United States Department of Agriculture

NATURAL RESOURCES CONSERVATION SERVICE (NRCS)

CONSERVATION PRACTICE STANDARD

VEGETATED TREATMENT AREA

CODE 635

(Ac.)

DEFINITION

An area of permanent vegetation used for agricultural wastewater treatment.

PURPOSE

Improve water quality by using vegetation to reduce the loading of nutrients, organics, pathogens, and other contaminants associated with livestock, poultry, and other agricultural operations.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies where:

- A vegetated treatment area (VTA) can be constructed, operated and maintained to treat contaminated runoff from such areas as feedlots, feed storage, compost areas, solid manure storage areas, barnyards, and other livestock holding areas; or to treat process wastewater from agricultural operations.
- A VTA is a component of a planned agricultural waste management system.

CRITERIA

Size the total treatment area for the VTA on both the contributing site water runoff and vegetation nutrient balances.

- Water balance is the soil's capacity to infiltrate and retain runoff within the root zone. Base the runoff determination on the most restrictive soil layer within the root zone regardless of its thickness. Use the soil's water holding capacity in the root zone, infiltration rate, permeability, and hydraulic conductivity to determine its ability to absorb and retain runoff.
- Nutrient balance utilizes the nutrients from the waste runoff to meet the nutrient removal requirements in the harvested vegetation. Base the nutrient balance on the most limiting nutrient (i.e., nitrogen or phosphorus).

Divert uncontaminated water from the treatment area to the fullest extent possible unless additional moisture is needed to manage vegetation growth in the treatment area.

Establish permanent vegetation in the treatment area. Use a single species or a mixture of grasses, legumes, and other forbs adapted to the soil and climate. Select species to meet the current site conditions and intended use. Selected species will have the capacity to achieve adequate density, vigor, and yield within an appropriate time frame to treat contaminated runoff. Complete site preparation and seeding at a time and in a manner that best ensures survival and growth of the selected species. Specific seeding requirements shall meet the VTA criteria located in South Dakota (SD) Range Technical Note No. 4 and the SD NRCS Conservation Practice Standard (CPS) Code 342, Critical Area Seeding.

Select vegetation that will withstand anticipated wetting or submerged conditions. Harvest vegetation as appropriate to encourage dense growth, maintain an upright growth habit, and remove nutrients and other contaminants that are contained in the plant tissue. Care shall be taken during harvest of the VTA area to not damage the functionality of the treatment area. Any wheel tracks, ruts, or other surface damage shall be repaired and re-vegetated.

Design the VTA based on the need to treat the runoff volume from the 25-year, 24-hour storm event from the agricultural animal management facility. Infiltrate a portion or the entire volume of the design storm, based on management objectives. Unless discharge is permitted by applicable regulations, store the noninfiltrated portion of the design volume for utilization or treatment.

The VTA must be designed to meet the minimum VTA size as required within the current version of the "SD Vegetated Treatment Area Design Worksheet" design tool.

For VTAs that treat runoff from an open feeding operation, a sediment basin or other solids removal method designed according to an appropriate SD NRCS CPS must be used to minimize entry of solids into the VTA. The design and construction of sediment basins shall be according to SD NRCS CPS Code 632, Solid/Liquid Waste Separation Facility.

For VTAs that treat runoff from a solid manure storage structure or facility, some means shall be provided to minimize entry of solids into the VTA.

Exclude all livestock, including grazing, from the VTA.

For VTAs that treat runoff from a solid manure storage structure or facility, some means shall be provided to minimize entry of solids into the VTA.

Utilize inlet control structures to control the rate and timing of inflow during normal operations and to control inflow as necessary for operation and maintenance.

Vegetated Treatment Areas shall not be located within the 100-year flood plain unless the structure is protected from inundation and damage that may occur during the 100-year flood event. For a structure to be protected from inundation, the lowest part of the top of the storage structure or floor of a building shall be at least 1 foot above the water surface elevation of the 100-year flood.

The water surface elevation of the 100-year flood can be determined by using Federal Emergency Management Agency (FEMA) 100-year floods, U.S. Geological Survey (USGS) 100-year flood prone maps, and/or completing a hydrologic and hydraulic analysis. If no FEMA or USGS 100-year flood delineation is available for the location of the waste storage structure, the 100-year flood elevation must be determined by completing a hydrologic and hydraulic analysis.

To determine the 100-year flood elevation using a hydrologic and hydraulic analysis, a 100-year flow must first be estimated by using USGS published peak-flow 100-year frequency estimates, using USGS flow-frequency regression equations, or utilizing a rainfall runoff model. If using a rainfall runoff model, a 100-year frequency – 24-hour duration storm peak flow estimate shall be determined. Manning's equation or a step-backwater program such as Hec/Ras must then be used to determine the 100-year flood elevation corresponding to the 100-year flow estimate.

Install VTAs where the water table is either naturally deep or artificially lowered so that the infiltrated runoff does not mingle with the groundwater at the bottom of the root zone. Subsurface drainage within the VTA is not allowed. Subsurface drainage may be used to lower the seasonal high water table to an acceptable level provided the subsurface drain lines are at least 10 feet away from the VTA boundary.

Unless soil moisture can be maintained to prevent drying and cracking, do not plan infiltration areas where soil features such as cracking will result in preferential flow paths that transport untreated runoff from the surface to below the root zone.

Ensure that appropriate erosion control measures and sheet flow control measures (i.e., gravel spreaders) are adequately addressed over the entire length of the VTA.

Additional Criteria for Sloped VTA Application Areas

Discharge into and through treatment areas shall be applied as sheet flow. Where sheet flow is planned, some means, such as a ditch, curb, gated pipe, level spreader, or a sprinkler system, shall be provided to disperse concentrated flow and ensure sheet flow across the treatment area. Land grading and structural components necessary to maintain sheet flow throughout the treatment area shall be provided as necessary.

Sloped vegetated treatment areas must have a minimum flow length of 100 feet. The natural or constructed slope of the VTA shall be 0.3 to 6 percent (%). The entrance slope to the VTA shall not be flatter than 1%.

Additional Criteria for Pressure Dosing Systems

Distribute the effluent over the VTA through sprinkler irrigation or other pressure dosing system. Match the application rate of sprinkler nozzles to the most restrictive soil infiltration rate or other factors to prevent effluent from discharging from the VTA.

CONSIDERATIONS

Additional nutrient and infiltration design guidance in Vegetated Treatment Systems for Open Lot Runoff, (Koelsch, et al. 2006).

Provide more than one vegetated treatment area to allow for resting, harvesting vegetation, and maintenance, and to minimize the potential for overloading.

Provide additional storage in the basin collection area to minimize or eliminate discharge into the VTA during rainfall events. Delay application until rainfall has ended to improve infiltration and nutrient uptake.

To maximize nutrient uptake, use warm and cool season species in separate areas to ensure that plants are actively growing during different times of the year.

Supplement water as necessary to maintain plants in a condition suitable for the treatment purpose.

Direct contaminated effluent to a waste storage facility during excessively wet or cold climatic conditions.

Consider suspension of application to treatment area when weather conditions are not favorable for aerobic activity or when soil temperatures are lower than 39° F. When soil temperatures are between 39° F and 50° F, consider reducing application rate and increasing application period while maintaining a constant hydraulic loading rate.

Manage the VTA to maintain vegetative treatment effectiveness throughout the growing season. Time the harvest of the VTA plants so vegetation can regrow to a sufficient height to effectively filter effluent late in the growing season.

Install a berm around the lower end of the VTA to contain excess runoff that may occur.

Effluent from the VTA may be stored for land application, recycled through the wastewater management system, or otherwise used in the agricultural operation.

Install fences or other measures to exclude or minimize access of the VTA to humans or animals.

Install a pumping system at the bottom of the VTA to either recirculate the effluent to the top of the VTA or transfer to a waste storage facility.

PLANS AND SPECIFICATIONS

Prepare plans and specifications that describe the requirements for applying the practice to achieve its intended use.

As a minimum include:

- Critical construction perimeters, necessary construction sequence, vegetation establishment requirements, level spreader mechanism requirements, associated practices and agronomic nutrient removal
- Plan view showing the location of the VTA
- Details of the length, width, and slope of the treatment area to accomplish the planned purpose (length refers to flow length down the slope of the treatment area)
- Herbaceous species, seed selection, and seeding rates to accomplish the planned purpose
- Planting dates, care, and handling of the seed to ensure that planted materials have an acceptable rate of survival
- Site preparation sufficient to establish and grow selected species

OPERATION AND MAINTENANCE (O&M)

Develop an O&M Plan consistent with the purposes of the practice, its intended life, safety requirements, and the criteria for its design.

Include the following items as appropriate:

- Control undesired weed species, especially state-listed noxious weeds, and other pests that could inhibit proper functioning of the VTA.
- Inspect and repair treatment areas after storm events to address gullies, reseed disturbed areas, and prevent concentrated flow.
- Apply supplemental nutrients and soil amendments as needed to maintain the desired species composition and stand density of herbaceous vegetation.
- Maintain or restore the treatment area as necessary by periodically grading or removing excess material when deposition jeopardizes its function. Reestablish herbaceous vegetation.
- Routinely dethatch or aerate a treatment area used for treating runoff from livestock holding areas in order to promote infiltration.
- Conduct maintenance activities only when the surface layer of the VTA is dry enough to prohibit compaction.

Monitor treatment areas in arid or semiarid regions that potentially could be affected by high salinity or sodium content for excessive salt and sodium buildup. Take corrective action if excessive salt or sodium is found.

Monitor all treatment areas to maintain optimal crop growth and environmental protection. Ensure that neither phosphorus is accumulating in the soil profile, nor nitrogen is leaching below the root zone.

REFERENCES

USDA, NRCS. National Engineering Handbook, Part 651, Agricultural Waste Management Field Handbook.

Koelsch, R., B. Kintzer, and D. Meyer (Eds.). 2006. Vegetated Treatment Systems for Open Lot Runoff - A Collaborative Report. USDA, NRCS.