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WISCONSIN FIELD OFFICE TECHNICAL GUIDE
450-11-TECHNICAL GUIDE
FOTG NOTICE WI-83

SUBJECT: WISCONSIN FIELD OFFICE TECHNICAL GUIDE

Purpose. Revisions to Wisconsin Conservation Practice Standards and Specifications.

Explanation of Changes.

Section IV: Conservation Practice Standards and Specifications:

Dike (CPS 356) - Standard only allows Class III dikes.

Vegetated Treatment Area (CPS 635) - Edited to improve clarity. Additionally criteria was added to address pretreatment and erosion control measures and remove minimum flow length which affected design of small facilities.

Wetland Restoration (CPS 657) - Planning shall be done with the use of a functional assessment type procedure, or a state approved equivalent. Applicable to embankment structural heights of six feet or less. Embankment design according to newly adopted WI NRCS CPS, Dike (Code 356) when the runoff volume from the 1% flood event from the drainage area above the impoundment increases the design storage volume of the impoundment by no more than two percent. Muskrat protection requirements for embankments constructed adjacent to streams or ditches with perennial flow.

Woody Residue Treatment (CPS 384) - Added definition for course woody debris. Reference to WDNR woody biomass was removed. Other changes to align with national standard.

Remove the following outdated Standards and Specifications from any printed copies of the WI FOTG:

- Index
- Vegetated Treatment Area (CPS 635)
- Wetland Restoration (CPS 657)
- Woody Residue Treatment (CPS 384)

Add the following Standards and Specifications from any printed copies of the WI FOTG:

- Index
- Dike (CPS 356)
- Vegetated Treatment Area (CPS 635)
- Wetland Restoration (CPS 657)
- Woody Residue Treatment (CPS 384)

A link to the Wisconsin FOTG is located on the Wisconsin NRCS website at:
http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/technical/fotg/

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NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

DIKE

CODE 356
(FT.)

DEFINITION
A barrier constructed of earth or manufactured materials.

PURPOSE
- To protect people and property from floods.
- To control water level in connection with crop production; fish and wildlife management; or wetland maintenance, improvement, restoration, or construction.

CONDITIONS WHERE PRACTICE APPLIES
All sites that are subject to damage by flooding or inundation and where it is desired to reduce the hazard to people and to reduce damage to land and property.

Sites where the control of water level is desired.

Class III dikes located on sites where damage likely to occur from failure will be minimal.

The dike standard does not apply to sites where Wisconsin NRCS Conservation Practice Standards (WI NRCS CPS) Pond (Code 378), Water and Sediment Control Basin (Code 638), Diversion (Code 362); Grade Stabilization Structure (Code 410); or Terrace (Code 600) are appropriate. Dikes used to reduce flooding are normally constructed adjacent and/or parallel to a stream, river, wetland or water body and are not constructed across the stream, river or water body. Dikes used to control water levels usually have small interior drainage areas in relation to the surface area of the regulated water level.

CRITERIA
General Criteria Applicable to All Purposes
Design and install measures according to a site-specific plan in accordance with all local, State, Tribal, and Federal laws and regulations.

Apply measures that are compatible with improvements planned or being carried out by others.

Upstream surface and subsurface drainage will not be impacted unless mitigation measures are implemented. The impoundment owner must have ownership or legal control of the impoundment including the right to flood all land in the impoundment up to the 1% flood event. Legal control is usually obtained through permanent easements recorded on the deed of the affected property.

The impact on water surface profiles of any fill placed in a floodplain area will be determined prior to construction of the project.

Classification. The dike classification is determined by the hazard to life, the design water height, and the value of the protected land, crops, and property. Classification must consider land use changes likely to occur over the life of the dike.

Constructed Elevation. The constructed elevation of a dike whose purpose is to control water level shall be the sum of the following:

- The water elevation at the highest water level control.
- The rise in water height above the highest water level control caused by a flood of the design frequency shown in Table 1. This is the design high water.
- The larger of the minimum freeboard shown in Table 1 or the wave height caused by wind of the design frequency shown in Table 1.
- The allowance for settlement.

Settlement. Settlement shall be based on an analysis of the fill material, foundation material and condition, and compaction methods.

In lieu of an analysis, the allowance for settlement shall be as follows:

1. For dikes constructed of compacted earth fill material, the allowance for settlement shall be a minimum of 5 percent of the dike height.
2. Class III dikes, constructed of fill material that is hauled from off-site, dumped, and shaped (referred to as "dumped and shaped"), the allowance for settlement shall be a minimum of 15 percent of the dike height. For fill material that is excavated adjacent to the dike and dropped from the excavator (referred to as "dropped"), the allowance for settlement shall be a minimum of 20 percent of the dike height. The allowance for settlement of dumped and shaped or dropped organic soil fill material shall be a minimum of 40 percent of the dike height. Organic soils are permitted only for Class III dikes 6 feet or less in height. Higher dike heights result in excessive settlement and decomposition. For the purpose of this standard, organic soils are described as follows:
    a. Soil layers that are not saturated with water for more than a few days at a time are organic if they have 20 percent or more organic carbon.

       OR

    b. Soil layers that are saturated for longer periods, or were saturated before being drained, are organic if:
        - They have 12 percent or more of organic carbon and no clay, or
        - 18 percent or more organic carbon and 60 percent or more clay, or
        - A proportional amount of organic carbon, between 12 and 18 percent, if the clay content is between 0 and 60 percent.

OR

c. All soils described in the local soil survey as an organic soil.

Top Width and Side Slopes. The minimum top widths and side slopes for earth embankments shall be as shown in Table 1.

All dikes must be accessible for maintenance activities. Typically, this may be along the top of the dike or along the berm. Access roads shall provide adequate width for maintenance equipment and inspection vehicles. The minimum width for vehicular traffic should be 12 feet. Provide wider areas for passing and turning around at regular intervals. Access roads may need to be controlled to prevent vandalism, accidents, and damage.

Berms. The need for a constructed berm on an embankment will be based on the results of an embankment and foundation stability analysis. If a stability analysis is not performed, all earth dikes shall have berms either constructed or occurring naturally on both sides meeting the following criteria:

- Where dikes cross channels, ditches, borrow areas, streams, sloughs, swales, gullies, etc., they shall have a berm constructed on each side. The top elevation of these berms shall be at least 1 foot above the average ground surface on each side of the channel, ditch, borrow area, stream, slough, swales, gully, etc., and sloped away from the dike.
- The minimum top width of natural or constructed berms shall be as shown in Table 1.
- The minimum side slope ratio of constructed berms shall be 2:1 (Horizontal:Vertical).
- Constructed berms shall be at a constant elevation and sloped away from the dike.

Dike Materials. Earth dike materials shall be obtained from required excavations and designated borrow areas. The selection, blending, routing, and disposition of materials in the various fills shall be subject to approval by the engineer or designer. Fill materials shall contain no frozen soil, sod, brush, roots, or other perishable materials. Rock particles larger than the maximum size specified for each type of fill shall be removed prior to placement and compaction of the fill. The types of materials used in the various fills shall be as listed and described in the specifications and drawings.

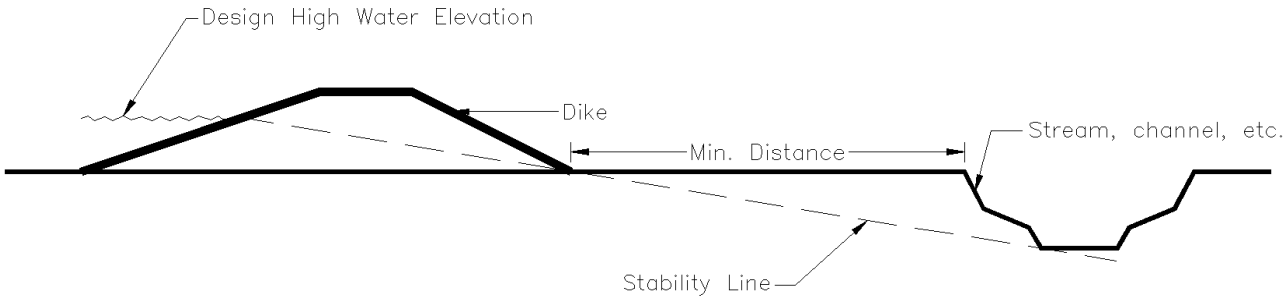
Embankment and Foundation Seepage. Embankment and foundation drainage and seepage control shall be designed on the basis of site investigation, laboratory data, seepage analysis, and stability analysis. The resulting design shall minimize seepage, prevent piping or undermining, and provide a stable embankment and foundation.

In the absence of more detailed data and analysis, the following criteria for a foundation cutoff apply for Class III dikes where H is equal to dike height:

- Minimum of H feet deep for $H<3$ feet.
- Minimum of 3 feet deep for $H\geq3$ feet.
- Minimum of 4 feet bottom width.
- 1:1 or flatter side slopes.

A stream, channel, ditch, borrow area, slough, swale, gully, etc. shall be far enough away from the dike so that the extension of a line drawn from the design high water elevation on one side of the dike to the dike toe on the opposite side shall not intersect any stream, channel, etc. (See Figure 1). This line criterion applies to both sides of the dike. This criterion will minimize the hazard to the dike caused by piping through the foundation.

Figure 1.



Interior Drainage. Dikes to prevent flooding shall be provided with interior drainage systems for the area being protected. The interior drainage system shall prevent flood damage to the interior area from a flood of the design frequency in Table 1 for both the 1-day and the 10-day storm duration. The interior drainage system may include storage areas, gravity outlets, and pumping plants as needed to provide the required level of flood protection.

Spillways. Spillways for Class III dikes shall meet the requirements for spillways in WI NRCS CPS Wetland Restoration (Code 657), WI NRCS CPS Ponds (Code 378), or NRCS Technical Release 60 as appropriate.

Dikes shall be protected from scour at pipe inlet and outlet locations by appropriate measures. A pump discharge pipe through a dike shall be installed above design high water, if feasible. Pump discharge pipes shall be equipped with a flexible connection or similar coupling to prevent vibration of the pumping plant being transmitted to the discharge pipe.

Slope Protection. Slopes of earthen dikes shall be protected from sheet, rill, and gully erosion; erosion from flowing floodwaters; and wave action created by wind and/or boat traffic. Erosion protection measures such as non-woody vegetation, berms, rock riprap, sand-gravel, or soil cement shall be utilized as needed.

CONSIDERATIONS

Location. When locating the site for the dike, consider the foundation soils, property lines, setbacks from property lines, exposure to open water, distance to streambanks, availability of outlets by gravity or pumping, buried, utilities, cultural resources, and natural resources such as wetlands, natural areas, and fish and wildlife habitat.

Fluvial geomorphologic concepts contained in National Engineering Handbook (NEH) Part 653, Stream Corridor Restoration Principles, Processes and Practices should be considered when placing a dike near a stream.

Berms. Give special consideration to wider berms, additional setbacks, or protecting the berm side slope when adjacent to actively eroding or moving streams to protect the dike for its design life.

Adverse Impacts. Adverse environmental impacts from the proposed dike will be evaluated. Any increases in flood stage caused by dike-induced flow restrictions will be evaluated for adverse impacts to unprotected areas. Adverse impacts should be minimized.

PLANS AND SPECIFICATIONS

Plans and specifications shall be prepared in accordance with the criteria of this standard and shall describe the requirements for applying the practice to achieve its intended purpose.

OPERATION AND MAINTENANCE

Operation and maintenance requirements for all dikes will be provided to the landowners.

Table 1. Minimum Design Criteria for Dikes

Classification	Material [1]	Height (H) in Feet [2]	Minimum Storm Design Frequency in Years	Minimum Freeboard in Feet	Minimum Top Width in Feet	Minimum Side Slope Ratio [3] (H:V)	Berm Width in Feet
Class III	Mineral Soils	0 to 3	10	H/3	4	2:1	8
		>3 to 6	10	1	6	2:1	8
		>6 to 12	25	2	8	2:1	8
	Organic Soils [4]	0 to 2	10	H/2	4	2:1	10
		>2 to 4	10	1	6	2:1	10
		>4 to 6	10	2	8	2:1	15

[1]Earth includes rock.
[2]Height is the difference between normal ground elevation at the dike centerline and the design high water elevation. When determining normal ground elevation, exclude crossings of channels, sloughs, small low areas, small ridges, swales, or gullies.
[3]Minimum side slope ratios are for compacted earth fill. Dumped earth fill without compaction will be flatter.
[4]Organic soils are permitted only for Class III dikes 6 feet or less in height. Higher dike heights result in excessive settlement and decomposition.

DEFINITIONS

1% Flood Event - A flood determined to be representative of large floods, which in any given year has a 1% chance of occurring or being exceeded. The 1% flood is based on a statistical analysis of lake level or streamflow records available for the watershed or an analysis of rainfall and runoff characteristics in the watershed, or both. This is commonly referred to as the 100 year event or regional flood.

Dike Height - Height is the difference between normal ground elevation at the dike centerline and the design high water elevation. When determining normal ground elevation, exclude crossings of channels, sloughs, small low areas, small ridges, swales, or gullies.

NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

WOODY RESIDUE TREATMENT

CODE 384
(ACRE)

DEFINITION
The treatment of residual woody material that is created due to management activities or natural disturbances.

PURPOSE
- Reduce hazardous fuels.
- Reduce the risk of harmful insects and disease.
- Protect/maintain air quality by reducing the risk of wildfire.
- To improve access for management purposes.
- Improve access to forage for livestock and wildlife.
- Develop renewable energy systems.
- Enhance aesthetics.
- Reduce the risk of harm to humans.
- Improve the soil organic matter.
- Improve site for natural regeneration.

CONDITIONS WHERE PRACTICE APPLIES
This practice applies on all lands, except active cropland, where woody residue requires treatment. This standard is not intended for sites where biomass will be harvested as a product.

CRITERIA
General Criteria Applicable to All Purposes
- Slash treatment and the condition and extent of residual slash shall be planned and the method selected based on the intended purpose(s) of the treatment.
- Slash treatment methods (i.e., burning, chipping, lop and scatter, removal, crushing) will achieve landowner objectives while adequately protecting land and water resources.
- Wisconsin Forestry Best Management Practices for Water Quality will be followed for all planned treatments.
- Care shall be taken to minimize injury to or function of the residual plant communities.
- Timing of treatment shall coincide with intended purpose(s) and minimize impact on other resources.

- Slash and other debris resulting from forest management operations shall be removed from stream courses, lakes, and ponds, neighboring lands, right-of-way clearings, roads and landings. Do not pile slash or move slash into riparian areas, floodplains, wetlands or vernal pools.
- Any burning activities shall comply with Wisconsin NRCS Conservation Practice Standard (WI NRCS CPS), Prescribed Burning (Code 338).
- Slash and debris left on the site after treatment will not present an unacceptable fire, safety, environmental, or pest hazard. Such remaining material will not interfere with the intended purpose of the treatment or other management activities.
- Retain slash and debris on sites that may be inhabited by threatened, endangered or special concern species if beneficial to specific species microhabitat requirements.

Additional Criteria Applicable to Reduce Hazardous Fuels

- Reduce height of slash to a maximum of 2.0 feet above the soil surface where wildfire is a concern and where the potential for damage by fire is moderate or high. Slash materials 3 inches in diameter and greater will be addressed.
- See WI NRCS CPS, Tree/Shrub Pruning (Code 660), to address reduction of ladder fuels in conjunction with this practice.

Additional Criteria to Reduce the Risk of Harmful Insects and Disease

- Degree, intensity and timing of slash treatment shall take full advantage of insect and disease characteristics and life cycles to minimize the impact of disease or insects on the forest vegetation.
- Pine Engraver - During harvesting and thinning operations in pine stands, scatter slash as much as possible to aid drying and breakdown of the material. Avoid piling fresh slash next to standing trees.
- Conifer Bark Beetles – During harvesting and thinning operations, remove potential bark beetle breeding material, including logs and tops down to 2 inches in diameter. Scatter remaining slash as much as possible to aid drying and breakdown of material. Material can also be scattered into openings to aid in drying.
- Treat slash in forests containing Emerald Ash Borer infected trees to halt the spread of the insect. Follow "Emerald Ash Borer and Forest Management" guidelines developed by Wisconsin Department of Natural Resources Division of Forestry.
- Utilize slash treatment as much as possible when making partial cuts in Black Cherry stands to address Peach Bark Beetle.
- Comply with WI NRCS CPS, Integrated Pest Management (Code 595), when pesticide applications are planned and applied.

Additional Criteria to Protect/Maintain Air Quality by Reducing the Risk of Wildfire

- Activities will be consistent with established regulations and guidelines for PM10 and PM 2.5 emissions, ozone precursors (NOx and VOCs), as well as smoke and dust, and state and local permit requirements.
- When feasible, use chipping, shredding, bio-fuel composting, or other technique in lieu of burning.
- Remove slash created by thinning and/or pruning to reduce available fuel.

Additional Criteria to Improve Access to Forage for Livestock and Wildlife

- Slash shall be piled or removed sufficiently to allow access to forage by the site's livestock and to maximize forage growth as part of an agro-forestry system.

Additional Criteria to Develop Renewable Energy Systems

- Removal of woody material shall not be detrimental to the site and will adequately protect soil and water resources. Adequate woody material will be left to maintain or improve nutrient and organic matter cycling.

Additional Criteria to Enhance Aesthetics

- Treat slash within 150 feet of a public road, trail or path and neighboring property boundaries.
- Slash that is scattered or piled and left on the site will be further treated to be no more than 18 inches above the soil surface. Slash that is piled and left on the site will be chipped and evenly distributed not to exceed a depth of 3 inches.

Additional Criteria to Reduce the Risk of Harm to Humans and Livestock

- Slash that is scattered or piled and left on the site will be further treated to meet client objectives and any state or local requirements for safe use of the area.
- Slash from forest management activities will be removed from right-of-way and within a strip 10 feet in width measured from the edge of clearings for utilities such as telephone lines, power lines, pipelines and other facilities.
- The tops of felled trees shall not be left hanging in standing trees. All trees cut shall be completely felled and not left leaning
- Slash from construction site clearings shall be treated concurrently with the construction operations.

Additional Criteria to Improve Soil Organic Matter

- Slash will be treated to create as much contact with the soil surface as practical to accelerate decomposition.
- Retain existing coarse woody debris and do not remove stumps or underground material.
- Retain slash less than 4 inch diameter in place.
- Minimize topsoil displacement and mixing into piles or windrows when machine piling slash and debris.

Additional Criteria to Improve the Site for Natural or Artificial Regeneration

- Slash will be treated to complement treatments specified in WI NRCS CPS, Tree/Shrub Site Preparation (Code 490).
- Retain slash material in areas susceptible to heavy browse for use as protection of seedlings.

CONSIDERATIONS

Additional recommendations relating to design that may enhance the use of, or avoid problems with, this practice but are not required to ensure its basic conservation functions are as follows:

- When determining method and timing of slash treatment consider air quality regulations, burning requirements, available resources, ability to use woody biomass and regeneration needs.
- Consider wildlife needs when performing and timing treatment.
- Consider the beneficial and other effects on cultural resources, and threatened and endangered species, natural areas, and wetlands.

PLANS AND SPECIFICATIONS

Specifications for applying this practice shall be prepared for each site and recorded using approved specification sheets, job sheets, technical notes and narrative statements in the conservation plan, or other acceptable documentation.

Plan documentation shall include:

- Plan/Site map with treatment area identified.
- Detailed guidance regarding timing, selected treatment(s) and specific results expected.
- Identify specific criteria for the selected treatment (residual height, % residual contact with soil surface, depth of chipped material, location & dimensions for slash piles, etc.)
- Identify targeted pest, disease or wildfire hazard as applicable.

OPERATION AND MAINTENANCE

Monitor populations and the potential of damage to site resources by harmful pests and take controlling actions as necessary. Comply with WI NRCS CPS, Pest Management (Code 595).

FEDERAL, TRIBAL, STATE, AND LOCAL LAWS

Users of this standard should be aware of potentially applicable federal, tribal, state and local laws, rules, regulations or permit requirements governing woody residue treatment. This standard does not contain the text of federal, tribal, state, or local laws.

REFERENCES

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Wisconsin Forest Management Guidelines, PUBFR226 2003. Wisconsin Department of Natural Resources (DNR), Division of Forestry, Madison, WI.

Wisconsin Slash Disposal Law S.26.12

DEFINITIONS

Coarse woody debris (CWD) or **coarse woody habitat** (CWH) refers to fallen dead trees and the remains of large branches on the ground in forests and in rivers or wetlands. A dead standing tree is known as a snag and provides many of the same functions as coarse woody debris. The minimum size required for woody debris to be defined as "coarse" is 3 inches in diameter.

NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

VEGETATED TREATMENT AREA

CODE 635
(ACRE)

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 wastewater (contaminated runoff from such areas as animal lots, feed storage areas, compost areas, barnyards, and other livestock holding areas; or to treat process milking center wastewater) from agricultural operations.
- A VTA is a component of a planned agricultural waste management system in accordance with Natural Resources Conservation Service (NRCS) Agricultural Waste Management Field Handbook (AWMFH), Chapter 9.

This practice does not apply to:

- Treatment of undiluted leachate.
- Treatment of runoff from manure stacks or waste storage facilities.
- Treatment of milking center wastewater or contaminated runoff using annually grown crops.

CRITERIA
General Criteria

VTAs shall comply with all federal, tribal, state, and local laws, rules, or regulations. The operator is responsible for securing required permits. This standard does not contain the text of the federal, tribal, state, or local laws.

Management Assessment

Perform a management assessment with the owner/operator to determine planned management and explore design options. Conduct, document, and incorporate the assessment into the design. In addition to the Waste Management System Inventory and Planning Worksheet contained in the Wisconsin supplement to Chapter 9 of the AWMFH, the management assessment for a VTA shall address the following:

1) Animal Lot
    a. Animal types and numbers
    b. Cleaning methods and frequency
    c. Drainage area
    d. Feeding locations and methods
    e. Animal time on lot
    f. Existing pretreatment
    g. Waste characterization
    h. Type of existing surface
    i. Type of proposed surface
2) Feed Storage Area
    a. Feed storage method (e.g. bunker, bag, pile)
    b. Feed storage area dimensions
    c. Drainage area contributing contaminated runoff
    d. Feed type
    e. Handling, cleaning methods, and frequency
    f. Type of existing surface
    g. Type of proposed surface
3) Milking Center Wastewater
    a. Daily milking center wastewater volume
    b. Existing handling of milking center wastewater

Site Assessment

Conduct, document, and incorporate a site assessment into the design. The assessment will determine physical site characteristics that may influence the placement, construction, maintenance, and environmental integrity of the VTA. Site assessment shall include, but is not limited to:

1) Distances to the nearest feature listed in the separation distances for the applicable size category and specific criteria.
2) Karst features within 500 feet of the proposed VTA outlet.
3) Location and identification of physical site features contributing to the characteristics of the runoff.

4) Soil investigation, including:

   a. A description of the soil layers using the Unified Soil Classification System and the USDA Textural Classification.

   b. The factors to identify subsurface saturation, as defined in Wisconsin NRCS Conservation Practice Standard (WI NRCS CPS), Waste Storage Facility (Code 313).

   c. Soil boring logs to characterize the soils and to a minimum depth below the planned VTA grade to ensure separation distances are achieved by conducting borings within 50 feet of the VTA footprint. Perform a minimum of one test pit or boring per 30,000 square feet of footprint, with a minimum of two per facility.

   d. Depth to bedrock encountered in soil borings and bedrock type.

   e. Depth to subsurface saturation encountered in the borings.

Tributary Water Exclusion
Divert uncontaminated water from the tributary area. The design shall account for precipitation, runoff, or subsurface flow entering the VTA up to the 25-year, 24-hour storm event. When planning to exclude outside tributary water with other conservation practices, their design shall be in accordance with WI Standards located in the Field Office Technical Guide (FOTG).

Cattle Access
Exclude all livestock, including grazing, from the VTA.

Vegetation in Treatment Areas
Wastewater shall be diverted from the VTA until vegetation required in the design is well established.

Establish permanent vegetation in the VTA using a single species or a mixture of grasses, legumes, and other forbs adapted to the soil and climate. Select species to meet the 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 wastewater.

Select, establish, and maintain vegetation in VTAs in accordance with criteria specified in WI NRCS CPS, Critical Area Planting (Code 342), or CPS, Tree/Shrub Establishment (Code 612).

Harvest VTA vegetation when appropriate to encourage dense, upright growth, and remove nutrients and other contaminants that are contained in the plant tissue at least annually. Care shall be taken to minimize damage to the VTA during harvest.

Siting Parameters
Locate or construct the VTA with 2 foot minimum depth of soil with at least 20 percent passing the No. 200 sieve (i.e., P200 ≥ 20 %).

Take care during construction to prevent soil compaction from construction machinery.

Separation is the closest distance from the finished VTA ground surface to the features listed below:

1) Minimum separation to bedrock shall be 4 feet. Excavation of bedrock is permitted to achieve the required separation distance. Do not remove bedrock by blasting. Evaluate the exposed bedrock surface to ensure a sound base for soil material. Treat fractures or voids to prevent migration of soil material. The surface of excavated bedrock shall have a minimum slope of 1 percent under and away from the VTA to prevent significant ponding on the rock surface. If bedrock is excavated, the material placed on the bedrock shall have a minimum of 20 percent passing the No. 200 sieve.
2) Minimum separation to subsurface saturation shall be 2.5 feet for feed storage contaminated runoff and 3 feet for animal lot contaminated runoff and milk center wastewater.

Subsurface drainage within the VTA is not allowed. Subsurface drain lines are to be at least 10 feet away from the VTA boundary.

Locate the VTA outside of regulated floodplains if possible. Provide protection from inundation or damage from a 25-year, 24-hour storm event.

Specific Criteria

Applicable to operations with over 500 Animal Units
The VTA shall be:

1) ≥ 250 feet from any private well,
2) ≥ 1000 feet from any community well,
3) ≥ 35 feet from wetlands and navigable streams and rivers, and
4) ≥ 75 feet from navigable lakes, ponds and flowages.

Limit the natural or constructed slope of the VTA from 0.3 to 6 percent.

The minimum size of the VTA shall be the area required to balance both the contributing site's 25-year, 24-hour water runoff and delivered nutrients.

1) Water balance is the soil's capacity to infiltrate and retain runoff within the root zone. Base the infiltration 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.
2) 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)

Design a Waste Storage Facility* (criteria contained within WI NRCS CPS, Waste Storage Facility (Code 313)) when required to hold leachate, wastewater, and manure during the growing and non-growing season with freeboard of 1 foot for operations ≥ 1000 animal units and 0.25 feet for all others.

Wastewater Application

Application by surface flow across the full width of a sloped VTA **is not** permissible. Distribute the wastewater uniformly over the entire VTA through sprinkler irrigation or other uniform application system. Match the sprinkler nozzle(s) application rate to the most restrictive soil infiltration rate or other factors to prevent non-uniform absorption and treatment in the VTA.

Apply wastewater only during the growing season of the VTA vegetation.

Apply wastewater only when soils are below field capacity. Avoid percolation below the root zone by not exceeding field capacity during application.

Use Table 1 for Available Water Capacity (AWC) in the VTA's root zone. Use the typical AWC unless lab data or specific soil map unit data found in NRCS Web Soil Survey are used.

Annual nutrient uptake of VTA vegetation shall be obtained from University of Wisconsin Extension publication A2809 "Nutrient Application Guidelines for Field, Vegetable, and Fruit Crops in Wisconsin" or other science-based publications.

Table 1. Available Water Capacity by Texture.[1]

Texture	Typical AWC (in./ft.)
Loamy sand	0.85
Loamy fine sand	1.25
Sandy loam	1.45
Fine sandy loam	1.70
Loam	2.00
Silt loam	2.40
Silt	2.00
Sandy clay loam	1.80
Clay loam	2.40
Silty clay loam	2.40
Sandy clay	1.90
Silty clay	1.90
Clay	1.80

[1]Adapted from NRCS National Engineering Handbook, Part 652 Irrigation Guide (1997).

Applicable to operations with over 300 and 500 or less Animal Units
Criteria for sites where the down gradient end of the VTA is:

1) ≥ 1000 feet from navigable lakes, ponds and flowages,
2) ≥ 300 feet from wetlands and navigable streams and rivers,
3) ≥ 500 feet from conduits to groundwater,
4) ≥ 300 feet from surface inlets that discharge to navigable waters,
5) ≥ 150 feet from channelized flow (i.e., a drainage area of ≥ 5 acres), and
6) ≥ 150 feet from subsurface drains.

Locate the VTA > 100 feet from any private water well.

Limit the natural or constructed slope of the VTA from 1 to 6 percent.

Each VTA shall treat a single source of wastewater.

Provide an analysis demonstrating wastewater applied to the VTA does not discharge to navigable waters for rainfall up to the 25-year, 24-hour storm event.

Apply wastewater uniformly across the full width of the VTA (e.g., level spreader, distribution pipe) or uniformly over the VTA. Place additional devices at intervals not to exceed 150 feet to maintain sheet flow down the length of the VTA.

Animal Lot
A collection practice is needed to operate the system throughout the year. Below are options:

- Design a Livestock Area Sediment Basin (criteria contained within WI NRCS CPS, Waste Separation (Code 632) to retain 100 percent of the 25-year, 24-hour storm event during the growing season.
- Design a Waste Storage Facility (criteria contained within WI NRCS CPS, Waste Storage Facility (Code 313) when required to hold contaminated runoff and manure during the non-growing season with 0.25 feet of freeboard.

Apply contaminated runoff only during the growing season for the VTA vegetation.

Apply contaminated runoff not to exceed the 25-year, 24-hour storm event volume per application.

Allow the VTA to rest 3 days between applications of contaminated runoff collected during the non-growing season.

Commence VTA application at least 24 hours after cessation of a ≥ 0.5 inch rain event (i.e., sunny day release), or immediately after cessation of a < 0.5 inch rain event.

Design each VTA to treat ≤ 10,000 square feet of animal lot area and not more than 98 animal units.

Design the VTA for a flow depth of 0.5 to 1.0 inches for the water separation facility's flood-routed 25-year, 24-hour storm event.

Design the minimum VTA size to be 150 percent of the animal lot size for paved lots and 100 percent of the animal lot size for earth lots.

The annual output of phosphorus from the VTA shall be 5 pounds or less as determined based on potentially affected resources documented in the site assessment, using the Agricultural Research Service procedure outlined in "An Evaluation System to Rate Feedlot Pollution Potential" and a series of rainfall events for a year contained in the Wisconsin supplement to Chapter 10 of the AWMFH.

Feed Storage
Design the feed storage area/collection system to achieve a maximum VTA flow depth of 1.75 inches for the 25-year, 24-hour storm event.

Design the VTA for a minimum flow through time of 22 minutes.

The maximum VTA width shall not be greater than 200 feet.

Feed storage contaminated runoff can be applied year-round.

Collect all leachate and the initial runoff volume of 0.20 inches from each rain event in a Reception Structure designed in accordance with the criteria contained in WI NRCS CPS, Waste Transfer (Code 634). This leachate and runoff shall not be applied to the VTA.

Milking Center Wastewater
VTA treatment is applicable for operations producing a maximum of 500 gallons of milking center wastewater per day.

Provide Reception Structure in accordance with criteria contained in WI NRCS CPS, Waste Transfer (Code 634) (i.e., pretreatment tanks), and size it to provide a minimum three-day hydraulic retention time prior to discharge to the VTA. The outlet from the pretreatment tank(s) shall be gravity flow to a dosing tank or chamber which shall be separate from the pretreatment tank(s). Locate a pump or siphon for pressure distribution of milking center wastewater in the dosing tank or chamber.

Size the VTA on the greater of either:

1) A minimum flow through time of 30 minutes at a maximum flow depth of 0.5 inches, or
2) A minimum area to accommodate up to an application depth of 0.9 inches per week.

The allowable soil dosing rate is shown in Table 2.

Evenly distribute milking center wastewater across the VTA discharging a minimum of 1.0 foot above the ground.

Applicable to operations up to 300 Animal Units

A) Criteria for sites where the down gradient end of the VTA is:

- ≥ 1000 feet from navigable lakes, ponds and flowages,
- ≥ 300 feet from wetlands and navigable streams and rivers,
- ≥ 500 feet from conduits to groundwater,
- ≥ 300 feet from surface inlets that discharge to navigable waters,
- ≥ 150 feet from channelized flow (i.e., a drainage area of ≥ 5 acres), and
- ≥ 150 feet from subsurface drains.

Locate the VTA > 100 feet from any private water well.

Infiltrate and treat a portion of the 25-year, 24-hour storm event and provide additional above separations to prevent significant discharges of pollutants (Wisc. Admin. Code NR 243.26(2)).

Limit the natural or constructed slope of the VTA from 1 to 6 percent.

Each VTA shall treat a single source of wastewater.

Apply wastewater uniformly across the full width of the VTA (e.g., level spreader, distribution pipe), or uniformly apply over the VTA. Place additional devices at intervals not to exceed 150 feet to maintain sheet flow down the length of the VTA.

Design shall use a Manning's n = 0.30 for shallow flow conditions.

Wastewater is allowed to be applied year round.

Animal Lot

Design a collection practice using the Livestock Area Sediment Basins criteria contained within WI NRCS CPS, Waste Separation (Code 632) or Reception Structures, Channels, Hoppers, and Pumps criteria contained in WI NRCS CPS, Waste Transfer (Code 634).

Design each VTA to treat ≤ 10,000 square feet of animal lot area and not more than 98 animal units.

Design the VTA for a flow depth of 0.5 to 1.0 inches for the waste separation and holding facility's flood-routed 25-year, 24-hour storm event.

Design the minimum VTA size to be 150 percent of the animal lot size for paved lots and 100 percent of the animal lot size for earth lots.

The annual output of phosphorus from the VTA shall be 5 pounds or less as determined based on potentially affected resources documented in the site assessment, using the Agricultural Research Service procedure outlined in "An Evaluation System to rate Feedlot Pollution Potential" and a series of rainfall events for a year contained in the Wisconsin supplement to Chapter 10 of the AWMFH.

Feed Storage

Design the feed storage area/collection system to achieve a maximum VTA flow depth of 1.75 inches for the 10-year, 24-hour storm event.

Design the VTA for a minimum flow through time of 22 minutes.

The maximum VTA width shall not be greater than 200 feet.

Collect all leachate and the initial runoff volume of 0.10 inches from each rain event to a Reception Structure designed in accordance with the criteria contained in WI NRCS CPS, Waste Transfer (Code 634). This leachate and runoff shall not be applied to the VTA.

Milking Center Wastewater
VTA treatment is applicable for operations producing a maximum of 500 gallons of milking center wastewater per day.

Design a Reception Structure in accordance with the criteria contained in WI NRCS CPS, Waste Transfer (Code 634) (i.e., pretreatment tanks) and size it to provide a minimum three-day hydraulic retention time prior to discharge to the VTA. The outlet from the pretreatment tank(s) shall be gravity flow to a dosing tank or chamber which shall be separate from the pretreatment tank(s). Locate a pump or siphon for pressure distribution of milking center wastewater in the dosing tank or chamber.

Size the VTA on the greater of either:

1) A minimum flow through time of 20 minutes at a maximum flow depth of 0.5 inches, or
2) A minimum area to accommodate up to an application depth of 0.9 inches per week.

The allowable soil dosing rate is shown in Table 2.

Table 2. Allowable soil dosing rates (gal/ft^2 of VTA)

Soil Drainage Class	Soil Depth > 40″	Soil Depth 24″ - 40″
Well Drained	0.300	0.250
Moderately Well Drained	0.250	0.200
Somewhat Poorly Drained	0.125	0.075

Evenly distribute milking center wastewater across the VTA discharging a minimum of 1.0 foot above the ground.

B) Criteria for sites where the down gradient end of the VTA (x) is between:
   - 250 ≤ x < 1000 feet from navigable lakes, ponds and flowages,
   - 150 ≤ x < 300 feet from wetlands and navigable streams and rivers,
   - 250 ≤ x < 500 feet from conduits to groundwater,
   - 150 ≤ x < 300 feet from surface inlets that discharge to navigable waters,
   - 50 ≤ x < 150 feet from channelized flow (i.e., a drainage area of ≥ 5 acres), and
   - 50 ≤ x < 150 feet from subsurface drains.

Locate the VTA > 100 feet from any private water well.

Infiltrate and treat a portion of the 25-year, 24-hour storm event and provide additional above separations to prevent significant discharges of pollutants (Wisc. Admin. Code NR 243.26(2)).

Limit the natural or constructed slope of the VTA from 1 to 6 percent.

Each VTA shall treat a single source wastewater.

Uniformly apply wastewater across the full width of the VTA (e.g., level spreader, distribution pipe), or uniformly over the VTA. Place additional devices at intervals not to exceed 150 feet to promote sheet flow down the length of the VTA.

Animal Lot
A collection practice is needed to operate the system throughout the year. Below are options:

- Design a Livestock Area Sediment Basin (criteria contained within WI NRCS CPS, Waste Separation (Code 632)) to retain 100 percent of the 25-year, 24-hour storm event during the growing season.
- Design a Waste Storage Facility (criteria contained within WI NRCS CPS, Waste Storage Facility (Code 313)) when required to hold contaminated runoff and manure during the non-growing season with 0.25 feet of freeboard.

Apply wastewater only during the growing season for the VTA vegetation.

Apply wastewater not to exceed the 25-year, 24-hour storm event volume per application.

Allow the VTA to rest 3 days between applications of wastewater collected during the non-growing season.

Commence VTA application at least 24 hours after cessation of a ≥ 0.5 inch rain event (i.e., sunny day release), or immediately after cessation of a < 0.5 inch rain event.

Design each VTA to treat ≤ 10,000 square feet of animal lot area and not more than 98 animal units.

Design the VTA for a flow depth of 0.5 to 1.0 inches for the water separation facility's flood-routed 25-year, 24-hour storm event.

Design the minimum VTA size to be 150 percent of the animal lot size for paved lots and 100 percent of the animal lot size for earth lots.

The annual output of phosphorus from the VTA shall be 5 pounds or less as determined based on potentially affected resources documented in the site assessment, using the Agricultural Research Service procedure outlined in "An Evaluation System to rate Feedlot Pollution Potential" and a series of rainfall events for a year contained in the Wisconsin supplement to Chapter 10 of the AWMFH.

Feed Storage
Design the feed storage area/collection system to achieve a maximum VTA flow depth of 1.75 inches flow depth on the VTA for the 25-year, 24-hour storm event.

Design the VTA for a minimum flow through time of 22 minutes.

The maximum VTA width shall not be greater than 200 feet.

Feed storage contaminated runoff can be applied year-round.

Collect all leachate and the initial runoff volume of 0.20 inches from each rain event to a Reception Structure designed in accordance with the criteria contained in WI NRCS CPS, Waste Transfer (Code 634). This leachate and runoff shall not be applied to the VTA.

Milking Center Wastewater
VTA treatment is applicable for operations producing a maximum of 500 gallons of milking center wastewater per day.

Design a Reception Structure in accordance with criteria contained in WI NRCS CPS, Waste Transfer (Code 634) (i.e., pretreatment tanks), and size it to provide a minimum three-day hydraulic retention time prior to discharge to the VTA. The outlet from the pretreatment tank(s) shall be gravity flow to a dosing tank or chamber which shall be separate from the pretreatment tank(s). Locate a pump or siphon for pressure distribution of milking center wastewater in the dosing tank or chamber.

Size the VTA on the greater of either:

A minimum flow through time of 30 minutes at a maximum flow depth of 0.5 inches, or

A minimum area to accommodate up to an application depth of 0.9 inches per week.

The allowable soil dosing rate is shown in Table 2.

Evenly distribute milking center wastewater across the VTA discharging a minimum of 1.0 foot above the ground.

C) Criteria for sites where the down gradient end of the VTA is:

- < 250 feet from navigable lakes, ponds and flowages,
- < 150 feet from wetlands and navigable streams and rivers,
- < 250 feet from conduits to groundwater,
- < 150 feet from surface inlets that discharge to navigable waters,
- < 50 feet from channelized flow (i.e., a drainage area of ≥ 5 acres), or
- < 50 feet from subsurface drains.

See criteria for operations with over 300 and 500 or less Animal Units

CONSIDERATIONS

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

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 wastewater to a waste storage facility during excessively wet or cold climatic conditions.

Consider suspension of application to VTA 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.

Consider installing a berm and/or a pumping system at the downstream end of the VTA to contain and/or recirculate the wastewater to the top of the VTA or transfer to a waste storage facility.

Consider storing wastewater from the VTA for land application, recycling through the VTA, or otherwise used in the agricultural operation.

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

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 parameters, necessary construction sequence, vegetation establishment requirements, and nutrient removal.

Plans and specifications will include:

- A plan view showing the location of the VTA,
- Details of the length, width, elevation, and slope of the VTA to accomplish the planned purpose,
- 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, and
- 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 may include the following items as appropriate:

- Scheduling of wastewater application, depth of application, rates, resting periods, etc. as applicable.
- Empty waste transfer structures after rainfall and runoff events to maintain storage for the next event.
- Control undesired weed species, especially state-listed noxious weeds, and other pests that could inhibit proper functioning of the VTA.
- Inspect and repair VTAs after storm events to address gullies, remove flow-disrupting sediment accumulation, reseed disturbed areas, and take other measures to 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 VTA as necessary by periodically grading or removing excess material when deposition or signs of burned-out areas persist and jeopardize its function. Re-establish herbaceous vegetation.
- 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 wastewater late in the growing season.
- Routinely dethatch or aerate a VTA in order to promote infiltration.
- Conduct harvesting and other maintenance activities only when the VTA is dry and moisture content in the surface soil will not result in compaction or rutting.
- Clean the animal lot and/or settling areas as needed or before rain events when possible to prevent migration of solids to the VTA.
- Maintain the VTA spreader to the initial design function.
- Harvest VTA vegetation as appropriate to encourage dense growth, maintain upright growth, and remove nutrients and other contaminants that are contained in the plant tissue.
- Monitor all VTAs to maintain optimal crop growth and environmental protection.
- Periodic checks of nozzles and spray heads for proper operation and wear
- Schedule of soil sampling and testing to ensure that neither phosphorus is accumulating in the soil profile, nor nitrogen is leaching below the root zone.
- Prior to construction, the owner/operator shall sign the operation and maintenance plan to indicate an understanding of the requirements and a commitment to operate and maintain the practice as specified.

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DEFINITIONS

Animal lots – An animal lot is an area, a building, or combination of contiguous areas and buildings intended for the confined feeding, breeding, raising or holding of beef and/or dairy cattle. An animal lot is specifically designed as a confinement area in which beef/dairy waste may accumulate, or where the concentration of beef or dairy animals is such that a vegetative cover is denuded and cannot be maintained within the enclosure.

Animal Units – A unit of measurement used to determine the total number of single animal types or combination of animal types, as specified in NR 243, which are fed, confined, maintained or stabled in an animal feeding operation.

Available water capacity (AWC) – The portion of water in a soil that can be readily absorbed by plant roots of most crops, expressed in inches per inch, inches per foot, or total inches for a specific soil depth. It is the amount of water stored in the soil between field capacity (FC) and permanent wilting point (PWP). Also called available water holding capacity (AWHC).

Bedrock – The solid or consolidated rock formation typically underlying loose surficial material such as soil, alluvium or glacial drift. Bedrock includes but is not limited to limestone, dolomite, sandstone, shale and igneous and metamorphic rock.
Note: Although solid or consolidated bedrock can sometimes be removed with typical excavation equipment, these materials are included in the above definition.

Channelized flow – Water movement in a surface drainage feature including, but not necessarily limited to: swales, draws, grass waterways, ditches, gullies, creeks, or rivers.

Conduits to groundwater – Sinkholes, swallets, fractured bedrock at the surface, mine shafts, non-metallic mines, tile inlets discharging to groundwater, quarries, or depressional groundwater recharge areas over shallow fractured bedrock. Wells were intentionally left out of this NR 151 list.

Contaminated Runoff – Runoff that has come through or across a barnyard or animal lot or feed storage area. It generally includes the runoff and any manure, sediment, feed, or other material carried in the runoff. It contains lower concentrations of contaminants than leachate from feed or manure.

Feed Storage Area – An area used to store livestock feed. Livestock feed may include field corn silage, haylage, and industrial by-products (i.e., distillers grain, brewers grain, candy, pizza crust, bakery waste, cotton seed, soy bean meal, animal fats, blood meal, fish meal, cannery waste, beet pulp, citrus pulp, soy hulls, corn midlings, whey, potatoes, grocery store vegetables). This is the area defined by the outside edge of the surface of where the feed is stored, including the apron.

Field capacity – The amount of water retained by a soil after it has been saturated and has drained freely by gravity. Can be expressed as inches, inches per inch, bars suction, or percent of total available water.

Hydraulic Loading Rate – Considered as the flow rate distributed over the surface area calculated as: HLR = Flow Rate / Surface Area.

Karst – Refers to areas of land underlain by carbonate bedrock (limestone or dolomite). Typical land features in karst areas include sinkholes, disappearing streams, closed depressions, blind valleys, caves, and springs. See the companion document in Chapter 10 of the AWMFH for additional discussion of karst features.

Leachate – Concentrated liquid which has percolated through or drained from animal feed. It contains much higher concentrations of contaminants than feed storage contaminated runoff. See WI FOTG Standard 629, Waste Treatment, for leachate quantity calculations.

Milking Center Wastewater – Consists of wash water used to clean the milk harvesting and milk cooling equipment. Other contaminated sources of wastewater (water softener) and wash water used to clean the floors and walls can be included in the combined flow of the milking center wastewater discharge. Wastewater from the floor of the holding area is excluded from treatment systems specified by this standard. Clean discharge water sources (plate cooler, roof water) and sanitary wastewater (toilets, sinks, clothes laundry) must be excluded from the treatment system.

Navigable Waters – As defined in Section 30.01 (4m) of the Wisconsin State Statutes, "navigable waters" means any body of water which is navigable under the laws of the State of Wisconsin. (Navigable stream, rivers, lakes, pond, flowages, etc.)

Permanent wilting point (PWP) – The moisture percentage, on a dry weight basis, at which plants can no longer obtain sufficient moisture from the soil to satisfy water requirements. Plants will not fully recover when water is added to the crop root zone once permanent wilting point has been experienced. Classically, 15 atmosphere (15 bars) or 1.5 mPa, soil moisture tension is used to estimate PWP.

Root Zone – Depth to which the roots of mature crops will extract available soil water.

Waste storage facility* (used for feed storage wastewater or a combination of manure and feed storage wastewater) – This is a new category of waste storage facilities that must meet the most stringent criteria contained in WI FOTG Standard 313, Waste Storage Facility, and Wisconsin administrative code NR-213.

Well Established – Vegetation is well established when there is 100% ground cover. This can be achieved by adequate existing sod, installed sod that is rooted and growing, or newly established vegetation that has gone through a growing season and provides 100% ground cover.

Wetlands – For the purposes of this technical standard, this includes all wetlands, including areas determined as prior converted (PC) in accordance with the 1985 Food Security Act (or similar FSA determinations), which retain wetland characteristics. This includes areas that may be exempt under the Wetland Conservation (WC) provisions, but that meet wetland criteria.

NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

WETLAND RESTORATION

CODE 657
(ACRE)

DEFINITION

The return of a wetland and its functions to a close approximation of its original condition as it existed prior to disturbance on a former or degraded wetland site.

PURPOSE

To restore wetland function, value, habitat, diversity, and capacity to a close approximation of the pre-disturbance conditions by restoring:

- Conditions conducive to hydric soil maintenance.
- Wetland hydrology (dominant water source, hydroperiod, and hydrodynamics).
- Native hydrophytic vegetation (including the removal of undesired species, and/or seeding or planting of desired species).
- Original fish and wildlife habitats.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies only to natural wetland sites with hydric soils which have been subject to the degradation of hydrology, vegetation, or soils.

This practice is applicable only where the natural hydrologic conditions can be approximated by actions such as modifying drainage, restoring stream/floodplain connectivity, removing diversions, dikes, and levees, and/or by using a natural or artificial water source to provide conditions similar to the original, natural conditions.

This practice is applicable to augmentation activities, on a degraded wetland, only when necessary to restore a wetland's lost function(s) or to reintroduce wetland vegetation and wetland hydrology to an area where these vegetative and hydrologic qualities previously existed.

Where embankments are a component of the restoration, this standard is applicable to:

- Embankment structures that are Low Hazard Class.
- Embankment structural heights of six feet or less.

This practice does not apply to:

- The treatment of point and non-point sources of water pollution (Wisconsin NRCS Conservation Practice Standard (WI NRCS CPS), Constructed Wetland (Code 656));
- The rehabilitation of a degraded wetland, the reestablishment of a former wetland, or the modification of an existing wetland, where specific wetland functions are augmented beyond the original natural conditions; possibly at the expense of other functions (WI NRCS CPS, Wetland Enhancement (Code 659));
- The creation of a wetland on a site location which was historically non-wetland (WI NRCS CPS, Wetland Creation (Code 658));
- The management of fish and wildlife habitat on wetlands restored under this standard.

CRITERIA

General Criteria Applicable to All Purposes

Design and install measures according to a site-specific plan in accordance with all local, State, Tribal, and Federal laws and regulations. Apply measures that are compatible with improvements planned or being carried out by others.

The purpose, goals, and objectives of the restoration shall be clearly defined in the restoration plan, including soils, hydrology, vegetation, and fish and wildlife habitat criteria that are to be met and are appropriate for the site and the project objectives.

These planning steps shall be done with the use of a functional assessment type procedure, or a state approved equivalent. The objectives will be determined by an analysis of current and historic site functions. They will be based on those functions which can reasonably be supported by current site constraints. Data from historic and recent aerial photography and/or other remotely sensed data, soil maps, topographic maps, stream gage data, intact reference wetlands, and historical records shall be gathered.

The soils, hydrology and vegetative conditions existing on the site, the adjacent landscape, and the contributing watershed shall be documented in the planning process.

The nutrient and pesticide tolerance of the plant and animal species likely to occur shall be evaluated where known nutrient and pesticide contamination exists. Sites suspected of containing hazardous material shall be tested to identify appropriate remedial measures. If remedial measures are not possible or practicable, the practice shall not be planned.

Excessive nutrient, pesticide, or other pollutant inflows will be controlled prior to site restoration. Examples of excessive inflows include direct runoff from a feedlot or other obvious pollution source, an actively eroding gully emptying into the site, or a poorly treated watershed that is contributing sediment and its associated pollutants.

Review the availability of sufficient water rights prior to restoration.

Upon completion, the site shall meet soil, hydrology, vegetation and habitat conditions of the wetland that previously existed on the site to the extent practicable.

Where off-site hydrologic alterations or the presence of invasive species impact the site, the design shall compensate for these impacts to the extent practicable.

Invasive species, federal/state listed noxious plant species, and nuisance species (e.g., those whose presence or overpopulation jeopardize the practice) shall be controlled on the site as necessary to restore wetland functions. The establishment and/or use of non-native plant species shall be discouraged.

The effect of any modification to the existing surface and/or subsurface drainage system on upstream, adjacent, and downstream landowners will be evaluated in the design. Upstream surface and subsurface drainage will not be impacted unless mitigation measures are implemented. The impoundment owner must have ownership or legal control of the impoundment including the right to flood all land in the impoundment up to the 1% flood event. Legal control is usually obtained through permanent easements recorded on the deed of the affected property.

The impact on water surface profiles of any fill placed in a floodplain area will be determined prior to construction of the project.

The lateral effects of existing drainage systems on or adjacent to the proposed restoration site must be addressed in planning and designing the wetland restoration.

The area downstream of any proposed embankment will be evaluated to ensure that a potential failure of the embankment during maximum pool conditions will not pose a hazard to existing houses, highways or other structures.

Criteria for Hydric Soil Restoration

Restoration sites will be located on soils that are hydric.

If the hydric soil is covered by fill, sediment, spoil, or other depositional material, the material covering the hydric soil shall be removed to the extent needed to restore the original soil functions.

Soil hydrodynamic and bio-geochemical properties such as permeability, porosity, pH, or soil organic carbon levels shall be restored to the extent needed to restore hydric soil functions.

Additional Criteria for Hydrology Restoration

The hydroperiod, hydrodynamics, and dominant water source of the restored site shall approximate the conditions that existed before alteration. The restoration plan shall document the adequacy of available water sources based on groundwater investigation, stream gage data, water budgeting, or other appropriate means.

The work associated with the wetland shall not adversely affect adjacent properties or other water users unless agreed to by signed written letter, easement or permit.

Timing and level setting of water control structures, if needed, will be based on the actions needed to maintain a close approximation of the original, natural hydrologic conditions.

The original natural water supply should be used to reestablish the site's hydrology to approximate the hydrologic conditions of the wetland type. If this is not possible, an alternate natural or artificial water supply can be used; however, these sources shall not be diverted from other wetland resources. If the alternate water source requires energy inputs, these shall be estimated and documented in the restoration plan.

To the extent technically feasible, reestablish macrotopography and/or microtopography. Use reference sites within the local area to determine desired topographic relief. The location, size, and geometry of earthen structures, if needed, shall match that of the original macrotopographic features to the extent practicable.

Macrotopographic features, including ditch plugs installed in lieu of re-filling surface drainage ditches, shall meet the requirements of other practice standards to which they may apply due to purpose, size, water storage capacity, hazard class, or other parameters.

Excavations from within the wetland shall remove sediment to approximate the original topography or establish a water level that will compensate for the sediment that remains.

The disposition of the spoil shall be as stated in Additional Criteria for Excavation.

Water control structures that may impede the movement of target aquatic species or species of concern shall meet the criteria in WI NRCS CPS, Fish Passage (Code 396).

Additional Criteria for Vegetative Restoration

Hydrophytic vegetation restoration shall be of species typical for the wetland type(s) being established and the varying hydrologic regimes and soil types within the wetland. Preference shall be given to native wetland plants with localized genetic material.

Where natural colonization of acceptable species can realistically be expected to occur within 5 years, sites may be left to revegetate naturally. If not, the appropriate species will be established by seeding or planting.

Adequate substrate material and site preparation necessary for proper establishment of the selected plant species shall be included in the plan.

Where planting and/or seeding is necessary, the minimum number of native species to be established shall be based on a reference wetland with the type of vegetative communities and species planned on the restoration site:

- Where the dominant vegetation will be herbaceous community types, a subset of the original vegetative community shall be established within 5 years, or a suitable precursor to the original community will be established within 5 years that creates conditions suitable for the establishment of the native community. Species richness shall be addressed in the planning of herbaceous communities. Seeding rates shall be based upon the percentage of pure live seed and labeled with a current seed tag from a registered seed laboratory identifying the germination rate, purity analysis, and other seed statistics.
- Where the dominant vegetation will be forest or woodland community types, vegetation establishment will include a mix of woody species (trees and/or shrubs) adequate to establish the reference wetland community.

Hydrologic conditions including duration, depth, and timing are primary factors in vegetation reestablishment. In some cases, vegetation after restoration can be predicted from historic records or existing vegetation on similar soils on nearby sites.

A specific site planting plan will be developed which will include the species to be planted, amounts and establishment procedures according to WI NRCS CPS, Conservation Cover (Code 327).

Disturbed areas on or near wetland restoration sites including embankments, constructed earth spillways, ditch plugs, or other non-vegetated areas (spoil disposal sites, construction haul roads, or similar areas) shall be re-vegetated according to WI NRCS CPS, Critical Area Planting (Code 342).

Additional Criteria for Excavation

Where an area containing hydric soil has been covered by sediment, land shaping or other activities, the wetland hydrology may be restored by excavating (scraping) the fill material and/or the sediment from the site.

Conduct soil borings to determine the approximate original hydric soil surface.

Excavated areas (scrapes) may also be constructed to provide diversity of habitat and to provide a source of fill materials for embankments or ditch plugs within the same wetland area. In this case, excavation may occur below the original hydric soil surface. Use caution to avoid excavating through any restrictive soil layer(s) in or below the hydric soil.

Newly excavated spoil not used in embankment or ditch plug construction shall not be disposed of in the following:

- U. S. Army Corps of Engineers jurisdictional wetlands,
- Existing non-degraded wetlands or other aquatic resources with intact native plant communities,
- Areas that will degrade functional values of the restored wetland.

Newly excavated spoil may be:

- Removed from the wetland area, or
- Placed below the planned normal water elevation to establish features beneficial for plant and animal biodiversity, or
- Spread above the planned normal water elevation in a layer averaging not more than 3 inches, but only in areas where the functional values of the restored wetland will not be degraded.

Wetland side slopes, shape, and size should approximate the original wetland configuration. When this cannot be determined, excavated scrapes shall have the following characteristics:

- Side slopes of 8:1 or flatter,
- An irregular shape to adapt to the site,
- Maximum depth of 4 feet,
- Size range from 0.1 acre to 1.0 acre, and
- A minimum 25-foot wide vegetated buffer area surrounding the scrape.

Additional Criteria for Subsurface Drain Removal or Destruction

The effects of a subsurface drainage system may be eliminated by performing one or more of the following:

- Removing or rendering inoperable a portion of the drain,
- Modifying the drain with a water control device, or
- Installing non-perforated pipe through the wetland site.

The minimum length of drain to be removed or rendered inoperable is shown in Table 1. Plan for additional sub-surface drain removal based on an evaluation of land grade, drain grade, and depth of the drainage system. Also, consider lateral effects of the outlet ditch when determining sub-surface drain removal locations. If present, underground reservoirs for drainage pumping plants shall be removed, crushed, or filled and capped.

If present, all sand and gravel bedding and filtering material or other flow enhancing material will also be removed. The trench will be filled or compacted to achieve a density equal to the adjacent material.

Where embankments will be constructed, all subsurface drains shall be removed starting at one-half the minimum distance shown on Table 1 downstream of the embankment center line and extending to 15 feet upstream from the upstream toe of the embankment.

Installation of non-perforated subsurface drain around or through the wetland may be necessary to allow upstream drainage systems to continue to function properly.

Functional subsurface drains downstream of the wetland shall have an end cap installed on the upstream end or other satisfactory end seal to prevent soil from filling the drain.

Additional Criteria for Surface Drain Filling

Where open channels and shallow surface drains provide surface and subsurface drainage, the channel or surface drain will be:

- Totally filled with earth, or
- Filled with a single ditch plug or a series of ditch plugs to the full depth of the ditch according to Table 1, or
- Filled with a ditch plug to a height less than the full depth of the ditch according to Table 1 and have an outlet designed according to WI NRCS CPS, Grade Stabilization Structure (Code 410), or WI NRCS CPS, Structure for Water Control (Code 587).

Where open channels and shallow surface drains provide only surface drainage, restoration may be achieved using an embankment. See Additional Criteria for Embankments.

Plan the number and spacing of ditch plugs based on an evaluation of land grade, drain grade, and depth of the drainage ditch. The end slopes on ditch plugs will be 3:1 or flatter on the downstream side and 5:1 or flatter on the wetland side.

Ditch plug fills will be compacted as needed to achieve the desired densities. To account for settlement, the earthfill height will be increased by at least 5 percent for mineral soils compacted by construction equipment operating over the fill area, and by at least 10 percent where fill is dumped, bulldozed, and shaped with limited compaction. The earthfill height will be increased by 20 percent where a mixture of mineral and organic soils is used. All fills using organic soils shall be increased by at least 33 percent to account for settlement.

Provisions will be made to store, pass, or divert the 10-year, 24-hour storm flow so that it does not cause erosion and flooding impacts where it enters any downstream facilities. Earthfill materials shall be placed such that there will be no flow over the ditch plug during a 10-year, 24 hour storm except where a grade stabilization structure or structure for water control is used. A minimum of 0.5 feet for freeboard shall be included in the settled fill height of a ditch plug above the adjacent original ground surface to insure that flows will be directed around the plug. A flow control device will be used where flow duration and rate would otherwise cause erosion and head cutting.

Table 1.

Minimum length of subsurface drain to be removed or rendered inoperable or
Minimum length of surface drain to be filled with ditch plug.
(The length is measured parallel to the direction of the surface drain flow along the top of the settled ditch plug.)

*Soil Permeability	*Soil Texture	**Minimum Distance (inches per hour)
> 2.0	Sandy & Organics	150 feet
0.6 - 2.0	Loamy	100 feet
< 0.6	Clayey	50 feet

*Soil texture and permeability are for the general soil profile, not just the surface layer. Where the permeable and texture vary throughout the profile, consider the type of drainage system and which layer(s) are critical. Standard values for permeability and texture for each soil map unit are in the Field Office Technical Guide.

**Lateral effects of drainage features computed according to EFH Chapter 19 procedures can be substituted for the minimum distances shown in Table 1 (except for drains under embankments).

Additional Criteria for Embankments

An earth embankment may be constructed to restore a wetland. Embankments generally are placed above the original ground surface to impound water above ground.

Embankments shall be designed in accordance with WI NRCS CPS, Dike (Code 356) when the runoff volume from the 1% flood event from the drainage area above the impoundment increases the design storage volume of the impoundment by no more than two percent.

All other embankments shall meet the hydrologic and hydraulic design criteria of WI NRCS CPS, Pond (Code 378) or NRCS Technical Release 60 as applicable.

The embankment shall be constructed of earthfill according to the following embankment criteria:

- Top width - 8 feet minimum for mineral soils and 16 feet minimum for organic soils.
- Side slopes - 5:1 or flatter upstream and 3:1 or flatter downstream.

Where existing embankments (dikes, levees, spoil berms, etc.) are present, the materials, dimensions, and structural soundness must be evaluated to determine suitability for the intended use.

Embankments should be located and shaped in a manner that is compatible with the existing landscape.

Embankments constructed adjacent to streams or ditches with perennial flow shall be protected from muskrat damage by one of the following:

- Installation of barriers, such as sheet piling or rock-filled trenches, within the embankment.
- Separating open water areas upstream of the embankment by distances of 75 feet for mineral soils, and 150 feet for organic soils.

Additional Criteria for Spillways for Embankments

A spillway, such as a pipe conduit, weir structure, chute spillway, lined or stone-centered waterway, shall be used where:

- A base flow exists, or
- There is a potential for a prolonged low flow, or
- There is a potential for frequent flow, or
- As required by WI NRCS CPS, Pond (Code 378) or NRCS Technical Release 60 as applicable.

Spillways designed to handle base flows shall have a minimum capacity of twice the base flow rate. The minimum pipe diameter, if used, shall be 4 inches.

Spillways required by WI NRCS CPS, Pond (Code 378) or NRCS Technical Release 60 shall pass the applicable design storm.

Rock structures shall meet the stone size and gradation requirements of WI NRCS CPS, Lined Waterway or Outlet (Code 468); or WI NRCS CPS, Grade Stabilization Structure (Code 410).

Where wetland water level manipulation may be desired, other structural details shall meet the requirements of WI NRCS CPS, Structure for Water Control (Code 587), as applicable.

Pipe components shall meet material requirements of WI NRCS CPS, Underground Outlet (Code 620); Subsurface Drain (Code 606); or WI NRCS CPS, Pond (Code 378).

Materials and design of filter and drainage diaphragms shall be in accordance with NRCS Technical Release No. 60, Earth Dams and Reservoirs.

CONSIDERATIONS

Wherever possible, this practice should be applied to sites that are adjacent to existing wetlands to increase wetland system complexity and diversity, decrease habitat fragmentation, and ensure colonization of the site by wetland plants and animals. A complex of multiple smaller wetland excavations (scrapes) are biologically more beneficial than a single larger unit.

Consider extra safety requirements for embankments constructed in series.

Where wetlands may pose a hazard to people, consider means to direct people away from hazards (fencing, warning signs at access points, etc.), or consider measures in design and construction of the wetland restoration to reduce hazards.

Sediment delivery to restored wetlands from surface water inflow should be minimized. This may be accomplished with watershed treatment, grassed or riparian filter areas, or sediment basins.

Additional excavations within or connected to the normal water area of the wetland should be considered to add biodiversity potential.

The Wetland Planning Checklist in the National Engineering Handbook, Part 650, Engineering Field Handbook, Chapter 13, Appendix, can serve as a guide for wetland restoration. A site visit checklist for documenting baseline wetland conditions and restoration changes is available for use.

Soil Considerations

Consider making changes to physical soil properties, including:

- Increasing or decreasing saturated hydraulic conductivity by mechanical compaction or tillage, as appropriate.
- Incorporating soil amendments.
- The effect of construction equipment on soil density, infiltration, and structure.

Consider changes in soil bio-geochemical properties, including:

- Increasing soil organic carbon by incorporating compost.
- Increasing or decreasing soil pH with lime, gypsum, or other compounds

Hydrology Considerations

Consider the general hydrologic effects of the restoration, including:

- Impacts on downstream stream hydrographs, volumes of surface runoff, and groundwater resources due to changes of water use and movement created by the restoration.
- Consider the impacts of water level management, including:
- Increased predation due to concentrating aquatic organisms, including herptivores, in small pool areas during draw downs
- Increased predation of amphibians due to high water levels that can sustain predators.
- Decreased ability of aquatic organisms to move within the wetland and from the wetland area to adjacent habitats, including fish and amphibians as water levels are decreased.
- Increases in water temperature on-site, and in off-site receiving waters.
- Changes in the quantity and direction of movement of subsurface flows due to increases or decreases in water depth.
- The effect changes in hydrologic regime have on soil bio-geochemical properties, including: oxidation/reduction; maintenance of organic soils; and salinity increase or decrease on site and on adjacent areas.

Vegetation Considerations

- The relative effects of planting density on fish and wildlife habitat versus production rates in woody plantings.
- The potential for vegetative buffers to increase function by trapping sediment, cycling nutrients, and removing pesticides.
- Vegetated buffer areas should be planned around all wetland restorations. For optimum nesting cover, a ratio of 4:1 (buffer area: water surface area) is recommended.
- The selection of vegetation for the protection of structural measures that is appropriate for wetland function.
- The potential for invasive or noxious plant species to establish on bare soils after construction and before the planned plant community is established.
- The use of prescribed burning to restore wetland and adjacent upland plant communities.
- The use of vegetative species that provide quick establishment on disturbed areas on or near wetland restoration sites including embankments, constructed earth spillways, ditch plugs, or other non-vegetated areas (spoil disposal sites, construction haul roads, or similar areas).

Fish and Wildlife Habitat Considerations

- The addition of coarse woody debris on sites to be restored to woody plant communities for an initial carbon source and fish and wildlife cover.
- The potential to restore habitat capable of supporting fish and wildlife with the ability to control disease vectors such as mosquitoes.
- The potential to establish fish and wildlife corridors to link the site to adjacent landscapes, streams, and water bodies and to increase the sites colonization by native flora.
- The need to provide barriers to passage for unwanted or predatory species.

PLANS AND SPECIFICATIONS

Plans and specifications for this practice shall be prepared for each site. Plans and specifications shall be recorded using approved specifications sheets, job sheets, or other documentation. The plans and specifications for structural features will include, at a minimum, a plan view, quantities, and sufficient profiles and cross-sections to define the location, line, and grade for stakeout and checkout. Alternatively, provide sufficient coordinate points with elevations to define the location, line, and grade for stakeout and checkout. Plans and specifications shall be reviewed and approved by staff with appropriate job approval authority.

The Wetland Planning Checklist in EFH Chapter 13, Appendix, can serve as a guide for wetland restoration. A site visit checklist for documenting baseline wetland conditions and restoration changes is available for use.

All wetland restoration activities shall comply with all federal, state, and local laws, rules or regulations governing flooding, surface and subsurface drainage, excavation, filling, and any other wetland-related activities. The landowner or agent is responsible for securing required permits before restoration. This standard does not contain the text of the federal, state, or local laws governing wetland restoration.

Interagency coordination of wetland restoration project site selection, planning, and approvals early in the planning process is essential to meet the various requirements of technical and regulatory agencies.

OPERATION AND MAINTENANCE

A separate Operation and Maintenance Plan will be prepared for sites that have structural features. The plan will include specific actions for the normal and repetitive operation of installed structural items, especially water control structures, if included in the project. The plan will also include the maintenance actions necessary to assure that constructed items are maintained for the life of the project. It will include the inspection schedule, a list of items to inspect, a checklist of potential damages to look for, recommended repairs, and procedures for documentation.

Management and monitoring activities needed to ensure the continued success of the wetland functions may be included in the above plan, or in a separate Management and Monitoring Plan. In addition to the monitoring schedule, this plan may include the following:

- The timing and methods for the use of fertilizers, pesticides, prescribed burning, or mechanical treatments.
- Circumstances when the use of biological control of undesirable plant species and pests (e.g. using predator or parasitic species) is appropriate, and the approved methods.
- Actions which specifically address any expected problems from invasive or noxious species.
- The circumstances which require the removal of accumulated sediment.
- Conditions which indicate the need to use haying or grazing as a management tool, including timing and methods.
- Timing and level setting of water control structures required for establishment of desired hydrologic conditions or for management of vegetation.
- Inspection schedule of embankments and structures for damage assessment.
- Depth of sediment accumulation allowed before removal is required.
- Management needed to maintain vegetation, including control of unwanted vegetation.

DESIGN DOCUMENTATION

Design

Depending on the type of wetland restoration, the following items will be documented as applicable.

Location map, drainage area, soil boring logs, description of restoration, hydrologic and hydraulic data, typical cross section of excavations, profile along center line of embankment or ditch plug, cross section of embankment or ditch plug, profile of vegetated spillway, side slopes, elevations of inlet and outlet of pipe, length and location of subsurface drain to be removed or rendered inoperable, length and location of surface drain to be filled, inlet invert elevation of water level control structure, seeding requirements.

Construction (As-Built) and/or Certification Documentation Requirements

Depending on the type of wetland restoration, the following items will be documented as applicable.

Length of subsurface or surface drain removed or inoperable, cross sections of excavations (scrapes), profile along center line of embankment or ditch plug, cross section of earthfill section, elevations of pipe inlet, outlet, spillway crest, and others that were required, length of spillway control section, spillway exit slope, materials documentation, statement as to adequacy of seeding.

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DEFINITIONS

1% Flood Event - A flood determined to be representative of large floods, which in any given year has a 1% chance of occurring or being exceeded. The 1% flood is based on a statistical analysis of lake level or streamflow records available for the watershed or an analysis of rainfall and runoff characteristics in the watershed, or both. This is commonly referred to as the 100 year event or regional flood.

Low Hazard Class - Dams located in rural or agricultural areas where failure may damage farm buildings, agricultural land, or township and country roads (NRCS TR-60).

Structural Height – The structural height is the difference in elevation (ft.) between the lowest point on the embankment top and the lowest elevation of the natural channel bottom at the downstream toe of the embankment. For an embankment across a ditch that is not navigable (with no prior stream history), the structural height is measured from the natural ground (adjacent to the ditch) to the design top of the embankment.