Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

GROUNDWATER RECHARGE BASIN OR TRENCH

CODE 815

(no)

DEFINITION

An off-channel impoundment with a permeable base underlain by an unconfined aquifer.

PURPOSE

This practice is applied for the following purpose:

- 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 practice applies to infiltration structures that are configured as a basin or a channel

where the following conditions occur:

- 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.
- Failure of any structures or conveyance systems associated with this practice will not result in loss of life; or damage to homes, commercial or industrial buildings, main highways, railroads, or public utilities.
- Any embankment is classified as low hazard according to section 520.21(E) of the NRCS National Engineering Manual (NEM).
- The site is underlain by 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.

This practice does not apply to:

- Practices intended to recharge confined aquifers.
- Direct recharge (injection) wells that deliver surface water directly to the underlying aquifer.
- On-Farm Managed Aquifer Recharge projects that inundate irrigated agricultural land for the purpose of groundwater recharge.
- Instream structures or any other impoundments intended primarily for flood control, water supply, sediment control, or habitat.
- Municipal stormwater management systems or other drainage structures that incidentally recharge groundwater.

- Leach fields for septic systems.

CRITERIA

General Criteria Applicable to All Purposes

Laws and Regulations. Plan, design, and construct the groundwater recharge basin or trench 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 impounded 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 significantly 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 facility must draw down sufficiently to accommodate the next planned delivery or design stormwater runoff event.

Siting Criteria. Groundwater separation shall be at least 10 feet from the basin or trench invert to the highest expected water table.

For recharge systems where infiltration through the existing surficial soil profile, to a 60 inches maximum depth is planned, the average field saturated hydraulic conductivity across the footprint shall not be less than one foot per day. Where data is unavailable, measure and evaluate field saturated hydraulic conductivity (K_{fs}) of unsaturated soils across the footprint of the proposed site. 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).

Where hardpans or other relatively impermeable soil horizons impede infiltration at an otherwise suitable recharge site, recharge basin design may include excavating or otherwise disrupting the limiting horizon(s) to improve recharge.

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.

Water Quality and Sedimentation. Pretreat the water prior to entering the basin or trench footprint as needed, to reduce sediment, nutrients, pesticides, salts, chemical pollutants, bacteria, algae, and other contaminants that could: degrade groundwater quality beyond acceptable/allowed levels; reduce infiltration rates by one order of magnitude or more for the first three years of operation; or reduce the physical capacity of the basin or trench by 25 percent or more during the first three years of operation.

Sample and test the water source(s) if published data is inadequate; if it is required by permitting agencies; or as part of a local or areawide groundwater management plan.

Potentially feasible pretreatment alternatives include Conservation Practice Standards (CPSs) Water and Sediment Control Basin (Code 638), Sediment Basin (Code 350), Denitrifying Bioreactor (Code 605), Filter Strip (Code 393), Grassed Waterway (Code 412), and Constructed Wetland (Code 656). Approved coagulants may be used where needed to reduce settling basin size or detention time.

Water Control. Control flows into and out of the infiltration basin or trench to prevent flows from exceeding design capacity; keep water deemed unsuitable for recharge from entering the infiltration facility; allow for pretreatment of water entering the facility; and to allow the basin or trench to dry out for maintenance and repairs. Use CPS Structure for Water Control (Code 587) as appropriate for flow control measures.

Inlet structures must not cause erosion that could clog the basin or trench bottom, threaten structural integrity, or impact other land uses.

Safety: Design measures necessary to prevent serious injury or loss of life in accordance with requirements in NRCS NEM, Part 503 Safety. Provide warning signs, fences, ropes, and other devices as appropriate, to ensure the safety of humans and livestock.

Instrumentation and Monitoring: Install observation wells 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 areawide 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 the local- or areawide groundwater management plan, install flowmeters, weirs, or other flow measurement devices at both the inlet and outlet of the recharge facility. Follow criteria in CPS Structure for Water Control (Code 587).

Follow criteria in CPS Pond (Code 378) for any excavated or embankment recharge structure.

Additional Criteria Applicable to Infiltration Structures Configured as Trenches

Infiltration trenches that also provide water conveyance shall be designed as open channels. Design open channel infiltration trenches following criteria in the CPS for Open Channel (Code 582).

Design the trench inlet and outlet water control structures to provide the required capacity and hydraulic retention time; control the upstream water elevation; and provide safe bypass of flows in excess of the design capacity. Use the criteria in CPS Structure for Water Control (Code 587), for the design.

CONSIDERATIONS

Clogging 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).

The assumed infiltration rate should include the clogging effect of fine-grained sediment anticipated for a single design storm or delivery.

Ideally, 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.

The rate at which the impoundment empties can be modified by adjusting the dimensions of the wetted area of the basin or trench.

Because of the need for regular drying and periodic cleaning of infiltration basins, hydraulic capacities are best expressed in long-term average infiltration rates (hydraulic loading rates) that take into account dry or “down” time (Bouwer, 2002; EWRI/ASCE, 2001).

Multi-basin recharge projects should be designed so that each basin is hydraulically independent and can be operated according to its best schedule (Bouwer, 2002; EWRI/ASCE, 2001).

The attenuation potential of the soils is commonly greater than that of the underlying vadose zone materials; consider the increased potential for groundwater contamination where excavation reduces the soil depth through which the recharging water would pass.

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).

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

Consider the possible impacts of infiltration basins or trenches 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.

PLANS AND SPECIFICATIONS

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:

- A plan view map showing the layout of the recharge basin or trench and appurtenant features, including elevations and the recharge footprint
- Typical profiles and cross sections of the recharge basin or trench and appurtenant features as needed
- Structural drawings adequate to describe the construction requirements
- Requirements for vegetative establishment or mulching, as needed
- Material, construction, and installation requirements for all safety features

OPERATION AND MAINTENANCE

Develop an operation and maintenance plan that is consistent with the purposes of this practice and the design life of the infiltration basin or trench. Include the following provisions:

- Maintain access to the facility for regular maintenance activities.
- Inspect 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.
- Inspect pretreatment devices and overflow structures for damage and sediment buildup and repair or clean out as needed, including any manufacturer recommendations.
- Monitor the rate of surface water decline in infiltration basins and trenches 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 as required or as part of a local- or area-wide groundwater management plan.
- Basins and trenches should be emptied and 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. Excavated material may not be used to augment the embankment. After removal of the 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.
- Trenches with filter fabric should be inspected for sediment deposits by removing a small section of the top layer. If inspection indicates that the trench is partially or completely clogged, it should be restored to its design condition. Replace first layer of aggregate and filter fabric if clogging appears only to be at the surface.
- 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.

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

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