



Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

SATURATED BUFFER

Code 604

(ft)

DEFINITION

A subsurface, multiple outlet distribution pipe to divert and spread drainage system discharge to a vegetated area creating increased soil saturation.

PURPOSE

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

- To reduce nitrate loading from subsurface drain outlets, addressing water quality degradation from excess nutrients in surface water.
- To enhance or restore saturated soil conditions in riverine, lacustrine fringe, slope, or depression hydrogeomorphic landscape classes, addressing degraded plant condition from inadequate structure and composition.

CONDITIONS WHERE PRACTICE APPLIES

This practice is applicable to crop lands with subsurface drainage systems that can be adapted to discharge to a vegetated area.

Apply this practice where the soils and topography are capable of maintaining a raised water table without adverse effects to channel banks, shorelines, or adjacent land.

This practice does not apply to drainage systems or underground outlet systems with surface inlets that facilitate entry of soil and debris capable of plugging the diversion pipe(s).

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

CRITERIA

General Criteria Applicable to All Purposes

Conduct geologic and soil investigations to confirm—

- Conditions such as a restrictive layer or a water table are present to create saturated conditions when water is diverted from the subsurface drainage system.
- The absence of pockets or layers of high conductivity soil which could provide preferential flow paths.
- Confirm the existence of at least 1% carbon in the soil at the 2.5 foot depth in the form of organic matter in the soils.

The minimum width of the vegetated buffer zone is 30 feet.

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.

Minimum design capacity of the saturated buffer is 15% of the capacity of the drainage system. Minimum hydraulic retention time for the drainage water in the saturated buffer is 3 hours.

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.

Provide a minimum cover of 1 foot over the top of the distribution pipe.

If the slope of the distribution pipe is more than twice the pipe friction slope at design flow, use flow restrictions (orifice plates) or multiple water control structures along the distribution pipe.

Use an appropriate model, such as DRAINMOD to estimate flow into the saturated buffer, flow along the distribution pipe and intermediate flow points. If DRAINMOD, or the soils data for input are not available, use the following to get minimum buffer dimensions:

- Use soil saturated hydraulic conductivity and average drain flow rate during the growing season to compute the length of distribution pipe required to provide adequate infiltration capacity for the required design flow.
- Use soil drainable porosity and saturated hydraulic conductivity, along with the lateral distance that leached water will travel from the distribution pipe to reach an outlet, to determine the retention time in the buffer. Retention time should be greater than 3 hours.

Design any necessary 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 design water table elevation over the distribution pipe during the management period based on expected flow rates from the subsurface drainage system. For systems discharging to saturated buffers, base the design flow rates on a design drainage coefficient or base flow rate.

Design the distribution pipe and overflow pipe according to the criteria found in NRCS CPS Subsurface Drain (Code 606). Ensure the capacity of the distribution pipe is larger than the available infiltration rate of the soil. Use nonperforated pipe for the overflow pipe for a distance sufficient to avoid draining the saturated soil zone around the water control structure, a minimum of 20 feet.

Situate the distribution pipes on a topographic contour or grade to facilitate uniform groundwater inflow to the saturated zone.

Design the system to maintain a water table below the ground surface across the entire buffer width when the distribution pipe water level is at design elevation. Install bank stabilization measures if a seepage face is likely to threaten bank stability. Utilize drainage models or other methods to predict the water surface profile across the buffer.

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. 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

For the purpose of this conservation practice, a saturated buffer is a vegetated strip of land with a shallow water table.

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 24 inches of the ground surface at the location of the distribution pipe.

Additional Criteria to Enhance or Restore Saturated Soil Conditions

Design the system to replicate groundwater levels shown in the "Water Features" section of the Soil Survey Report.

CONSIDERATIONS

Consider using other practices and management systems to achieve a reduction of nitrate-nitrogen levels separately or in conjunction with this practice. 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 saturated buffers where they intercept a subsurface drain outlet draining at least 15 acres or with a minimum flow rate of 0.5 cfs.

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.

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 tree clearing or establishment of an herbaceous zone outside the treed area should be used for water distribution areas.

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 in conjunction with the criteria in NRCS CPS Drainage Water Management (Code 554). Provide this to, and review it 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 the following in the plan:

- 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. Isenhardt. 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. Isenhardt. 2012. *Re-saturating Riparian Buffers using Tile Drainage*. Unpublished.

Jaynes, D.B. and T.M. Isenhardt, 2014. *Reconnecting Tile Drainage to Riparian Buffer Hydrology*. Journal of Environmental Quality 43:631-638. doi: 10.2314/jeq2013.08.0331.