Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

ON FARM RECHARGE

CODE 817

(ac)

DEFINITION

The periodic application of surface or stormwater to cropland with connectivity to an unconfined aquifer.

PURPOSE

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

- To recharge a specific aquifer to reduce the risk of natural resource degradation, or limitation to land use caused by groundwater depletion.

CONDITIONS WHERE PRACTICE APPLIES

This standard applies where the following conditions occur:

- A water conveyance system, including all the necessary on-farm structures for water control and distribution, either exists or can be installed under this practice
- nutrient and pest management practices have been historically applied to the extent that groundwater quality will not be reduced when recharge occurs.
- An adequate supply of water is available for recharge, either as stormwater runoff or surface water deliveries included as part of a local- or areawide groundwater management plan.
- The site is underlain by soils and vadose zone materials with sufficiently high vertical and horizontal hydraulic conductivity, and connectivity to an unconfined aquifer with adequate transmissivity and groundwater storage capacity.
- Recharge can occur without unacceptable levels of groundwater quality degradation, and without elevating subsurface water levels that could negatively impact onsite- or nearby land uses or sensitive habitats.
- Crops grown on lands within the recharge footprint can withstand the effects of periodic inundation and saturated conditions throughout its entire root zone, without reducing plant productivity and health to unacceptable levels.

This standard does not apply to:

- Dedicated basins or channels where the recharge footprint is used exclusively for groundwater recharge.
- Stormwater management systems or other drainage structures that incidentally recharge groundwater.
- Groundwater recharge to support desired land use goals or ecological processes on rangeland or non-irrigated pasture.

CRITERIA

General Criteria Applicable to All Purposes

Apply this practice as an integral part of an overall system that balances the needs and capabilities of the agricultural operation, with local- and areawide groundwater management goals.

Laws and Regulations. Plan, design, and construct this practice to meet all federal, state and local laws and regulations.

Water Availability. The producer shall ensure that all rights have been secured as needed, for water that will be applied and infiltrated as a result of this practice.

Unless a mitigation plan is submitted and accepted as required by the permitting agencies, onsite or offsite diversion of flood flows intended for recharge as part of the project, shall not degrade habitat quality or adversely affect aquatic and riparian species in the watershed or downstream.

Determine the volume of water available for infiltration, the anticipated rate of delivery, and the projected delivery schedule. If the planned water source includes stormwater runoff or unregulated streamflow, estimate water availability based on a hydrologic evaluation of the contributing watershed, and the capacity of the planned or existing collection and conveyance network.

Water in the recharge footprint must infiltrate sufficiently to accommodate the next planned delivery, significant runoff event, or scheduled resumption of agricultural operations.

Siting Criteria. The highest expected water table should be at least 5 feet below the surface of the recharge footprint.

Rates of surface infiltration and deep percolation must be sufficiently high to be able to transmit water beyond the root zone without adversely impacting crop yield. Determine the saturated hydraulic conductivity (Kfs) of unsaturated soils across the footprint of the proposed site. If data is not available, use field methods that are suitable for the texture, soil profile (uniform or layered), and approximate hydraulic conductivity range expected (ASTM D5126). Note that infiltrometer tests do not directly measure field-saturated hydraulic conductivity; infiltration data can be fitted to empirical models such as those developed by Green and Ampt and Philip (ASTM D5126).

Site Investigation Plan and Hydrogeologic Investigation. A Site Investigation Plan (SIP) shall be developed for the inundated area based on a hydrogeologic investigation that characterizes the potential for water that is applied to reach the appropriate aquifer.

On-Farm Conveyance and Water Control. All structures required for water conveyance and control necessary to maximum recharge shall be in- place such as: measuring devices, diversion boxes, checks, turnouts, pipelines, ditches, valves, pumps, and gates. Design the physical components of the System for water conveyance and control in accordance with all or portions of applicable NRCS Conservation Practice Standards (CPSs), including, but not limited to:

- Irrigation Pipeline (Code 430)
- Irrigation Canal or Lateral (Code 320)
- Dike (Code 356)
- Diversion (Code 362)
- Irrigation Field Ditch (Code 388)
- Structure for Water Control (Code 587)
- Pumping Plant (Code 533)
- Surface Drain, Field Ditch (Code 607)

Where applicable, follow criteria for aboveground, multi-outlet distribution pipelines set forth in CPS Irrigation System, Surface and Subsurface (Code 443).

Grade the recharge footprint as needed to ensure uniform distribution of the water to be infiltrated, using criteria in the CPS for Irrigation Land Leveling (Code 464) or Land Smoothing (Code 466).

Control flows into and out of the recharge footprint to prevent flows from exceeding design capacity; keep water deemed unsuitable for recharge from entering the recharge area; allow for pretreatment of water entering the facility; and allow the recharge footprint to dry out sufficiently for maintenance and scheduled resumption of agricultural operations. Use CPS Structure for Water Control (Code 587), as appropriate for flow control measures.

Modify the existing drainage system as needed, to accommodate planned recharge.

All structures and water delivery components shall be able to convey the expected maximum flow and provide adequate capacity and freeboard.

Erosion Control. Application of this practice shall not result in soil erosion that creates a resource concern. Provide nonerosive gradients on all unlined ditches. If water is conveyed on slopes steep enough to cause excessive flow velocities, install structural erosion control measures such as pipe drops or chutes. Inlet structures must not cause erosion that could clog or impact other uses within the recharge footprint or threaten the integrity of nearby roads or structures.

If permanent erosion control measures cannot be implemented in a timely manner, use appropriate temporary measures to control erosion. During and after construction, use erosion and sediment control measures to minimize off-site damages.

Water Quality and Sedimentation. Pretreat the water prior to entering the recharge footprint as needed, to reduce sediment, nutrients, pesticides, salts, chemical pollutants, bacteria, algae and other contaminants that could degrade groundwater quality beyond allowed levels, or reduce infiltration rates by one order of magnitude or more for the first three years of operation.

Potentially feasible pretreatment alternatives include, but are not limited to:

- Water and Sediment Control Basin (Code 638)
- Sediment Basin (Code 350)
- Denitrifying Bioreactor (Code 605)
- Filter Strip (Code 393)
- Grassed Waterway (Code 412)
- Constructed Wetland (Code 656)
- Conservation Cover (Code 327)
- Cover Crop (Code 340)
- Field Border (Code 386)
- Residue and Tillage Management, No Till (Code 329)-CPS-4
- Residue and Tillage Management, Reduced Till (Code 345)

Gypsum may be applied where needed to improve infiltration; follow criteria set forth in CPS Amending Soil Properties with Gypsum Products (Code 333).

Recharge sites must be assessed for nutrient and pesticide management and leaching hazard in accordance with criteria set forth in:

- Pest Management Conservation System (Code 595)
- Nutrient Management (Code 590)

Safety: Design measures necessary to prevent serious injury or loss of life in accordance with requirements of NRCS National Engineering Manual (NEM), Part 503, Safety.

Instrumentation and Monitoring: Install Monitoring Wells (Code 353) within or near the recharge footprint as needed, to monitor infiltration rates and groundwater levels, and to sample for contaminants and other chemical constituents, as required by the state or local permitting agencies, or as part of a local or regional groundwater management plan. Design and install the wells using criteria in ASTM D5092, state well standards, and in keeping with local requirements. Existing wells located nearby that are screened within the same unconfined aquifer that is targeted for recharge may also be used.

Where required by law or included as part of a local or areawide groundwater management plan, install flowmeters, weirs, or other flow measurement devices at both the inlet and outlet of the recharge area. Follow criteria in CPS Structure for Water Control (Code 587).

CONSIDERATIONS

Many of the principles of surface water irrigation apply to design of systems. Refer to NEH Part 653, Chapter 4 (USDS NRCS, 2012) for technical information, considering that the system should be designed for uniformity, but also for high rates of deep percolation and low irrigation efficiency.

Clogging of the recharge footprint can occur in response to deposition and accumulation of suspended solids including sediment, algae, and sludge; formation of biofilms and biomass on and in the soil; precipitation of calcium carbonate and other salts on and in the soil; and formation of gases within the soil that may block pores and reduce hydraulic conductivity (Bouwer, 2002).

This clogging effect of fine-grained sediment on infiltration rates resulting from a single design storm or delivery.

Recharge water quality evaluations should consider seasonal variations and long-term trends caused by varying land uses and watershed hydrology, rather than relying solely on average values which are likely to mask the impacts of single events or temporally variable conditions on water quality (EWRI/ASCE, 2001).

Recharge facilities should fully drain within 24 to 48 hours after being inundated. This will allow avoidance of mosquito breeding, indication of issues caused by clogging, soil compaction, high water table. Also, microbiological decomposition can be impeded if soils are unable to dry out and anaerobic conditions exist between storm events.

Coordinate with the local Mosquito and Vector Control District to ensure compliance with mosquito abatement Best Management Practices (BMPs).

Consider the possible impacts of the system on stream flows in nearby drainages; recharge near a stream channel could potentially cause a losing stream to periodically or even permanently shift to a gaining stream, which would indicate that a portion of the recharged water is reemerging as surface flow.

Consider maintaining vegetation on most of the recharge footprint to reduce clogging and improve infiltration by using conservation practices that will increase soil health, increase organic matter, minimize soil compaction and manage soil moisture. Potential alternatives are Cover Crop (code 340), Conservation Cover (code 327), Residue and Tillage Management, No Till (code 329), Controlled Traffic Farming (code 334), and Residue and Tillage Management, Reduced Till (code 345).

Consider the impacts on soil health, nutrient status and root health. Prolonged flooding kills earthworms, changes soil microbial populations and nutrient chemical form, and depletes oxygen levels, which may cause root disease. Consider creating raised tree line rows on newly planted orchards so the crown of the root ball is above the flood line. Some crops, such as pear trees, are more adapted to prolonged submersion than other crops.

PLANS AND SPECIFICATIONS

Construction Plans and specifications shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose.

The construction plans shall include all the necessary information, views, and requirements required to construct the structure such as:

- All components required for Plans and Specifications for the individual practices that together comprise the on-farm groundwater recharge system.
- A plan view map showing the layout of all components that comprise the on-farm groundwater recharge system, including elevations and the recharge footprint
- Typical profiles and cross sections of system components as needed
- Structural drawings adequate to describe the construction requirements
- Requirements for vegetative establishment or mulching, as needed

OPERATION AND MAINTENANCE

Develop an operation and maintenance plan that is consistent with the purposes of this practice and the design life of the system; maintenance is particularly critical for recharge facilities, which are prone to clogging. Include the following provisions:

- Maintain access to the cropland that is inundated for regular maintenance activities.
- Inspect the inundation area annually, for signs of wetness or damage to structures, standing water, trash and debris, sediment accumulation, slope stability, standing water, and material buildup. Remove trash and debris and dispose of properly.
- Monitor the rate of surface water decline in the recharge footprint following major recharge events to maintain infiltration rates.
- Measure and record water levels in observation wells approximately three days following a recharge event. Submit data as appropriate to the local groundwater monitoring entity or as part of a local- or area-wide groundwater management plan.
- Recharge areas should be dried at least annually, to allow accumulations of fine-grained sediment and organics to decompose, crack, and curl. If the clogging is predominantly organic, an extended drying period may be needed (Bouwer, 2002).
- Mechanically or manually remove surface crusts from the recharge footprint when accumulated sediment reduces original infiltration rate by 25-50 percent, and properly dispose or stockpile the excavated material. After removal of the clogging material, the surface should be disturbed using tillage to break up any crusting, and then smoothed and lightly compacted to prevent the migration of fine particles down into the profile on first flooding.
- Repair undercut and eroded areas at inflow and outflow structures. Seed or sod as needed to restore ground cover.

REFERENCES

ASTM D3385. Standard Test Method for Infiltration Rate of Soils in Field Using Double-Ring Infiltrometer. ASTM International, West Conshohocken, PA. www.astm.org.

ASTM D4043. Standard Guide for Selection of Aquifer Test Method in Determining Hydraulic Properties by Well Techniques. ASTM International, West Conshohocken, PA. www.astm.org.

ASTM D4050. Standard Test Method for (Field Procedure) for Withdrawal and Injection Well Testing for Determining Hydraulic Properties of Aquifer Systems. ASTM International, West Conshohocken, PA. www.astm.org.

ASTM D5092. Standard Practice for Design and Installation of Groundwater Monitoring Wells. ASTM International, West Conshohocken, PA. www.astm.org.

ASTM D5126. Standard Guide for Comparison of Field Methods for Determining Hydraulic Conductivity in Vadose Zone. ASTM International, West Conshohocken, PA. www.astm.org.

ASTM D5753. Standard Guide for Planning and Conducting Geotechnical Borehole Geophysical Logging. ASTM International, West Conshohocken, PA. www.astm.org.

ASTM D5777. Standard Guide for Using the Seismic Refraction Method for Subsurface Investigation. ASTM International, West Conshohocken, PA. www.astm.org.

ASTM D6391. Standard Test Method for Field Measurement of Hydraulic Conductivity Using Borehole Infiltration. ASTM International, West Conshohocken, PA. www.astm.org.

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