4 feet)). Local research and Extension Service information with applicable crops may serve as a guide for establishing appropriate nozzle spacing, height, and row arrangement.

Use CU (Heermann–Hein CU for center pivots) that is greater than or equal to 90% for all LPIC and MESA Systems with nozzle heights less than 7 feet.

Use CU greater than or equal to 85% (76% DU) for MESA Systems with nozzle heights 7 feet or greater.

Land Slope. Do not install LPIC and MESA systems on fields where the land slope is greater than 3.0 percent on more than 50 percent of the field for fine textured soils or greater than 5 percent on more than 50 percent of the field on coarse textured soils.

Additional Criteria Applicable to Fixed-Solid-set, Big Gun and Periodic Move Sprinkler Systems

Design Capacity. Design sprinkler irrigation systems with either (1) a design capacity adequate to meet peak water demands of all crops to be irrigated in the design area, or (2) adequate capacity to meet requirements of selected water applications during critical crop growth periods when less than full irrigation is planned. In computing capacity requirements, make allowance for reasonable application water losses.

Design Application Rate. Use a design application rate within a range established by the minimum practical application rate under local climatic conditions, and the maximum application rate consistent with soil intake rate, slope, and conservation practices used on the land. If two or more sets of conditions exist in the design area, use the lowest maximum application rate for areas of significant size as the maximum.

Lateral Lines. Unless pressure reducers or regulators are installed at each outlet, or other pressure compensating or flow control devices are used, design lateral lines so that the pressure variation or flow variation at any sprinkler, resulting from friction head and elevation differential, does not exceed 20 percent of the design operating pressure or 10 percent of the design flow of the sprinklers, respectively.

Distribution Patterns and Spacing. Select a combination of sprinkler spacing, nozzle size, and operating pressure that provides the design application rate and distribution.

If available, use CU (or DU) data in selecting sprinkler spacing, nozzle size, and operating pressure. Use a CU that is greater than the following:

75 % (60% DU) for deep-rooted (4 feet or more) field and forage crops where fertilizers and pesticides are not applied through the system.

85 % (76% DU) for high-value or shallow-rooted crops and for any crop where fertilizer or pesticides are applied through the system.

In the absence of CU data, use a maximum lateral and nozzle spacing that complies with the following criteria:

1. For low (2-35 pounds/square inch (psi))-, moderate (36-50 psi)-, and medium (51-75 psi)-pressure sprinkler nozzles, use a spacing along lateral lines that does not exceed 50 percent of the wetted diameter, as given in the manufacturer's performance tables, when the sprinkler is operating at design pressure. Use a spacing of laterals along the main line that does not exceed 65 percent of this wetted diameter.

   If winds that can affect the distribution pattern are likely during critical crop growth periods, reduce spacing to 60 percent for average velocities of 1 to 5 miles per hour (mph), to 50 percent for average velocities of 6 to 10 mph, and to 45 percent for average velocities greater than 10 mph.

2. For high-pressure and big gun type sprinklers (>75 psi), use a maximum distance (diagonal) between two sprinklers on adjacent lateral lines that does not

exceed two-thirds of the wetted diameter under favorable operating conditions

If winds that can affect the distribution pattern are likely during critical crop growth periods, reduce the diagonal spacing to 50 percent of the wetted diameter for average velocities of 5 to 10 mph and to 30 percent for average velocities greater than 10 mph.

3. Sprinkler spacing requirements for orchards, including subtropical fruits:

a) Triangular pattern. Design the spacing along lateral lines to not exceed 65 percent of the effective wetted diameter. Design the spacing of laterals along the main line to not exceed 70 percent of the effective wetted diameter.

b) Square or rectangular pattern. Design the nozzle spacing along the lateral and the lateral spacing along the main line to not exceed 65 percent of the effective wetted diameter at the design operating pressure.

c) Reduce spacing between sprinklers and lateral lines by 2.5 percent for each mph over 3 mph average wind velocity normally occurring during planned hours of operation.

Risers. Except for under-tree operation, install riser pipes used on lateral lines high enough to prevent interference with the distribution pattern when the tallest crop is irrigated. Minimum riser heights are shown below:

Sprinkler discharge *(gallons/minute)*	Riser length *(inches)*
Less than 10	6
10-25	9
25-50	12
50-120	18
More than 120	36

Anchor and stabilize risers over 3 feet in height.

Additional Criteria Applicable to Traveling Sprinkler Irrigation Systems

Follow the recommendations in Table 11-31, National Engineering Handbook (NEH) Section 15, Irrigation, Chapter 11, Sprinkler Irrigation for towpath spacing.

Additional Criteria Applicable to Retrofit/Conversion of Existing Center Pivot Systems to LEPA, LESA, LPIC or MESA Systems

Design Criteria. Design the retrofitted system to meet the requirements for design capacity, distribution patterns, nozzle spacing, height, row arrangement, storage and slope for the new type system (i.e. LEPA, LESA, LPIC, or MESA) stated in this standard.

Repair/Replacement of Existing Parts and Equipment. Test the system at design pressure after nozzle replacement is completed. Repair or replace any component that leaks during this test and then recheck for leaks.

Additional Criteria Applicable to Climate Control and/or Modification

Design Capacity. For temperature control, design the sprinkler irrigation system with sufficient capacity to satisfy the evaporative demand on a minute-by-minute basis throughout the peak use period. NEH, Part 623, Chapter 2 contains guidance on using sprinkler irrigation systems for temperature control.

For frost protection, design the system so that it is capable of applying the necessary rate, based on the minimum temperature, maximum anticipated wind speed, and relative humidity, in a uniform manner. Provide sufficient capacity to supply the demand for the entire crop being protected. NEH, Part 623, Chapter 2 contains guidance on using sprinkler irrigation systems for frost protection.

Additional Criteria Applicable to Chemical, Nutrient and/or Waste Water Application

Install and operate a sprinkler irrigation system for the purpose of chemical or nutrient application (chemigation) in conformance with all federal, state and local laws, rules and regulations, particularly OCG Annotated, Chapter 40-23-1 and federal regulations PB-87-1. Include backflow and anti-siphon prevention measures when pumping from wells or using chemigation. Additionally, protect surface waters from direct application.

Locate Injectors (chemical, fertilizer or pesticides) and other automatic operating equipment adjacent to the pump and power unit and install them in accordance with state regulations, or lacking the same, in accordance with manufacturer's recommendation. Use a chemical injection device that is within 1 percent of maximum injection rates and easily calibrated and adjustable for all chemicals at the required injection rate.

Design sprinkler irrigation systems used to apply waste with sprinkler nozzles of sufficient size to prevent clogging. Treatment of the wastewater using solid separators, two stage lagoons, two-stage waste holding ponds, etc., may be needed to reduce percent solids.

Design Application Rate and Timing. Use application rates that meet the levels specified in General Criteria. Apply chemicals in the minimum length of time it takes to deliver the chemicals and flush the pipelines at rates specified by the label.

Coefficient of Uniformity. If available, use CU (or DU) data in selecting sprinkler spacing, nozzle size, and operating pressure. Use a CU greater than or equal to 70% for wastewater and greater than or equal to 85% (76% DU) for chemigation or fertigation. If CU data is not available, use distribution patterns and spacing requirements that meet the appropriate specific criteria of this standard.

Nutrient and Pest Management. Apply chemicals, fertilizers and liquid manure in accordance with appropriate NRCS Practice Standards: 590 – Nutrient Management, 595 – Pest Management, 633 – Waste Utilization and 634 – Manure Transfer. Do not exceed chemical or nutrient application amounts given in these standards.

NEH, Part 623, Chapter 2 contains guidance on using sprinkler irrigation systems for chemigation.

Additional Criteria Applicable to Leaching

Design Application Rate and Depth. Use application rates that meet the levels specified in General Criteria. Determine design depth as defined in NRCS, National Engineering Handbook, Part 623, Chapter 2, Irrigation Water Requirements.

Management or Reclamation Plan. Develop a plan conforming to the requirements contained in NRCS Practice Standard 610 – Salinity and Sodic Soil Management.

Additional Criteria Applicable to Reduction in Particulate Matter Emissions to Improve Air Quality

These criteria pertain to sprinkler systems used to improve air quality by controlling dust emissions from confined animal pen areas and other critical areas such as unpaved roads, staging areas, and equipment storage yards.

Install fixed solid set sprinklers or periodic move sprinkler systems for dust control to conform to the criteria stated above, unless described by criteria in this section. Install and operate sprinkler systems for dust control on confined animal pen areas to provide application coverage on the majority of pen areas occupied by livestock, except for feed bunk aprons. Design the system so that the quality of discharge water is pathogen free and fit for animal consumption.

Capacity and Application Rate. For dust control, design the sprinkler irrigation system with sufficient capacity and operational flexibility to apply the design application depth every three days or less. Design the system with adequate capacity to allow for reasonable water losses during application.

Design the minimum design application rate to meet the maximum total daily wet soil evaporation rate, with allowances for moisture input to pen areas from animal manure and urine.

Apply open-lot management practices that include scraping and removal of manure in pens between occupations, and shaping of the holding areas to prevent water ponding and chronic wet areas.

Avoid over-application and excessive sprinkler overlap to minimize runoff and reduce odor and fly problems.

Water Amendments. Appropriately labeled chemicals for pest control or dust suppression may be applied through the sprinkler system when designed, installed and operated with appropriate backflow prevention and anti-siphon devices. When chemicals are applied through the sprinkler system, protect surface waters and livestock watering facilities from direct application unless chemical labels indicate that direct application will not negatively impact animal health or water quality.

Distribution Patterns and Spacing. Select a combination of sprinkler spacing, nozzle size, and operating pressure that provides the design application rate and distribution pattern.

Use a maximum spacing of sprinklers along laterals that is less than or equal to 75 percent, and greater than or equal to 50 percent of wetted diameter listed in manufacturer's performance tables. Use spacing between lateral that complies with the following criteria:

1. For medium (51-75 psi)-pressure sprinkler nozzles, use spacing of laterals along the main line that is less than or equal to 90 percent, and greater than or equal to 70 percent of wetted diameter.

2. For high-pressure sprinklers (>75 psi), use a maximum distance between two sprinklers on adjacent lateral lines that is less than or equal to 100% of wetted diameter.

If winds impact distribution patterns during critical dust emission periods, equip the system with timer overrides and the flexibility to be operated manually during periods of lesser wind, such as late evening and early morning.

Risers. Install riser pipes used in lateral lines high enough to minimize interference with the distribution pattern. Construct the risers in a manner that provides protection from corrosive soils, equipment damage, and livestock damage. Install the riser so that the discharge sprinkler is not less than 6 feet above ground surface. Anchor and stabilize the risers.

System Valves and Controllers. Due to high application rates inherent with large sprinkler nozzle diameters, utilize an automatic irrigation control system for all nozzles greater than 0.5 inch diameter. Design the system with an automated control system that utilizes electro-hydraulic valves facilitating automatic operation. Use valves of a size and quality consistent with standard engineering practice. Design the operating system to provide the flexibility to change sprinkling duration in one-minute increments and have a minimum of six start times per-day to provide for adjustment for climate conditions.

Equip systems with a rain sensor connected to the control valve network set to prohibit system operation during rainfall events.

Incorporate manual zone isolation valves to isolate laterals allowing partial system operation during periods of maintenance and repair.

In areas of uneven or sloping terrain incorporate a control valve or low-head drainage device at each sprinkler to ensure that line drainage to the lowest sprinkler is minimized.

CONSIDERATIONS

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

Application rates near the end of a center pivot may exceed soil intake rate. Light, frequent applications can reduce runoff problems, but may increase soil surface evaporation. Nozzle offsets or booms can be used to reduce peak application rates.

For low suspended nozzle application systems, row arrangement, nozzle spacing, discharge nozzle type and configuration, along with height all impact CU. Consider a system design and field management that complements each other to yield the highest CU. In general, circular rows for center pivot systems and straight rows for linear move systems provide higher CU's.

Some aspects of non-uniformity tend to average out throughout the irrigation season while others tend to accumulate. Factors that tend to average out during the irrigation season are climatic conditions and uneven travel speed for systems that start and stop. Factors that tend to accumulate during the irrigation season are nozzle discharge variances due to pressure or elevation differences, surface movement of water, and poor water distribution around field boundaries.

Consider the effects of a center pivot end gun operation on CU. A large end gun may reduce the average CU by 1 percent for each 1 percent of the area covered past the main system hardware.

Consider the on and off effects of center pivot corner arm units and end guns on overall sprinkler performance. Discharges reduce flow in the main tower, significantly lowering the CU.

Beneficial effects of conservation practices applied to limit surface redistribution of water and runoff may diminish over the irrigation season.

Consider the velocity of prevailing winds and the timing of occurrence when planning a sprinkler system. Systems designed to operate in varied time increments aid in balancing the effects of day and night wind patterns.

Consider filtering or screening the irrigation water before it enters the system if it contains particulate matter, algae, or other material that could plug the sprinkler nozzles.

Install drop tubes alternately on both sides of the mainline and when used in-crop install a flexible joint between the gooseneck pipes and the application device. Weight or secure drops in windy areas.

Consider different sprinkler application depths and application rates with hand move and center pivot systems. With hand move systems, the application rates more nearly match the soil infiltration rate so that large irrigations can be applied and the number of hand moves reduced. With an automated system, such as a center pivot, hand labor is not a major consideration and small applications at high rates are normal.

Fertilizer and chemical application amounts may vary from prior application methods and rates, due to precise applications possible with some sprinkler irrigation systems.

Management of sprinkler irrigation systems normally include utilizing soil water stored in the root zone, especially during critical crop growth stages.

Deflection of spans on center pivots and linear-move systems is common when the lateral is loaded (filled with water). Consider this deflection when determining nozzle heights. Wheel track depth will also affect nozzle height.

Water distribution is greatly affected by nozzle spacing and height for LPIC and MESA systems. In general, smaller, more closely spaced nozzles will yield a higher uniformity than larger, more widely spaced nozzles.

On center pivot or linear move systems, divert nozzles away from wheel tracks to avoid rutting.

Low pressure systems (35 psi or less) are sensitive to small changes in nozzle pressure. Consider using pressure regulators on all low pressure systems where elevation differences, pumping depth variations, and end gun or corner arm operation can significantly change nozzle discharge and sprinkler uniformity. Also consider installing a pressure gauge at both ends of the sprinkler system to monitor system pressure.

Consider system effects on the water budget, especially the volume and rate of runoff, infiltration, evaporation, transpiration, deep percolation, and ground water recharge.

Consider system effects on erosion and movement of sediment, and soluble and sediment-attached substances carried by runoff.

Consider system effects on soil salinity, soil water or downstream water quality including subsurface drains. Crops may be more sensitive to salts applied to plant foliage during sprinkling than to similar water salinities applied by surface irrigation, subirrigation, and microirrigation. Information on foliar injury from saline water applied by sprinkler irrigation is contained in NEH, Part 623, Chapter 2. If the salt content of the irrigation water is high, consider other irrigation methods.

Where wastewater is used for irrigation, consider timing of irrigation based on prevailing winds to reduce odor. In areas of high visibility, consider irrigating at night. The use of wastewater may reduce the life of the system due to corrosion or abrasion.

When utilized for particulate matter reduction, check to assure adequate animal feeding operation water supplies are available to meet other operating needs, during sprinkler system operation.

Treat irregularly shaped pen areas that are impractical to treat with a sprinkler system and where potential dust sources may occur for dust control with tanker water trucks equipped with hoses, or nozzles designed to apply water at rates similar to an equivalent sprinkler system.

Open-feedlot management practices that minimize thickness of loose manure will reduce water demands for dust control, as well as, reduce wet areas and ponding that could increase ammonia emissions.

PLANS AND SPECIFICATIONS

Prepare plans and specifications for constructing irrigation sprinkler systems that comply with this standard and describe the requirements for properly installing the practice to achieve its intended purpose.

OPERATION AND MAINTENANCE

Develop an operation and maintenance plan that provides:

- specific instructions for operating and maintaining the system to insure that it functions properly.
- information regarding periodic inspections and prompt repair or replacement of damaged components.

As a minimum include the following items in the plan:

- Periodic checks and removal of debris and sediment as necessary from nozzles to assure proper operation.
- Inspection or testing of all pipeline and pumping plant components and appurtenances, as applicable.
- Regular testing of pressures and flow rates to assure proper operation.
- Periodic checks of all nozzles and spray heads for proper operation and wear.
- Routine maintenance of all mechanical components in accordance with the manufacturer's recommendations.
- Prior to retrofitting any electrically powered irrigation equipment, electrical service must be disconnected and the absence of stray electrical current verified.
- Operate the system in accordance with the approved IWM plan.