NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

VEGETATED TREATMENT AREA

(Ac.)

CODE 635

DEFINITION

An area of permanent vegetation used for agricultural wastewater treatment.

PURPOSE

To improve water quality by reducing loading of nutrients, organics, pathogens, and other contaminants associated with livestock, poultry, and other agricultural operations.

CONDITIONS WHERE PRACTICE APPLIES

Where a Vegetated Treatment Area (VTA) can be constructed, operated and maintained to treat contaminated runoff from such areas as feedlots, compost areas, barnyards, and other livestock holding areas; or to treat process wastewater from agricultural operations.

CRITERIA

I. General Criteria

Vegetated treatment areas shall comply with all applicable laws, rules, regulations, and permit requirements including those applicable to the discharges of waters to the state.

Base designs on the Slow Rate Process described in the latest edition of the Environmental Protection Agency "Technology Transfer Process Design Manual for Land Treatment of Municipal Wastewater" or other technically acceptable reference. Refer to the additional criteria in the next section.

Evaluate each specific site to determine if a Vegetated Treatment Area will meet the objectives in reducing the pollutants of concern.

On farms where a waste storage facility exists that can handle liquids, direct wastewater to the waste storage facility whenever practical.

Control the sources of wastewater, to the extent practical, to reduce the total volume, frequency, and concentrations of pollutants to increase the effectiveness of the treatment area.

Pretreat inflow to wastewater treatment areas to exclude solids from the treatment area.

Treatment areas should be located outside of the 100 year floodplain. However, if site restrictions require location within a floodplain, they shall be protected from inundation or damage from a 25-year flood event, or larger if required by law.

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. The portion of the design volume not infiltrated shall be stored for utilization or treatment unless discharge is permitted by applicable regulations.

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.

The VTA design for processed water shall be based on the nutrient contents of the processed water and the VTA's ability to hold and uptake the nutrients.

Nutrient loading of VTAs shall be based on crop removal of the vegetation used in the VTA.

Establishment of vegetation. Divert effluent runoff away from the VTA until the vegetation is well established. A minimum height of 4 inches and 90% ground cover is desirable. Use the seeding mixture in the following table. Prepare the seedbed, lime, fertilize, and mulch the area in accordance with the Critical Area Planting (342) standard.

Species	Pounds per Acre	Pounds per 1,000 sq. ft.
Orchard grass (Dactylis glomerate)	6	0.15 (2.5 oz)
Smooth Brome grass (Bromus inermis)	8	0.19 (3 oz)
Eastern Gamma grass* (Tripsacum dactuloides) * Use only stratified seed	10	0.25 (4 oz)
Perennial Ryegrass (Lolium perenne)	2	0.05 (1 oz)

Clean water shall be diverted from the treatment area to the fullest extent possible unless needed to promote vegetation growth in the treatment area.

The treatment area design shall:

- Exclude, to the fullest extent possible, clean surface water resulting from the peak discharge of a 25-year, 24-hour storm from the treatment. Clean water that is not diverted shall be included in the design of the VTA and components;
- Exclude subsurface seepage onto the treatment area.

There shall be a minimum of 2 feet of soil depth between the finished surface of the treatment area and the seasonal high water table, and a minimum of 3 feet of soil depth to bedrock. Subsurface drainage shall not be provided within the VTA. 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.

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

Distribution trenches used to create an even flow across the width of the treatment area shall be lined when treatment area soils exceed a permeability (ksat) of 2.0 inches per hour (14 micro-m/sec).

Treatment areas shall be fenced as needed to exclude livestock, other animals, or humans that would inhibit its function.

If sprinkler application is used, design the sprinkler system to provide uniform coverage over the entire treatment area. Refer to the Irrigation System, Sprinkler (442) standard for criteria for irrigating wastewater. In addition, dose the wastewater at a sufficient pressure to operate the sprinkler nozzle(s) within the manufacturer's recommended pressure range. Nozzles must operate during all the applicable seasons. The sprinkler application rate shall not exceed the soil infiltration rate.

Pumps, siphons, tanks, and other devices required for transporting and dosing of wastewater shall meet the Manure Transfer (634) Standard.

Treatment areas with more than one type of wastewater shall meet the criteria for each type.

II. Additional Criteria For Treating Wastewater With The Slow Rate Process

The slow rate process refers to a specific remediation technique involving the application of wastewater to a vegetated surface for treatment as it flows down through the plant-soil matrix.

Base the design hydraulic loading on the more restrictive of two limiting conditions – the capacity of the soil profile to transmit water (soil permeability) or in the nitrogen concentration in the water percolating below the root zone. The percolate nitrate-nitrogen concentration leaving the root zone shall not exceed 10 mg/L. The anticipated nutrient loading shall not exceed the vegetation's agronomic nutrient requirement.

Storage shall be provided when the amount of available wastewater exceeds the design hydraulic loading rate or for area non-operating periods.

Apply wastewater to the treatment area utilizing a method that will result in an even application of

the entire area and a rate that does not exceed the infiltration rate of the soil.

A. Runoff from Barnyards and Concentrated Livestock Areas

These additional criteria apply to vegetated treatment areas for runoff from feedlots, barnyards, and manure stacking facilities:

1. General

- Verify the soil type and properties, and measure the depth to seasonal water table and bedrock with at least one test pit in the area of the treatment area.
- The natural or constructed VTA slope shall be between 0.3 and 6 percent, although slopes from 2 to 6 percent are recommended. The entrance slope of the VTA shall not be flatter than 1 percent.
- The minimum separation distance of the lower end of the area from surface water, wetland, surface drain, road ditch, or other conveyance that discharges to surface water or wetland shall be a minimum of 50 feet for slopes of 3% or less, or 100 feet for slopes exceeding 3%. This distance may be reduced to 25 feet and 50 feet, respectively, if runoff will not be directed to the area during the months of November through March.
- The entire treatment area shall be at least 100 ft from a drinking well, and the area shall not discharge in the direction of a well.
- The minimum permeability (ksat) in the treatment area shall be 0.6 inch per hour (4.2 micro-m/sec), and the maximum permeability shall be 6 inches per hour (42 micro-m/sec), unless the site and soils are modified to achieve acceptable permeability.

2. Solids Removal

Provide a settling facility between the waste source and the treatment area to remove solids, designed for ease of cleanout.

Design the settling facility to hold the solids resulting from a 25 year, 24 hour storm event from the contributing area. The settling facility shall have sufficient capacity and outlet control to reduce the 25 year, 24 hour peak flow to a peak flow that does not exceed the 2 year, 24 hour storm, without overtopping the facility.

At a minimum, the settling facility shall have sufficient capacity below the overflow to store 0.5 inch of manure solids from the concentrated waste area and an additional 1.25 inches of runoff to the top of the settling facility. Disregard any basin outflow when computing this minimum storage.

Provide additional storage capacity, based on frequency of cleaning, for manure and other solids settled within the basin. If the basin is to be cleaned after every 2-inch rainfall or when the solids storage is full, no additional storage is required. If infrequent cleaning of the basin is planned, additional storage equivalent to at least 0.5-inch runoff from the concentrated waste area shall be provided for each month between planned cleanings.

If the wastewater is expected to contain floating solids, the settling facility shall be equipped with screens or baffles.

In addition, follow the criteria in the Sediment Basin (350) standard if the contributing drainage area exceeds 1 acre or the settling facility includes an earth embankment greater than 3 feet high.

The settling facility shall be designed to completely discharge the stored liquid runoff in no longer than 12 hours, although less than 4 hours is recommended, and not produce a sustained trickle flow to the treatment area.

3. Dosing of Wastewater

The treatment area shall be pressure dosed with the effluent from the settling facility unless all of the following conditions are met:

- The wastewater source is a barnyard or feedlot (not a stacking facility),
- The barnyard is uniformly sloped, and the lower edge of the barnyard or feedlot is curbed to contain the 25 year, 24 hour peak flow plus a minimum of 0.5 inch of solids storage. A separate settling facility is not required.

- The slope length of the barnyard or feedlot plus any other contributing drainage area is not more than 50 feet,
- The curbs will have slots or holes to release the water at a controlled rate onto a treatment area.
- The barnyard will be regularly scraped to minimize solids getting to the VTA.

Pressure dosing of effluent from a settling facility shall use a pump, siphon, or flout, at a sufficient rate to force the water to flow down the slope of the treatment area. Dosing shall be from a dosing tank separate from the settling facility. Provide a minimum of 3 feet of head at the dosing orifices.

4. Treatment Area Sizing

The dimensions of the treatment area for barnyard and concentrated livestock areas shall satisfy all of the following criteria:

- The minimum treatment area size shall handle the maximum weekly runoff volume at a design application depth of 0.5 inch or less. Base the maximum weekly runoff volume on Exhibit 10C of the AWMFH for concrete feedlots.
- The design application depth shall not exceed 25% of the available water capacity of the soil within the root zone and above the seasonal water table and/or bedrock.
- The flow length of the area shall be sufficient to provide a minimum of 15 minutes of flow-through time, calculated using Manning's n-value of 0.24 at a design flow depth of 0.5 inch or less. The minimum flow length is 100 feet.
- The area width shall be sufficient to pass the peak flow from the settling facility at the design flow depth.
- The annual nitrogen loading rate from the barnyard or other concentrated waste area runoff shall not exceed the annual vegetative uptake.

An exception to the above criteria is where slotted curbs may be used as described in the previous section. In such cases, the treatment area width shall be equal to the barnyard width. The minimum treatment area flow length shall be 100 feet.

B. Treatment of Milkhouse Washwater

These additional criteria apply to treatment areas for milkhouse washwater:

1. General

- Verify the soil type and properties, and measure the depth to seasonal water table and bedrock with at least one test pit in the area of the treatment area.
- Base the volume of milkhouse washwater on specifically measured farm data whenever possible. In the absence of such data, use a minimum of 4 gallons per day per cow, except for milking parlor operations, where a minimum of 8 gallons per day per cow shall be used.
- Make provisions for dealing with waste milk in the conservation plan and addressed in the design. Waste milk must not be applied to or permitted to reach the treatment area.
- The natural or constructed VTA slope shall be between 0.3 and 6 percent, although slopes from 2 to 6 percent are recommended. The entrance slope of the VTA shall not be flatter than 1 percent.
- The minimum separation distance of the lower end of the area from surface water, wetland, surface drain, road ditch, or other conveyance that discharges to surface water or wetland shall be a minimum of 100 feet for slopes of 3% or less and 150 feet for slopes of 4 to 6%. This distance may be reduced to 50 feet and 100 feet, respectively, if washwater will not be directed to the area during the months of November through March.
- The entire treatment area shall be at least 100 ft from a drinking well, and the area shall not discharge in the direction of a well.
- Base the minimum permeability (ksat) in the treatment area on the dosage rate. The maximum permeability shall be 6 inches per hour (42 micro-m/sec), unless the site

and soils are modified to achieve acceptable permeability.

2. Solids Removal and Dosing

Provide at least one grease trap to collect milk fats with a minimum storage capacity of 3 days of milkhouse waste production. The outlet shall draw wastewater off the bottom 1 to 1.5 feet of the tank.

On milkhouse systems that may allow manure to enter the waste stream (like parlor systems), install a septic settling tank upstream of the grease trap.

The wastewater shall be pressure dosed by pump, siphon, or flout to a perforated pipe at the upper end of the VTA, or through a sprinkler system. Do not dose effluent directly from settling tanks or grease traps. A separate pump or distribution tank is required. The perforated distribution pipe shall have drain holes to help prevent freezing. Provide a minimum of 3 feet of head at the dosing orifices.

Do not apply wastewater to the area more than once every 3 consecutive days.

3. Treatment Area Sizing

The dimensions of the treatment area for milkhouse wastes shall satisfy all of the following criteria:

- The maximum weekly hydraulic loading, including rainfall, shall be 2 inches.
- To limit the annual nitrogen application of the wastewater effluent to the vegetative uptake, size the treatment area to provide a minimum of 11 square feet of treatment area per gallon per day (gpd) of milkhouse wastewater.
- The design application depth shall not exceed 0.5 inch per dose.
- The design application depth shall not exceed 25% of the available water capacity of the soil within the root zone and above the seasonal water table and/or bedrock.
- The flow length of the area shall be sufficient to provide a minimum of 15 minutes of flow-through time, calculated using Manning's n-value of 0.24 at a design flow depth of 0.5 inch or less. The minimum flow length is 100 feet. This flow length criterion does not apply to VTAs receiving wastewater through a sprinkler system.
- The area width shall be sufficient to pass the design dosage rate at the design flow depth.

C. Runoff from Composting Facilities

These additional criteria apply to treatment areas for runoff from composting facilities.

Unless all the following conditions are met, use the criteria under runoff from barnyards and concentrated livestock areas in section A above:

- The composting facility operator must have and be following a compost mix design that meets the criteria in the Composting Facility Standard (317). Of particular importance are the C:N ratio and moisture level.
- The quantity of raw manure is no more than 10 percent of the area of the total compost pad, and raw manure is routinely mixed with the correct amounts of carbon within 2 weeks of placing on the pad.
- The runoff from raw materials contained on the compost pad, especially raw manure, is contained and controlled. This also applies to mixing areas on the pad. No free water (water not generated from storm runoff) can flow from the compost or ingredients onto the treatment area.
- The maximum flow length across the contributing compost pad is less than 150 feet. Provisions shall be incorporated to ensure that runoff leaves the compost pad across the entire length or width of the pad, and does not concentrate before leaving the compost pad. A slotted curb or similar device may be necessary to distribute the flow across the entire width or length.
- The maximum slope of the compost pad onto the treatment area is 1.5 percent unless provisions to reduce the velocity of the

discharge before entering the treatment area are made by use of curbs, level distribution pad, or similar means.

- Water flows to the treatment area only during a storm runoff event.

If all conditions above are met, then the following can be used to design the treatment area for the composting facility:

- If minimal solids transport to the treatment area is anticipated, then a settling facility is not required. Solids must be excluded from the treatment area.
- The discharge outlet onto the treatment area shall be on the contour. Construct the area so the discharge is uniform over the entire width of the treatment area and concentrated flow does not occur.
- The width of the treatment area shall match the compost pad width (perpendicular to the flow).
- The minimum total flow length of the treatment area(s) shall be 100 feet. If the runoff from the pad drains in two directions and is served by two treatment areas, then the minimum flow length for each is 50% of the contributing flow path across the pad or 50 feet, whichever is greater.
- The lower end of the area shall be a minimum of 50 feet from surface water, wetland, surface drain, road ditch, or other conveyance that discharges to surface water or wetland.
- The entire treatment area shall be at least 100 feet from a drinking well, and the area shall not discharge in the direction of a well.
- The natural or constructed VTA slope shall be between 0.3 and 6 percent, although slopes from 2 to 6 percent are recommended. The entrance slope of the VTA shall not be flatter than 1 percent.
- Travel lanes for managing the composting facility must not cross the treatment area. If travel lanes are needed, then the treatment area is to be placed downhill from the travel lane. A redistribution curb or other similar device will be required to reestablish sheet flow onto the treatment area. Design travel lanes to minimize rutting and ponding of water.

D. Treatment of Silage Leachate

These additional criteria apply to treatment areas for runoff from silos:

1. General

- Verify the soil type and properties, and measure the depth to seasonal water table and bedrock with at least one test pit in the area of the treatment area.
- Take measures to exclude floatable and settleable solids from the treatment area.
- The natural or constructed VTA slope shall be between 0.3 and 6 percent, although slopes from 2 to 6 percent are recommended. The entrance slope of the VTA shall not be flatter than 1 percent.
- The lower end of the area shall be a minimum of 100 feet from surface water, wetland, surface drain, road ditch, or other conveyance that discharges to surface water or wetland.
- The entire treatment area shall be at least 100 ft from a drinking well, and the area shall not discharge in the direction of a well.
- The minimum permeability (ksat) in the treatment area shall be 0.6 inch per hour (4.2 micro-m/sec), and the maximum permeability shall be 6 inches per hour (42 micro-m/sec), unless the site and soils are modified to achieve acceptable permeability.
- The high concentrated silage effluent must not be applied or allowed to discharge onto the treatment area. The concentrated effluent must be stored separately and applied to the land according to nutrient management plan, or diluted at least 1:1 with clean water prior to applying to a treatment area. If leachate is diluted and applied to a treatment area, then provisions must be included in the design to adjust the level of dilution in case the vegetation on the area is damaged by the 1:1 dilution.

- Water shall flow to the treatment area only during storm runoff events.
- Gravity discharge may be used to dose the area if provisions are included to prevent a sustained trickle flow.

2. Treatment Area Sizing

The dimensions of the treatment area for diluted silage leachate shall satisfy all of the following criteria:

- The maximum weekly dosage resulting from the silo runoff produced by the highest weekly average rainfall shall be 1 inch.
- The design application depth shall not exceed 25% of the available water capacity of the soil within the root zone and above the seasonal water table and/or bedrock.
- The flow length of the area shall be sufficient to provide a minimum of 15 minutes of flow-through time, calculated using Manning's n-value of 0.24 at a design flow depth of 0.5 inch or less. The minimum flow length is 100 feet. This flow length criteria does not apply to VTAs receiving wastewater through a sprinkler system.
- The area width shall be sufficient to pass the dosage rate at the design flow depth.

CONSIDERATIONS

General

Use sound judgment when planning a treatment area for wastewater. Consider the following to help ensure proper treatment of the wastewater:

- size of the operation and amount of wastewater to be treated,
- the location of the area in relation to public view,
- buffer areas to water resources, and
- the application methods.

Consider converting all or part of the waste handling system on the farm from a solid to liquid or slurry system to avoid the need for treatment areas.

More than one treatment area should be considered to allow for resting, harvesting vegetation, maintenance, and to minimize the potential for overloading.

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

When soil temperatures are between 39°F and 50°F reduction of application rate and increased application period while maintaining the hydraulic loading rate constant should be considered.

Consider suspension of application to treatment areas when weather conditions are not favorable for aerobic activity or when soil temperatures are lower than 39°F. Consider storage of the wastewater or an alternative treatment method. Refer to the Waste Treatment (629) Standard.

Consider adding a level lip spreader at the downstream end of the treatment area. This would help ensure sheet flow upon release of the water from the area during particularly heavy flows, and encourage further treatment of the wastewater beyond the area.

Consider buffer areas longer than the minimum length below areas, particularly as slope increases to further protect surface water resources.

Control the inflow as necessary to make operation and maintenance activities easier to perform.

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

Barnyard runoff

Minimize the amount of barnyard paving to what is required for pollution control. Barnyard paving increases the amount of runoff needing treatment.

Source control of waste for barnyards also includes improved management by frequent scraping of the barnyard to minimize manure accumulation.

Consider relocation of barnyards to provide more separation from water resources and allow more room for treatment of runoff.

Consider roofing of the barnyard to eliminate storm runoff and the need for a treatment area when critical resources are within 200 ft of end of

the treatment area, or the required operation and maintenance will be a hardship on the operator.

Milkhouse wastewater

Consider liquid storage for operations generating more than 300 gallons of milkhouse wastewater per day. Making use of waste storage facilities on neighboring farms should be considered if available.

There are numerous methods to reduce the volume of milkhouse wastewater that is generated on the farm varying by method (management changes to equipment changes) and by cost. See the reference section for additional information.

The amount of milk fats entering the pretreatment tanks can be reduced in various ways. Examples include pre-rinsing pipelines and the bulk tank and feeding to livestock, storing colostrum and transitional milk to feed to livestock or land spreading. See the reference section for additional information.

Options to deal with waste milk are providing an emergency separate storage to temporarily contain the waste milk until it can be collected and properly disposed. A small lined pond could also be used to temporarily store waste milk. A system and plan are needed to provide an option for dealing with instances where waste milk must be disposed, so that the treatment area is protected.

Composting facilities

Consider use of windrow or pile covers to manage moisture content and minimize potential for leaching and to reduce the concentration of contaminated runoff.

Refer to the Composting Facility (317) Standard for additional considerations in the design and operation of the facility to ensure stable compost is produced and that contaminated runoff is minimized.

Silage leachate

Source control of concentrated leachate includes harvesting of silage at moisture levels at 70% moisture and below, when very little leachate is generated (65% and below for tower silos). For corn silage, planting shorter season varieties of corn can result in a drier crop when harvested.

Cover silos to prevent rainfall from entering and leaching through the silage or haylage.

Divert all surface water from bunk silos, and subsurface water should be intercepted and diverted before it becomes contaminated.

Consider using silage bags instead of bunk silos to reduce the potential for producing leachate.

If possible, add silage leachate to liquid or slurry waste storage facilities. However, do not mix silage with manure in enclosed tanks because silage accelerates the release of hydrogen sulphide gas from manure. Mix only with manure in uncovered, outdoor storage facilities.

PLANS AND SPECIFICATIONS

Prepare plans and specifications in accordance with the criteria of this standard that describe the requirements for applying the practice to achieve its intended use. Include critical construction perimeters, necessary construction sequence, vegetation establishment requirements, and nutrient removal.

Plans and specifications will include:

- A plan view showing the location of the VTA.
- Length, width, and slope of the treatment areas to accomplish the planned purpose (length refers to flow length down the slope of the treatment area)
- Herbaceous species and 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
- Statement that only viable, certified weed free, high quality, and regionally adapted seed will be used
- Site preparation sufficient to establish and grow selected species.

OPERATION AND MAINTENANCE

An operation and maintenance plan shall be developed that is consistent with the purposes of the practice, its intended life, safety requirements, and the criteria for its design.

The plan shall include the following at a minimum as appropriate:

- Routine inspections of distribution system, including septic tanks, grease traps, dosing tanks, pumps, siphon, flouts, distribution piping, and holes and slots as applicable, to ensure proper operation.
- Routine inspections and emptying of septic tanks and grease traps as required to maintain capacity.
- To encourage dense growth, maintain an upright growth habit, and remove nutrients and other contaminants that are contained in the plant tissue, cut to a height of 3 to 5 inches when the seed heads appear, but at least three times each year.
- Routinely scrape barnyards that are treated by a VTA to minimize solids getting to the VTA.
- Manage the VTA to maintain 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.
- Conduct maintenance activities only when the treatment area is dry and moisture content in the surface soil layer will not allow compaction. Avoid driving over treatment areas if moisture conditions will result in rutting.
- 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 fill in gullies, remove flow disrupting sediment accumulation, re-seed disturbed areas, and take other measures to prevent concentrated flow.
- Apply supplemental nutrients 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 when deposition jeopardizes its function, and then reestablishing to herbaceous vegetation.
- Routinely de-thatch and/or aerate treatment areas used for treating runoff from livestock holding areas in order to promote infiltration.
- Prevent grazing in treatment areas.

REFERENCES

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- Estimating The Volume Of Wastewater (A3609)
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Pollution Control Guide for Milking Center Wastewater Management, North Central Regional Extension Service, NCR549, 1995.

How to Handle Seepage from Farm Silos, Ontario Ministry of Agriculture and Food, 1995.

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