Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

SATURATED BUFFER

Code 604

(ft)

DEFINITION

A subsurface, perforated distribution pipe used to divert and spread drainage system discharge to a vegetated area to increase soil saturation.

PURPOSE

Install the practice to achieve one or more of the following purposes:

- To reduce nitrate loading from subsurface drain outlets.
- To enhance or restore saturated soil conditions in riverine, lacustrine fringe, slope, or depression hydrogeomorphic landscape classes.

CONDITIONS WHERE PRACTICE APPLIES

This practice is applicable to lands with a subsurface drainage system adaptable to discharge in a vegetated area.

Apply this practice where the soils and topography of the vegetated discharge area can maintain a raised water table without adverse effects to crops, channel banks, shorelines, or adjacent land.

This practice does not apply to drainage systems or underground outlet systems that have surface inlets which allow entry of soil and debris capable of plugging the distribution pipe(s).

Do not use this practice to discharge septic system effluent or animal waste.

CRITERIA

General Criteria Applicable to All Purposes

Conduct on-site geologic and soil investigations and an assessment of the stream geomorphology to confirm—

- Conditions, such as a restrictive layer, are present to create saturated conditions when water is diverted from a subsurface drainage system.
- The absence of pockets or layers of high conductivity soil that could provide preferential flow paths.
- A minimum of 0.75 percent organic carbon (1.2 percent organic matter) in the top 2.5 feet of soil.
- The absence of abandoned drain pipes or clay tile in the buffer area that could continue to drain the buffer. The minimum width of the vegetated buffer zone is 30 feet.
- The geomorphic condition of the stream, including potential for downcutting or lateral migration.

The vegetated buffer zone is defined as the area between the distribution pipe and the receiving channel on which permanent vegetation is maintained.

Locate and design the system to maximize the amount of subsurface drainage water distributed to the potentially saturated soil zone. Ensure there are no adverse impacts to adjacent lands.

Avoid placing the distribution pipe along any channels incised deeper than 8 feet, unless a slope stability analysis and assessment of stream geomorphology show an acceptable level of safety against saturated streambank failure. Slope stability analysis may encompass geological investigations and reliance on local knowledge and field observations of bank stability and lateral migration potential. Geological investigations will consist of soil probing or boring to the restrictive layer to characterize soil texture and cohesion, and do not generally require laboratory analysis. Local knowledge and field observations rely on signs that imply the bank does not exhibit an existing condition of slope instability, and has adequate slope and vegetation cover. An assessment of the stream geomorphology is important to ensure that the stream channel is stable, does not show signs of recent or potential lateral shifting in the floodplain, and that the increased saturation from the buffer will not destabilize the bank.

Avoid placing the distribution tile along any channel that is subject to active lateral migration, unless measures are installed to prevent excessive geomorphic change to the configuration of the streambank.

For sites with obvious and observed bank stability problems, or if the proposed condition is predicted to introduce bank stability problems, refer to Conservation Practice Standard (CPS) Streambank and Shoreline Protection (Code 580) for protective measures, or alternatively find a more stable site for the proposed saturated buffer.

Provide a minimum cover of 2.4 feet over the top of the distribution pipe.

Flow. DRAINMOD or other appropriate model simulations, drainage mainline capacity, or drainage system drainage coefficient with area drained can be used to determine drainage system capacity.

Minimum saturated buffer design flow is five percent of drainage system capacity or as much as practical based on the available length of the vegetated buffer.

Use soil profile saturated hydraulic conductivity, saturated buffer design flow rate, and hydraulic heads available at a particular site to compute minimum buffer dimensions and length of distribution pipe required to meet selected saturated buffer design flow.

Water control structure. Design the water control structure using the criteria found in CPS Structure for Water Control (Code 587). Locate the water control structure where it is accessible for water table observation and for operation and maintenance.

Design the water control structure to maintain the target water table elevation(s) over the distribution pipe during the management period. Convey drainage water exceeding the design capacity of the saturated buffer through an overflow pipe to a suitable, stable outlet. Use nonperforated pipe for the overflow pipe for a minimum of 20 feet from the water control structure to avoid draining the saturated soil zone around the water control structure.

The water control structure must not cause water to back up into a main or lateral beyond a property line unless the upstream landowner provides written permission.

Distribution pipe. Design the distribution pipe and overflow pipe according to the criteria found in CPS Subsurface Drain (Code 606). Ensure capacity of the distribution pipe is greater than the saturated buffer design flow to ensure that the soil lateral flow capacity rather than distribution pipe capacity limits saturated buffer flow.

Situate the distribution pipes on a topographic contour or grade to facilitate uniform groundwater inflow to the saturated zone. Add additional water control structures as needed for flow uniformity. The maximum elevation difference between structures is 3 feet.

Vegetation. Vegetate the soil saturation area and any other disturbed areas to prevent erosion and to utilize nitrogen from the drain water.

Protect all disturbed areas from erosion within 14 days of construction by seeding or mulching according to Iowa Construction Specifications IA-5, Pollution Control, and IA-6, Seeding and Mulching for Protective Cover. Refer to CPSs Conservation Cover (Code 327) or Critical Area Planting (Code 342) for criteria on seed selection, seedbed preparation, fertilizing, and seeding.

Additional Criteria to Reduce Nitrate Loading

Ensure saturated conditions are within the high soil organic carbon region of the soil profile when adequate drain flows exist. Design the system to maintain a water table within 12 inches of the ground surface at the location of the distribution pipe during the management period. Maintain the water control structure at the design level except when the water table must be lowered for providing an adequate root zone for the crop, trafficability for field work, adverse weather conditions, or system maintenance.

Additional Criteria to Enhance or Restore Saturated Soil Conditions

Design the system to replicate groundwater levels shown in the “Water Features” section of the USDA Web Soil Survey reports.

CONSIDERATIONS

Consider using other practices and management systems in conjunction with this practice to achieve a reduction of nitrate-nitrogen levels. Examples include CPSs Nutrient Management (Code 590), Cover Crop (Code 340), Drainage Water Management (Code 554), Denitrifying Bioreactor (Code 605), and Constructed Wetland (Code 656).

Consider adding an envelope around the drain to improve exit flow. Refer to criteria in CPS Subsurface Drain (Code 606).

For cost-effectiveness, consider locating the saturated buffer where it will intercept a subsurface drain outlet draining at least 15 acres.

Consider installing observation wells in the buffer midway between the distribution pipe and the stream bank or shoreline to facilitate water table documentation and sampling.

A saturated buffer may infiltrate less overland flow than a nonsaturated buffer.

Where possible to maintain a water table at or near the buffer soil surface, planting the buffer to a mix of hydrophytic species suitable for wet soil conditions will enhance nitrate removal and increase soil carbon replacement at and near the soil surface.

Installation of this practice may enhance wildlife and pollinator habitats.

Install an anti-seep collar if piping of trench earth fill along the bypass pipe is a concern.

Consider measures to reduce the potential for root plugging of distribution lines by woody species. Set planted trees back far enough that distribution lines will not be under the drip line of mature tree canopies. Plant herbaceous species in areas over distribution lines. If the riparian area is currently in trees, either clear the trees or establish an herbaceous zone outside the tree line for the water distribution area.

PLANS AND SPECIFICATIONS

At a minimum, include the following in the plans:

- A plan view of the layout of the water distribution system.
- Profile(s) of the existing drain, distribution pipe, and outlet channel.
- Details of required structure(s) for water-level control.
- Vegetation establishment requirements.
- Construction specifications that describe site-specific installation requirements.

OPERATION AND MAINTENANCE

Develop an operation and maintenance plan. Review this plan with the land manager. Specified actions include normal repetitive activities in the application and use of the practice (operation), and repair and upkeep of the practice (maintenance). At a minimum, include a description of—

- Planned water level management and timing.
- Inspection and maintenance requirements of the water control structure(s), distribution pipe(s), and contributing drainage system, especially upstream surface inlets.
- Periodic removal of invasive trees or shrubs to reduce distribution line plugging.
- If the site is to be monitored, include the monitoring and reporting requirements designed to demonstrate system performance and provide information to improve the design and management of this practice. At a minimum, record water levels (elevations) at the control structure, observation ports, and if used, observation wells. Record water levels biweekly when a water table is present and following precipitation events that result in high flows.

REFERENCES

Jaynes, D.B. and T. Isenhart. 2011. Re-saturating Riparian Buffers in Tile Drained Landscapes. A Presentation of the 2011 IA-MN- SD Drainage Research Forum. November 22, 2011. Okoboji, IA.

Jaynes, D.B. and T. Isenhart. 2012. Re-saturating Riparian Buffers using Tile Drainage. Unpublished.

Jaynes, D.B. and T.M. Isenhart, 2014. Reconnecting Tile Drainage to Riparian Buffer Hydrology. Journal of Environmental Quality 43:631-638. doi: 10.2314/jeq2013.08.0331. Advances in Agronomy 92:75-162.