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 are capable of maintaining 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 geologic and soil investigations 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 soil profile 12-30 inches below the ground surface
- 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.

Avoid placing the distribution pipe along any channels incised deeper than 8 feet, unless a slope stability analysis shows 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. The latter method relies on signs that imply the bank does not exhibit an existing condition of slope instability, and has adequate slope and vegetation cover with a stream channel and does not show recent lateral shifting in the floodplain.

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 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 NRCS Conservation Practice Standard (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 in excess of the design capacity of the saturated buffer through an overflow pipe to a suitable, stable outlet. Use non-perforated 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 has given written permission.

Distribution pipe
Design the distribution pipe and overflow pipe according to the criteria found in NRCS 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 one foot.

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 by seeding or mulching. Refer to NRCS CPS 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 NRCS 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 NRCS 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 non-saturated 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.*