

**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.

appropriate OK NRCS Conservation Practice Standards and Specifications. The criteria for the design of components not addressed in a OK NRCS Conservation Practice Standard shall be consistent with sound engineering principles.

PURPOSE

This practice may be applied as part of a conservation management system to support one or more of the following:

- Conserve irrigation water supplies
- Improve offsite water quality

Collection Facilities. Facilities for the collection of irrigation tailwater can be an integral part of irrigation systems covered by OK NRCS Conservation Practice Standards, Irrigation System, Surface and Subsurface (443) and 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, as needed.

CONDITIONS WHERE PRACTICE APPLIES

Tailwater recovery systems are suitable for use on lands and facilities 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.

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.

This standard applies to the planning and functional design of irrigation tailwater recovery systems including, but not limited to, pickup ditches, sumps, collection 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.

Berms greater than 1.0 feet in height 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:

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.

Facilities needed for a tailwater recovery system shall be designed and constructed according to

- 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

Conservation practice standards are reviewed periodically, and updated if needed. To obtain the current version of this standard, contact the Natural Resources Conservation Service.

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loams, fine sandy loams, and very fine sandy loams)

Determine the minimum depth and width requirements for stability of permanently vegetated channels using the 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 in 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.

For systems where tailwater is discharged into an irrigation collection basin or regulating reservoir or into a pipeline having facilities for regulating fluctuating flows (i.e. a float valve), small sumps with frequently cycling pumping plants may be used. For systems unable to regulate flows, tailwater sumps or collection basins shall be made 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 Regulating Reservoir (552) 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, the sealing guidance found in the applicable OK NRCS Conservation Practice Standards for Pond Sealing or Lining shall be installed.

Sumps and collection 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. A sediment trap shall be provided for 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, as needed.

RUSLE2 technology or other appropriate methods may be utilized to determine sediment storage capacity. As a minimum, the sediment storage capacity shall meet the anticipated annual sediment accumulation. The trap shall be of such dimensions that it can be readily cleaned out as needed. The end slopes shall be properly designed to accommodate the type of equipment anticipated to perform maintenance and clean out. As a minimum, the sediment trap shall have a 10-foot bottom width, 2:1 side slopes, and 2:1 end slopes. The length of the sediment trap 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 to trap sediment.

Mechanical Inlet Structure. Inlet structures shall be provided to convey irrigation tailwater and/or storm runoff into the collection basin without erosion damage to the entrance channel or side slope. To the extent feasible, inlets shall be designed such that 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 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.

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 necessary as determined on a site-specific basis.

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 capacity of conveyance facilities shall be determined by an analysis of the expected runoff rate, the planned irrigation collection basin or regulating reservoir storage capacity, and the anticipated irrigation application. 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.

Additional Criteria Applicable To Improving Water Quality

Storage Facilities. Where additional storage is required to provide adequate retention time for the breakdown of chemicals in the runoff waters, storage facilities shall be sized accordingly. Allowable retention times shall be site specific to the particular chemical used.

Seepage from a storage facility shall be controlled to the extent possible when the storage facility is expected to receive chemical-laden waters. Control may be in the form of natural soil liners, soil additives, commercial liners, or other approved methods.

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).

CONSIDERATIONS

Water Quantity

- Irrigation systems should be designed to limit tailwater volumes to that needed for effective operation. This reduces the need or minimizes the size and capacity of collection, storage, and transportation facilities.
- Changes in irrigation water management activities will be necessary to accommodate return flows.
- Collection basin dimensions should be selected based on storage requirements, site conditions, and construction equipment planned for use.
- Downstream flows or aquifer recharge volumes dependent on runoff will be reduced and could cause undesirable environmental, social, or economic effects. Existing wetland hydrology could be impacted by this practice.

Water Quality

- Effects on surface and groundwater quality by the movement of sediment

and soluble and sediment-attached substances should be considered

- Nutrient and pest management measures should be planned to limit chemical-laden tailwater as much as practical. Chemical-laden water can create a potential hazard to wildlife, especially waterfowl that are drawn to ponded water.
- Protection of system components from storm events and excessive sedimentation should be considered.
- Effects on the visual quality of water resources should also be considered.

Other Considerations

- A 20-foot wide berm may be constructed between the sediment trap and tailwater collection basin to store clean-out materials until dry enough for disposal.
- If screening, aesthetic, or wildlife plantings are planned, they shall be planted at the designated locations and in accordance with appropriate conservation practice standards.
- This practice may adversely affect cultural resources and must comply with GM 420, Part 401 during planning, installation, and maintenance.

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 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:

- Periodic cleaning and re-grading 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 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 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).

Dispersed soil 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 back fill 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.

Where 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 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 as 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' 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.