**NATURAL RESOURCES CONSERVATION SERVICE**

**CONSERVATION PRACTICE STANDARD**

# IRRIGATION SYSTEM, TAILWATER RECOVERY

**(No.)**

**CODE 447**

## DEFINITION

A planned irrigation system in which all facilities utilized for the collection, storage, and transportation of irrigation tailwater and/or rainfall runoff for reuse have been installed.

## PURPOSE

This practice may be applied as part of a resource management system to achieve one or more of the following purposes:

- Conserve irrigation water supplies.
- Improve offsite water quality.
- Reduce energy use.

## CONDITIONS WHERE PRACTICE APPLIES

Tailwater recovery systems are suitable for use on lands that are served by a properly designed and installed irrigation system where recoverable irrigation runoff and/or rainfall runoff flows can be anticipated under current or expected management practices.

This standard applies to the planning and functional design of irrigation tailwater recovery systems including, but not limited to: pickup ditches, sumps, collecting basins, pumping plants and pipelines. It does not apply to detailed design criteria or construction specifications for individual structures or components of the recovery system.

## CRITERIA

General Criteria Applicable To All Purposes

The installation and operation of a tailwater recovery system shall comply with all federal, state and local laws, rules and regulations.

Appropriate NRCS standards and specifications shall be used in the design and construction of facilities needed for a tailwater recovery system. The criteria for the design of components not addressed in a NRCS Conservation Practice Standard shall be consistent with sound engineering principles.

**Collection Facilities.** Facilities for the collection of irrigation tailwater can be an integral part of irrigation systems covered by NRCS Conservation Practice Standards, Irrigation System, Surface and Subsurface (443), and Irrigation System, Sprinkler (442). These facilities may include, but are not limited to, ditches, culverts, pipelines, water control and/or grade stabilization structures or other erosion control measures.

Depending on site conditions, a ditch or dike is used to direct surface irrigation runoff to the storage facility without causing erosion and to prevent water ponding on the lower end of the field and damaging growing crops. Berms 1.0 feet or less unsettled height (typically bladed near the lower end of furrows) do not require a design. Berms higher than 1.0 feet shall be designed to carry runoff from a 10-year, 24-hour storm. The minimum channel capacity shall pass the 2-year, 24-hour runoff with out-of-bank flow across the end of the irrigation furrows. The velocity in this channel, as computed by Manning's formula using an "n" value of 0.035, shall not exceed the following:

a. 2.5 ft./sec. for erosion resistant soils (clays, silty clays, sandy clays, and clay loams)

b. 2.0 ft./sec. for average erosion resistant soils (loams, silt loams, silty clay loams, and sandy clay loams)

c. 1.5 ft./sec. for easily eroded soils (sandy loams, fine sandy loams, and very fine sandy loams)

Minimum depth and width requirements for stable, permanently vegetated channels can be determined using procedures in the NRCS National Engineering Handbook, Part 650,

Engineering Field Handbook, Chapter 7, Grassed Waterways, or Agricultural Research Service (ARS) Agriculture Handbook 667, Stability Design of Grass-Lined Open Channels.

**Storage Facilities.** Facilities are needed to store the collected water until it is redistributed through the irrigation system. Runoff volume and rate, as well as the required level of water control at the point where the tailwater is returned to the irrigation system, should be considered in determining the size of the storage facility.

Sumps with frequently cycling pumping plants may be used when tailwater is discharged into a collection basin, regulating reservoir, or pipeline having facilities for regulating fluctuating flows (i.e., a float valve). For systems unable to regulate flows, tailwater sumps or collection basins shall be large enough to provide the regulation needed to permit efficient use of the water.

Volume shall be sufficient to store tailwater runoff from one complete irrigation set. Storage requirement shall meet the criteria listed in this standard and the guidance provided in the Oklahoma Irrigation Guide, Chapter 7, Part 652.0710. The criteria found in the OK NRCS Conservation Practice Standard, Irrigation Reservoir (436) shall also apply. Storage may be increased to allow for normal sedimentation. This will be in addition to sediment trap storage.

Collection basins shall be surrounded by berms to prevent surface water from entering at points other than the mechanical inlet structure. A storm bypass or auxiliary spillway shall be provided with a capacity to pass runoff from a 25-year, 24 hour storm. Berms shall be set a minimum of 1 foot above the maximum planned water surface in the collection basin or the auxiliary spillway crest, whichever is higher. The minimum top width for berms shall be 8 feet.The maximum design water surface shall be at the flowline elevation of the inlet structure.

Retrievable tailwater depth shall be a minimum of 5 feet and a maximum of 12 feet measured from the flowline elevation of the inlet structure to the bottom of the collection basin. If needed, an additional 1.0-foot of depth may be added to allow for pump suction clearance. For stationary pumps, a deepened area 10-foot by 10-foot may be sufficient.

Excavation and embankment slopes shall be stable for the soil conditions and shall not be steeper than 2:1. One or both ends may be flattened to 6:1 slopes for maintenance and clean out.

If necessary to prevent excessive seepage, sealing guidance found in the applicable OK NRCS Conservation Practice Standards for Pond Sealing or Lining shall be followed.

When energy sources for tailwater pump back systems are subject to interruption, safe emergency bypass areas cannot be provided, or tailwater discharges violate local or state regulations, minimum tailwater storage requirements shall include a volume adequate to store the complete runoff from a single irrigation set.

Sumps and collecting basins shall be equipped with inlets designed to protect the side slopes and the collection facilities from erosion. A dike, ditch, or water control structure shall be provided, if required by state law, to limit the entrance of rainfall runoff into the designed inlet. Sediment traps shall be installed as needed.

**Conveyance Facilities.** All tailwater recovery systems require facilities to convey water from the storage facility to a point of entry back into the irrigation system. These facilities may consist of a pumping plant and pipeline to return the water to the upper end of the field, or a gravity outlet having a ditch or pipeline to convey the water to a lower elevation in the irrigation system. Other components or combinations of components may be needed based on a site-specific analysis.

The minimum pump capacity shall be large enough to meet pumping needs of the selected irrigation method. Pipelines used to convey water from the collection basin to the area being irrigated may be buried or laid on the ground surface.

The discharge capacity of conveyance facilities shall be determined by an analysis of the expected runoff rate, the planned irrigation collecting basin or regulating reservoir storage capacity, and the anticipated irrigation application rate. If the return flow is used as

an independent irrigation supply rather than as a supplement to the primary irrigation water supply, the rate and volume of flow must be adequate for the method(s) of water application employed.

**Sediment Traps**. A sediment trap shall be included with each tailwater collection basin. The trap shall be located immediately ahead of where tailwater enters the collection basin. The collection basin should be between the irrigated field and the sediment trap to protect against excessive siltation and to prevent degrading the field end slope. If it is not practical to locate the trap behind the collection basin, it shall be protected by a berm.

RUSLE2 technology or other appropriate methods may be used to determine sediment storage capacity. Minimum sediment storage capacity shall equal the anticipated annual sediment accumulation. The trap shall have dimensions that expedite cleaning operations. End slopes shall accommodate the type of equipment performing maintenance and cleanout functions. As a minimum, the sediment trap shall have a 10-foot bottom width, 2:1 side slopes, and 2:1 end slopes. Sediment trap length shall be based on the sediment storage capacity. Permanent vegetated strips (grass or alfalfa) may be used in conjunction with sediment traps to prevent erosion and trap additional sediment.

**Mechanical Inlet Structure**. Inlet structures shall be installed to convey irrigation tailwater and/or storm runoff into the collection basin without erosion of the entrance channel or side slopes. Inlets shall be designed so storm water runoff is conveyed around the tailwater recovery collection basin to a stable outlet. Structures may consist of chutes, drop structures, or pipes (10-inch I.D. minimum) using galvanized corrugated steel, corrugated aluminum, welded steel, plastic, or other approved materials.

The invert of the inlet structure discharging into the tailwater collection basin shall be a minimum of 1.0 foot below the field surface. Anti-seep collars are not required for inlet pipes. OK NRCS Conservation Practice Standard, Structure for Water Control (587) shall be used for additional guidance.

Additional Criteria Applicable To Improving Water Quality

**Storage Facilities.** Storage facilities shall be enlarged when additional storage volume is required to prolong retention time for the breakdown of chemicals in the runoff water. Retention times shall be soil-, site-, and chemical-specific.

Controls must be used to reduce seepage of chemical-laden waters from tailwater retention ponds. Controls include: natural soil liners, soil additives, and commercial liners.

Where additional storage is required to provide for sediment deposition, storage facilities shall be sized accordingly. Allowable retention times shall be site specific to the particular soil type(s).

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**

**Water Quantity**

- Irrigation systems should be designed to limit tailwater volumes to that needed for effective operation. This reduces the need and minimizes the size and capacity of collection, storage, and conveyance facilities.

  Where tailwater recovery systems collect rainfall runoff for storage and are used as an irrigation source, the size and capacity of collection and storage facilities will be based on the expected volume and rate of runoff and water needed to meet crop needs.

- Changes in irrigation water management activities may be needed to optimize the use of return flows.

- Downstream flow or aquifer recharge volumes dependent on runoff will be reduced, and this could have undesirable environmental, social, or economic consequences.

**Water Quality**

- Effects on surface and groundwater quality by the transport of sediment, as well as soluble, and adsorbed contaminants should be considered. Contaminant transport can create a potential hazard to wildlife; especially waterfowl that are attracted to ponded water.
- Nutrient and pest management measures should be followed to decrease the volume and concentration of chemical-laden tailwater.
- Protection of system components from storm events and excessive sedimentation should be considered.

**Other Considerations**

- This practice may adversely affect cultural resources and must comply with NRCS General Manual 420, Part 401 during planning, installation, and maintenance.
- Effects on the visual quality of water resources should be also considered.
- A berm may be constructed between the sediment trap and tailwater collection basin to store clean-out materials until dry enough for disposal.
- If aesthetic or wildlife plantings are included, they shall be planted at designated locations and in accordance with appropriate conservation practice standards.

**PLANS AND SPECIFICATIONS**

Plans and specifications for irrigation tailwater recovery systems shall be prepared for specific field sites in accordance 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 shall be prepared for the landowner or operator responsible for facility operation and maintenance. Minimum plan provisions include:

- Periodic cleaning and re-grading of collection facilities to maintain proper flow lines and functionality.
- Periodic checks and removal of debris from trash racks and structures to assure proper operation.
- Periodic removal 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.
- Routine maintenance of all mechanical components in accordance with the manufacturer’s recommendations.

# NATURAL RESOURCES CONSERVATION SERVICE
# CONSERVATION PRACTICE GENERAL SPECIFICATION
# IRRIGATION SYSTEM, TAILWATER RECOVERY
# (No.)

**Code 447**

## CONSTRUCTION SPECIFICATIONS

Site Preparation, excavation, borrow, earthfill placement, cutoff trench, and materials shall comply with the OK NRCS Conservation Practice Specification, Pond (378).

Dispersive soils shall not be used in embankment or berm fill or as backfill for mechanical inlet structures. Soils high in salts (resistivity of less than 2000 ohm/cm for uncoated steel or less than 1200 ohm/cm for galvanized steel) shall not be used as backfill where steel pipes are used as part of the mechanical inlet.

If used, concrete shall be 3000 psi (28 days), Type I unless soils testing indicate any of the following conditions: pH less than 5.0, sodium and/or magnesium sulfate greater than 7000 parts per million (ppm), sodium chloride greater than 10,000 ppm, or electrical conductivity (EC) greater than 15.6 mmho/cm.

When pipes are used as the inlet structure, the following actions will be utilized for pipe installations:

1. The entire length of the pipe shall be bedded on (i) a minimum of two feet of compacted material, (ii) firm earthen material at least two feet below the natural ground surface, or (iii) a combination of (i) and (ii).

2. Material located within 6 inches of the pipe (including rocks, clods, or foreign materials) shall be less than an inch in diameter.

3. If the bed surface will not readily conform to the shape of the pipe or contains slick or impervious areas, it shall be broken up to a minimum depth of 3 inches.

4. Materials located within the upper 3 inches of the pipe foundation and within 3 inches of the pipe shall be wet enough to effectively compact and fill all voids adjacent to the pipe. Water will be added when needed to ensure adequate compaction.

5. Water-packing is an option for materials having a predominance of sand (classifying as SM or SC) if the following procedures are utilized:

   a) Water-packing may proceed in distances not to exceed 10 feet in length.

   b) Earthen dikes not exceeding 3 feet in width will be constructed on both sides of the pipe to the same height.

   c) Water shall be added to the area upstream of the dike, and soil shall be added until the water is displaced by soil.

   d) The entire length of the pipe will be water-packed to at least the spring line.

6. Water-packing or hand or mechanical tamping will be required to extend 2.0 feet above the pipe before placing or compacting fill over the pipe with earth moving equipment.

## VEGETATIVE SPECIFICATIONS

Disturbed areas requiring establishment of vegetation shall be sprigged or seeded and fertilized according to the OK NRCS Conservation Practice Standard, Critical Area Planting (342). Seedbed preparation; seeding dates, mixtures, and rates; stabilizing measures; mulching; fertilizer; and lime requirements shall be specified for each area.