June 8, 2016

WISCONSIN FIELD OFFICE TECHNICAL GUIDE
450-11-TECHNICAL GUIDE
FOTG NOTICE WI-80

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:

Clearing and Snagging (Code 326) – The changes were made to provide better clarity and include the use of active voice and the removal of all occurrences of the word "shall." The References section remains unchanged; however, one of the references, 210-NEH, Part 654, "Stream Restoration Design," now appears in the "Considerations" section, where it specifically identifies Technical Supplement 14E of this reference for use in determining the forces acting on woody debris and the necessary anchoring.

Contour Orchard and Other Perennial Crops (Code 331) – Removed wind erosion as one of the purposes and the technology addresses only sheet and rill erosion from water. Provided edits to the purposes to align with the NRCS list of natural resource concerns. Added the criteria for additional temporary erosion control measures on sites that are disturbed. Reduced the allowable contour row grade from 10% to 4%. Added criteria for inward sloping benches to improve sediment trapping on the slopes. Added minor edits throughout the standard to improve clarity.

Cross Wind Ridges (Code 588) –Revised the definition to ridges formed by tillage, planting or other operations and aligned perpendicular to prevailing wind direction during critical wind erosion periods and revised the purpose to reduce soil particulate emissions to the air to reduce soil particulate emissions effecting air quality. Added the implementation requirement document to the specifications and plans.

Cross Wind Trap Strips (Code 589C) – Removed the purpose to induce windborne sediment deposition as this is covered under the purpose to reduce soil erosion and induce windblown sediment deposition. Deleted the purpose to provide food and cover for pollinators and wildlife. In the general criteria for the practice, changed the language from using university extension guides to NRCS approved technical references for seeding and establishment.

Field Border (Code 386) – Revised the condition where the practice applies to cover only existing cropland and pastureland and deleted the purpose to manage pest populations. Added the implementation requirement document to the specifications and plans.

Fish Raceway or Tank (Code 398) – The purpose was refined, the criteria was modified, and the references were updated. Other changes improved the clarity of the language used in the standard.

Herbaceous Weed Control (Code 315) - Minor updates to bring the WI standard current.

Mulching (Code 484) – Deleted the purpose to moderate soil temperature and suppress weeds as these do not address a resource concern and revised the "Conditions where practice applies" to remove this practice from being used for weed control for production agriculture. Added the implementation requirement document to the specifications and plans.

Residue and Tillage Management, Reduced Till (Code 345) – Incorporated "346 Residue and Tillage Management, Ridge Till" into this standard; changed the name from Residue and Tillage Management, Mulch Till; added criteria to establish a maximum soil tillage intensity value of 80; clarified the air quality purpose to reduce tillage-induced particulate emissions vs. only PM-10 emissions; revised the criteria for energy savings to a 25-percent reduction from the current baseline; and added implementation requirements to the specifications and plans.

Saturated Buffer (Code 604) – This is a new conservation practice standard developed from an existing interim conservation practice standard Saturated Buffer (Code 739).

Stripcropping (Code 585) – Revised the definition to stress alternating strips of erosion susceptible crops and revised the wind erosion purpose to reduce wind erosion and associated transport of sediment and other wind borne contaminants. Added the implementation requirement document to the specifications and plans.

The following revisions to the Wisconsin FOTG have been posted on the Wisconsin e-FOTG website:

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

- Index
- Clearing and Snagging (Code 326)
- Contour Orchard and Other Perennial Crops (Code 331)
- Cross Wind Ridges (Code 588)
- Cross Wind Trap Strips (Code 589C)
- Field Border (Code 386)
- Fish Raceway or Tank (Code 398)
- Herbaceous Weed Control (Code 315)
- Mulching (Code 484)
- Residue and Tillage Management, Reduced Till (Code 345)
- Stripcropping (Code 585)

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- Saturated Buffer (Code 604)
- Stripcropping (Code 585)

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

CLEARING AND SNAGGING

CODE 326
(FT.)

DEFINITION
Removal of vegetation along the bank (clearing) and selective removal of snags, drifts, or other obstructions (snagging) from natural or improved channels and streams.

PURPOSE
Reduce risks to agricultural resources or civil infrastructure by removing obstructions that hinder channel flow or sediment transport to:

- Restore flow capacity and direction.
- Prevent excessive bank erosion by eddies or redirection of flow.
- Reduce the undesirable formation of bars.
- Minimize blockages by debris and ice.

CONDITIONS WHERE PRACTICE APPLIES
Any natural or improved channel where the removal of vegetation, trees, brush, and other obstructions is needed to accomplish one or more of the listed purposes.

CRITERIA
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 design must address all modified flow conditions caused by clearing and snagging.

Capacity
Determine the capacity of the channel, both before and after modification, using National Engineering Handbook (NEH) Part 654, Stream Restoration Design, Chapter 6, Stream Hydraulics. Select a value of Manning's "n" roughness coefficient to determine channel capacity after modification that reflects the degree of natural changes and maintenance expected to occur in future years.

Location
Include the perimeter and flow area of the channel in the area to be cleared and snagged. Trees on the bank that are leaning over or other objects that may fall into the channel may be included.

Clearing and snagging may also be used for other areas, such as temporary disposal areas or travelways, required for implementation of this practice.

Stability

Clearing and snagging activities may affect channel stability. The effect on downstream and upstream reaches due to the removal of obstructions must be analyzed using appropriate stream and channel geomorphologic procedures. Avoid or mitigate activities that negatively affect stability.

Debris Disposal

Remove cleared and snagged material from the floodplain or deposit in areas or in a manner that will not significantly affect the flow capacity of the floodplain. Designate locations to dispose of any garbage encountered during clearing and snagging operations; such as construction materials, metal, rubber, glass, and plastic.

Vegetation

Restore all areas denuded and/or disturbed during clearing and snag removal by planting vegetation, unless the disturbance is minimal and conditions are highly conducive for natural regeneration of vegetation. Use native vegetation where practical. Vegetation established as part of this practice should include ecologically suitable species obtained from local sources wherever practical.

Minimize disturbance of wetlands, riparian areas, and fish and wildlife habitat sites and avoid disturbance where possible.

The establishment of vegetation on cleared and snagged areas will be in accordance with the criteria contained within WI NRCS Conservation Practice Standard (WI NRCS CPS) Critical Area Planting (Code 342).

CONSIDERATIONS

Debris in stream systems affects the physical characteristics of the stream as well as the diversity and abundance of its aquatic organisms. Fisheries and/or aquatic biologists can assist in evaluating and incorporating measures to improve aquatic and riparian-wetland habitat.

Incorporate enhancements for fish and wildlife values as needed and practical. Special attention should be given to landscape aesthetics and to protecting and maintaining key shade, food, and den trees. Use WI NRCS CPS Stream Habitat Improvement and Management (Code 395).

Retain or replace habitat-forming elements that provide cover, food, pools, and water turbulence, to the extent possible.

Root balls of fallen trees that are securely anchored in the channel or naturally formed logjams may provide fish habitat and/or stability. The effects of these items must be included in the channel capacity hydraulic analysis. Existing root structure and stumps firmly within the soil should remain to help stabilize the soil and facilitate resprouting of woody vegetation.

Incorporate existing on-site woody debris into the design to help stabilize banks, modify channel flow, provide anchorage and food for invertebrates, and provide habitat and cover for fish. Note that woody debris should be securely fastened as dislodged woody debris may be a risk to downstream structures such as bridges, dams, or other civil works. Use NEH Part 654, Stream Restoration Design Technical Supplement 14E, for determining the forces acting on woody debris, and the necessary anchoring.

Erosion rates decline as a percentage of vegetative roots in a streambank increases. Selection of appropriate riparian vegetation will increase the streambank's ability to resist future erosion.

Clearing and snagging activity may resuspend sediments in the flow. Consider treatments that promote beneficial sediment deposition and the filtering of sediment and dissolved substances.

During construction, woody materials may float downstream and cause additional snags and drifts. Incorporate measures and practices, as needed and practical to address this concern.

Schedule in-stream work to avoid environmentally sensitive periods such as spawning and migration to the fullest extent possible.

Incorporate measures and practices, as needed and practical, to address modified flow conditions such as:

- A lowered hydraulic gradient which may drain adjacent flood plains more quickly.
- Decreased groundwater recharge in water-losing streams resulting from reduced residence time in the channel and adjacent floodplains.

Ground-disturbing activities associated with this practice have the potential to adversely affect protected plant species and may encourage the establishment of exotic and/or nonnative species. Quickly revegetating disturbed areas can minimize the introduction of nonnative species.

Temporary erosion and sediment best management practices can be used to minimize the delivery of fine sediment to adjacent and downstream reaches.

Incorporate construction methods that enhance fish and wildlife values as needed and practical to include:

- Use hand-operated equipment, water-based equipment, or small equipment to minimize soil, water, and other resource disturbances.
- Operate heavy machinery from atop adjacent streambanks to the fullest extent possible.
- After the material has been removed from streambank locations, limit machinery access to riparian areas to minimize damage to stream habitat.

PLANS AND SPECIFICATIONS

Prepare plans and specifications for clearing and snagging that describe the requirements for applying the practice to achieve its intended purpose(s).

As a minimum, include, as applicable, the following items in the plans and specifications:

- Map of overall area including limits of clearing and snagging required.
- Location of ingress and egress to the site.
- Description of works of improvement, extent of removal, and manner of disposal.

- Location of disposal areas or location of areas off limits for disposal of debris.
- Requirements for disposal area to address final dressing, stabilization, drainage, and vegetation.
- Location and description of trees or woody vegetation to be left undisturbed.
- Method of debris disposal.
- Manner and sequence of construction operations so that impacts on the environment will be minimized.
- Erosion control measures, as applicable.
- Vegetative requirements for areas denuded and disturbed, as applicable.

Carry out all operations in a safe and skillful manner. Observe all safety and health regulations and use appropriate safety measures.

OPERATION AND MAINTENANCE

Provide an operation and maintenance plan to the landowner/user to maintain channel capacity and vegetative cover. Items to include are:

- Assess the area after each major storm event for downed trees and debris accumulation. Remove or relocate and anchor downed trees and debris accumulations that are causing bank erosion problems as soon as possible.
- Periodically inspect the area for signs of streambank undermining or instability. Remove any debris accumulations that may contribute to the instability and closely monitor the area.
- Clear any vegetation and/or debris that block side drainage structures and channels.

REFERENCES

USDA-NRCS. 2007. National Engineering Handbook, Part 654, Stream Restoration Design. Washington, D.C.

USDA-NRCS. 2009. National Biology Handbook, Part 614, Stream Visual Assessment Protocol Version 2. Washington, D.C.

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NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

CONTOUR ORCHARD AND OTHER PERENNIAL CROPS

CODE 331
(AC.)

DEFINITION

Planting orchards, vineyards, or other perennial crops so that all cultural operations are done on or near the contour.

PURPOSE

- Reduce sheet and rill soil erosion
- Reduce transport of excessive sediment and other associated contaminants
- Improve water use efficiency with improved infiltration

CONDITIONS WHERE PRACTICE APPLIES

This practice applies on sloping land where orchards, vineyards, or other perennial crops are to be established. Refer to WI NRCS Conservation Practice Standard (WI NRCS CPS) 330, Contour Farming for guidance on establishing contour lines on crop fields.

CRITERIA

General Criteria Applicable to All Purposes

Where sites are disturbed, install temporary erosion control measures until plantings and companion cover is established.

Divert overland flow from adjacent sites to ensure the proper functioning of this practice.

Avoid applying this practice on areas that have evidence of mass movement or have the potential for landslides.

Row Grade

Maximum row grade will be aligned as closely to the contour as feasible, but not to exceed:

- one-half of the up and downhill slope percent used for conservation planning, or
- 4 percent, whichever is less.

Up to a 25-percent deviation from the design row grade is permitted within 150 feet of a stable outlet.

When the row grade reaches the maximum design grade, establish a new baseline up or down slope from the last contour line and the new key line shall be used for the layout of the next contour pattern.

On soils with slow to very slow infiltration rates (hydrologic soil group C or D) or where the planted crop could be damaged by ponded water conditions for periods of greater than 24 hours, establish a row grade of not less than 0.2 percent.

Critical Slope Length
Do not install on hill slopes that are longer than the critical slope length.

When the critical slope length is exceeded, shorten slope lengths through the use of diversions, terraces, or other structures.

Use the current Revised Universal Soil Loss Equation (RUSLE2) to determine the critical slope length.

Stable Outlets
Runoff from contour rows shall not cause erosion as the volume of water increases to the stable outlet.

If contour rows show visible erosion as a result of an extended row length, reduce the row grade and/or seed perennial grass, or perennial vegetative mixes within 150 feet of the stable outlet.

Contour rows that deliver runoff to the field boundaries where erosion is expected shall refer to WI NRCS CPS 386, Field Border.

Additional Criteria to Improve Infiltration and Reduce Transport of Sediment and Other Associated Contaminants
Provide an inward-sloping bench or berm at or near the tree or vine row.

CONSIDERATIONS

Fields that have irregular topography are not well suited for this practice because of the difficulty of meeting the row grade criteria.

Use topographic surveys, topographical maps or other planning tools to determine whether planting patterns will fit the slopes.

Following the level contour may not be desirable where slow drainage may increase disease problems or where furrows could fill with water and overtop.

Outward sloping benches are subject to erosion caused by runoff from slopes above the bench.

This practice works best as a system in combination with vegetative ground cover and appropriate irrigation conveyance practices, where applicable.

Vegetative ground cover, particularly in alleys between rows of trees/vines, in row furrows, and on terraces and diversions can increase infiltration, reduce runoff, aid in controlling erosion, provide habitat for beneficial species and pollinators, and facilitate nutrient cycling.

PLANS AND SPECIFICATIONS

Plans and specifications shall be prepared for each field site where contour orchards or other perennial crops will be installed. Record practice specifications using Wisconsin NRCS Job Sheet 331 Contour Orchards and Other Perennial Crops or other appropriate material. Plans and specifications will include:

- Percent land slope used for conservation planning,
- The minimum and maximum allowable row grades for the contour system,
- A site map, and photograph of the field showing:
    - the approximate location of the baselines used to establish the system
    - the location of stable outlets for the system
- Temporary cover specifications, where appropriate

An evaluation of the conservation system, determined using the current RUSLE2 program computations to verify maximum row grades and critical slope length shall be documented in the job sheet.

OPERATION AND MAINTENANCE

Maintenance needed for this practice includes:

- Performing all cultural operations between tree or vine rows on or near the contour.
- Periodic inspection and repair of stable outlets, after intense storm runoff events.
- Protecting uphill and downhill farm roads from erosion.
- Maintain adequate vegetative cover to control erosion at field boundaries and other susceptible erosive locations within the planning unit.

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. This standard does not contain the text of federal, tribal, state, or local laws.

REFERENCES

Foster, G.R., D.C. Yoder, G.A. Weesies, D. K. McCool, K.G. McGregor, and R.L. Binger. 2003. User's Guide – Revised Universal Soil Loss Equation (RUSLE2). Version 2. USDA. http://fargo.nserl.purdue.edu/rusle2_dataweb/RUSLE2_Index.htm.

USDA, NRCS, Wisconsin Electronic Field Office Technical Guide (eFOTG), Section IV, Practice Standards and Specifications.

USDA, NRCS, Wisconsin Practice Standard 386 Field Border.

USDA, NRCS, Wisconsin Job Sheet 331 Contour and Other Perennial Crops.

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NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

CROSS WIND RIDGES

CODE 588
(AC.)

DEFINITION
Ridges formed by tillage, planting or other operations and aligned perpendicular to prevailing wind direction during critical wind erosion periods.

PURPOSE
This practice supports one or more of the following purposes:

- Reduce soil erosion from wind – Resource concern (SOIL EROSION - Sheet, rill, & wind erosion).
- Protect growing crops from damage by windblown soil particles – Resource concern (DEGRADED PLANT CONDITION – Undesirable plant productivity and health).
- Reduce soil particulate emissions affecting air quality – Resource concern (AIR QUALITY IMPACTS - Emissions of Particulate Matter (PM) and PM Precursors).

CONDITIONS WHERE PRACTICE APPLIES
This practice applies to cropland with soils that are stable enough to sustain effective ridges and cloddiness, such as loamy and clayey soil materials.

This practice is not well adapted on soils with lower aggregate stability such as sandy soil materials and certain organic soils.

CRITERIA
General Criteria Applicable to All Purposes

The ridge orientation, height, spacing, and time period that ridges are present shall be determined using the current approved wind erosion prediction technology and the wind erosion analysis shall account for all existing or planned practices in the conservation management system planning unit.

Orientation of ridges during critical erosion periods shall not exceed 45 degrees from perpendicular to erosive wind direction.

Spacing between ridges shall be no more than 4 times the designed height of the created ridges.

Additional Criteria to Protect Growing Crops from Damage by Windblown Soil Particles.
Wind erosion shall not exceed the crop tolerance of sensitive crops to damage by windblown soil particles as specified in the National Agronomy Manual (Table 502-1). Wind erosion shall not exceed the erosion rates for the client's production goals and planned conservation management system.

CONSIDERATIONS

To be most effective, cross wind ridges should be oriented perpendicular to the direction of erosive winds.

Transport of windblown sediment and sediment-borne contaminants off-site can be reduced by this practice when used in a resource management system.

Adjacent fields, roads or field corners may need treatment to stop saltation of soil particles onto fields protected by cross wind ridges.

To be effective on coarse textured soils such as very fine sandy loams, fine sandy loams, sandy loams, and sand soils;cross wind ridges should be established when the soil is moist. Ridges on these soils will deteriorate quickly and shorten the protection period.

Cross wind ridges may be created at right angles to the predominant erosive wind direction on bare unprotected fields as a form of emergency tillage to reduce wind erosion. Cross wind ridges generally will have a temporary impact on reducing wind erosion and may not last throughout the critical wind erosion period.

Cross wind ridges are most effective when used in combination with other practices in a conservation management system to reduce wind erosion.

PLANS AND SPECIFICATIONS

Specifications for establishment and operation of this practice shall be prepared for each field or treatment unit according to the selected conservation practice purposes, criteria, operation and maintenance in this conservation practice standard. Below are the minimum specifications and documentation requirements for each field:

1. Conservation Plan Map identifying practice location.
2. Crop rotation and tillage operation used to create ridges
3. Critical erosion periods of the prevailing wind direction, ridge orientation, and installation date of ridges, ridge height, and ridge spacing
4. Soil loss computations

Record practice design information and requirements using NRCS Wisconsin Job Sheet 588 Cross Wind Ridges.

OPERATION AND MAINTENANCE

Ridges shall be established or re-established by equipment such as chisel plows, drills with hoe openers, or other implements that form effective ridges.

After establishment, ridges shall be maintained through those periods when wind erosion is expected to occur, or until growing crops provide enough cover to protect the soil from wind erosion.

If ridges become ineffective they shall be re-established unless doing so would damage a growing crop.

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. This standard does not contain the text of federal, tribal, state, or local laws.

REFERENCES

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NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

CROSS WIND TRAP STRIPS

CODE 589C
(AC.)

DEFINITION
Herbaceous cover established in one or more strips typically perpendicular to the most erosive wind events.

PURPOSE
This practice is applied to support one or more of the following:

- Reduce soil erosion from wind and wind-borne sediment deposition.
- Induce snow deposition to improve soil moisture management.
- Improve plant health by protecting the growing crops from damage by wind-borne soil particles.
- Improve air quality by reducing the generation of airborne particulate matter.

CONDITIONS WHERE PRACTICE APPLIES
This practice applies to cropland or other land susceptible to wind erosion.

CRITERIA
General Criteria Applicable to All Purposes

Orientation and Width of Trap Strips
The appropriate orientation and width of the trap strips shall be determined using current NRCS approved wind erosion prediction technology. The minimum width shall be:

- At least 15 feet when vegetation or stubble in the strip will normally be one foot or more in height during periods when wind erosion is expected to occur. The effective width of strips shall be measured along the prevailing wind direction during those periods when wind erosion is expected to occur.
- The effective width of strips shall be measured along the prevailing wind direction during those periods when wind erosion is expected to occur. A width of at least 25 feet is required when the effective height of the vegetation or stubble in the strip will normally be less than one foot during periods when wind erosion is expected to occur.

Vegetative Cover
Trap strips may consist of perennial or annual plants, growing or dead, that meet the following criteria:

- Adapted to site conditions.
- Erect during critical wind erosion periods.
- Living vegetation is tolerant to sediment deposition.
- Tolerant to accumulated snow deposition in places were significant snow deposition is expected.

Refer to the USDA – NRCS Wisconsin Agronomy Technical Note 5, "Establishing and Maintaining Native Grasses, Forbs and Legumes" (TN-5), USDA – NRCS Wisconsin Agronomy Technical Note 6 "Establishing and Maintaining Introduced Grasses and Legumes" (TN-6) and Wisconsin Agronomy Technical Note 7, "Cover and Green Manure Crops Benefits to Soil Quality" (TN-7), and to the USDA – NRCS Wisconsin Biology Technical Note 8, "Pollinator Biology and Habitat" (TN-8) regarding vegetation establishment and species selection for use in trap strip systems.

Additional Criteria to Reduce Soil Erosion from Wind and Wind-Borne Sediment Deposition and Improve Air Quality by Reducing the Generation of Airborne Particulate Matter

Location of Trap Strips
Trap strips established for these purposes shall be located as follows:

- At the windward edge of fields; or
- Immediately upwind from areas to be protected from erosion or deposition; or
- In recurring patterns interspersed between erosion-susceptible strips.

Direction and Width of Erosion-Susceptible Crop Strips
The effective width of the cropped strips shall be measured along the prevailing wind direction during those periods when wind erosion is expected to occur.

The width of cropped strips shall be determined using current NRCS approved wind erosion prediction technology. Calculations shall account for the effects of other practices in the conservation management system. Soil loss rates shall meet the planned soil loss objective.

Additional Criteria to Induce Snow Deposition and Soil Moisture Management

Location of Trap Strips
Trap strips shall be established immediately upwind from areas to where snow will accumulate.

Direction, Minimum Height and Interval Width of Trap Strips
Trap strips shall be placed as perpendicular to the snow-bearing winds as possible. The minimum height of the vegetation shall be three feet. The distance between strips (interval) shall be no more than 20H (20 times the height of the vegetation in the winter months) across the area to receive the snow.

Additional Criteria to Improve Plant Health by Protecting Growing Crops from Damage by Wind-borne Soil Particles

Location of Trap Strips
Trap strips shall be established immediately upwind from areas used for sensitive crops. There shall be no potentially erodible area located between the trap strip and the crop to be protected.

Direction and Width of Sensitive Crop Strips
The width of the crop strips shall be determined using current NRCS approved wind erosion prediction technology to estimate wind erosion during specific crop stage periods.

The effective width shall not exceed the width permitted by the crop tolerance to the maximum wind erosion the crop plants can tolerate without significant damage due to abrasion, burial, or desiccation as specified in the NRCS National Agronomy Manual. Other accepted technical references or planned crop protection objectives or alternatives for the period needed for the crop protection may be utilized.

CONSIDERATIONS

Consider trap strip designs to provide cover or travel corridors for wildlife.

Consider vegetation that provides food or cover for wildlife species in the area.

Consider adding forbs and legumes for pollinators and for other beneficial insects. Utilize a diverse mix of plant species that bloom at different times throughout the year. Refer to the USDA – NRCS Wisconsin TN-5, TN-6, TN-7 and TN-8 regarding vegetation establishment and species selection for wildlife food and habitat.

Consider mowing or other mechanical disturbance of vegetation outside of the primary nesting season for ground-nesting birds.

Consider trap strip designs that result in multiple structural levels of vegetation within the strip to maximize wildlife use.

The effectiveness of cross wind trap strips is maximized when strips are oriented as close to perpendicular to the most erosive wind events for the period for which the system is designed.

Selection of plants for use in trap strips should favor species or varieties tolerant to herbicides used on adjacent crops or other land uses.

Consider the use of other WI NRCS Conservation Practice Standards such as residue management practices (329 or 345); Herbaceous Wind Barriers (603); Strip Cropping (585); or Windbreak/ Shelterbelt Establishment (380) with trap strips to maximize snow distribution, enhance wildlife cover and improve the trapping capability of strips.

PLANS AND SPECIFICATIONS

Specifications for establishment and maintenance of this practice shall be prepared for each field or treatment unit according to the Criteria, Operation and Maintenance described in this standard to meet the planned purpose(s).

The following are the minimum specifications to include:

- Purpose(s) of the trap strips.
- Location and orientation of trap strips.
- Width of the trap strip(s).
- Width of the crop interval or distance between trap strips.
- Seedbed preparation, timing, and seeding method.
- Liming and fertilizer applications, where applicable shall include form, rates, timing and method of application of soil amendments
- Species selected and seeding rates based on pure live seeds.
- Height of vegetation to be maintained during the critical crop stage periods.
- Time of mowing and/or harvests, where applicable.

Specifications shall be recorded using Wisconsin NRCS Job Sheet 589C Cross Wind Trap Strips or other documents that include all plans and specification requirements in this section.

OPERATION AND MAINTENANCE

After establishment, perennial trap strips shall be fertilized as needed to maintain plant vigor.

Noxious weeds shall be controlled.

Mowing or grazing of trap strips shall be managed to allow re-growth to the planned height before periods when wind erosion or crop damage is expected to occur.

When feasible, schedule harvest, mowing or other mechanical disturbance of vegetation outside of the primary nesting season for ground-nesting birds.

Wind-borne sediment accumulated in trap strips shall be removed and distributed over the surface of the field as determined appropriate and trap strips shall be re-established if necessary.

Trap strips shall be re-established or relocated as needed to maintain plant density, width, and height.

Periodically evaluate the trap strip effectiveness to meet the planned purpose(s).

FEDERAL, TRIBAL, STATE, AND LOCAL LAWS

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REFERENCE

USDA, Natural Resources Conservation Service, National Agronomy Manual, 4th Edition, Feb. 2011. Website: http://directives.sc.egov.usda.gov/ Under Manuals and Title 190.

USDA – NRCS Wisconsin Agronomy Technical Note 7, "Cover and Green Manure Crops Benefits to Soil Quality"

USDA – NRCS Wisconsin Biology Technical Note 8 "Pollinator Biology and Habitat"

USDA – NRCS Wisconsin Agronomy Technical Note 5 Establishing and Maintaining Native Grasses, Forbs and Legumes

USDA – NRCS Wisconsin Agronomy Technical Note 6 Establishing and Maintaining Introduced Grasses and Legumes

USDA-NRCS Wisconsin Electronic Field Office Technical Guide (eFOTG), Section IV, Practice Standards and Specifications

USDA-NRCS Wisconsin Job Sheet 589C Cross Wind Trap Strips

Wind Erosion Prediction System (WEPS) website: http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/technical/tools/weps/

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NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

FIELD BORDER

CODE 386
(AC.)

DEFINITION
A strip of permanent vegetation established at the edge or around the perimeter of a field.

PURPOSES
This practice may be applied as part of a conservation management system to support one or more of the following:

- Reduce erosion from wind and water – Resource Concern (SOIL EROSION - Sheet, rill, & wind erosion
- Protect soil and water quality – Resource Concerns (SOIL QUALITY DEGRADATION – Compaction and WATER QUALITY DEGRADATION – Excess nutrients in surface and ground waters)
- Provide wildlife food and cover and pollinator or other beneficial organism habitat – Resource Concern (INADEQUATE HABITAT FOR FISH AND WILDLIFE – Habitat degradation)
- Increase carbon storage – Resource Concern (SOIL QUALITY DEGRADATION – Organic matter depletion)
- Improve air quality – Resource Concern (AIR QUALITY IMPACTS - Emissions of Particulate Matter - PM - and PM Precursors)

CONDITIONS WHERE PRACTICE APPLIES
This practice applies to cropland and grazing lands located around the inside perimeter of fields to support or connect other buffer practices within and between fields.

CRITERIA
General Criteria Applicable to All Purposes

Extent
Field borders will be established around the inside perimeter field edges to the extent necessary to address the identified resource protection needs and producer objectives.

All field borders shall be at least 20 feet wide and will be sized to accommodate the travel and turning needs of the current farm equipment. Minimum field border widths shall be based on local design criteria specific to the purpose for installing the practice.

Plant species, seedbed preparation, seeding rates, dates, depths, and planting methods will be consistent with Wisconsin NRCS Conservation Practice Standard (WI NRCS CPS) 342, Critical Area Planting, or 327, Conservation Cover. Refer to NRCS Wisconsin Agronomy Technical Note 5 (TN-5), Establishing and Maintaining Native Grasses, Forbs and Legumes, and NRCS Wisconsin Agronomy Technical Note 6 (TN-6), Establishing and Maintaining Introduced Grasses and Legumes, for specific details. Use Biology Technical Note 8 (TN-8) for specific pollinator habitat information.

Select grass/forb/legumes species that are persistent throughout the year, stiff-stemmed and having upright growth characteristics to trap wind and waterborne soil particles.

Field borders may be established by leaving appropriate areas of existing pasture or hay land vegetation when rotating to row crops where the existing cover is sufficient to control erosion.

Concentrated Flow Channels
Ephemeral gullies and rills present in the planned border area will be eliminated during seedbed preparation.

Ephemeral gullies and rills located immediately upslope from the planned border area shall be treated to ensure more of a sheet flow into the planned border area.

Additional Criteria to Reduce Erosion from Wind and Water
The amount of surface or canopy cover needed from the field border shall be determined using the current water and wind erosion prediction tools. Soil erosion estimates will account for all practices in the managed system.

Water Erosion Reduction
Install borders to protect sloping end rows, headlands, and other areas where concentrated water flows will enter or exit the perimeter or edge of a field. Orient plant rows as closely as possible, perpendicular to sheet flow direction.

If these areas are mowed or harvested for hay, the last cutting will not be later than September 1st for native species and September 15th for introduced species, to allow sufficient time for the vegetation to recover prior to a killing frost.

The minimum height of grass, forbs or legumes shall be one foot during the critical erosion period (spring).

Wind Erosion Reduction
Provide a stable area on the upwind edge of the field as determined by prevailing wind direction data.

Plant stiff-stemmed, upright grasses to trap saltating soil particles.

The minimum height of grass, forbs and legumes shall be one foot during the critical erosion period (spring).

Field borders shall not be burned.

Additional Criteria to Protect Soil and Water Quality

Reducing Runoff and Increasing Infiltration

- Install borders where they will slow or collect surface runoff in locations where runoff enter and exit the field edges.
- The minimum width for this purpose shall be 30 feet and have a vegetation stem density with a retardance of moderate to high (e.g. equivalent to a good stand of wheat).
- Field borders shall not be burned.
- Design widths must comply with all applicable state and local regulations relating to manure and chemical application setbacks. Refer to WI NRCS CPS 590, Nutrient Management.

Reducing Soil Compaction from Equipment Parking and Traffic

- Border widths will be designed to accommodate equipment turning, parking, loading/ unloading during planting and harvest operations. If cover is destroyed by this use, it shall be re-established.
- Field Borders shall not be used as a field road.

Additional Criteria to Provide Wildlife Food and Cover and Pollinator or other Beneficial Organism Habitat

- The minimum width for this purpose shall be 30 feet.
- After establishment the entire field border shall not be mowed. Spot treatment is required for noxious weeds or invasive plants throughout the growing season. Mowing is allowed after August 1st and before September 1st for native species and before September 15th for an emerging weed problem.
- Mowing, harvesting, and pesticide applications shall be scheduled to accommodate life cycle requirements of pollinators and other beneficial organisms. Avoid unnecessary vehicle traffic in field border areas. Try to keep the cover at an optimum successional state for target wildlife species.
- For pollinator animals and other beneficial organisms that prey on target pests, select diverse plant species that meet dietary, nesting and cover requirements for the intended species. Refer to TN-5 and TN-6 for a list of approved plant species and Wisconsin Biology Technical Note 8 for a list of herbaceous and woody plants. Use WI NRCS CPS, 612, Tree Planting for pollinators and other beneficial organisms and targeted wildlife species.
- When wildlife or pollinators are a targeted concern, lower groundcover is allowed as long as soil erosion is controlled.
- Select species that provide adequate habitat food source and cover for the wildlife species of interest.

Additional Criteria to Increase Carbon Storage

- Establish plant species that produce large amounts of above- and below-ground biomass to provide increase soil organic matter and improve soil quality.
- Maximize the length and width of herbaceous border to fit the site and increase total biomass.
- Field borders shall not be burned.
- The roots of established vegetation shall not be disturbed with any soil disturbing tillage operation.

Additional Criteria to Improve Air Quality

- Establish plant species with morphological characteristics that optimize interception and adhesion of airborne particulates.
- Select plants with persistent roots and residue that stabilize soil aggregates and mitigate the generation of airborne particulates.
- The file border shall not be burned when the objective is to improve air quality.
- Establish species resistant to damage from equipment traffic.

CONSIDERATIONS

The following statements below are planning recommendations relating to the use of this practice:

Considerations to enhance wildlife and/or pollinator value

- Field borders can serve as corridors to connect existing and planned habitat blocks.
- To minimize wildlife mortality and habitat degradation, turn or drive machinery on field borders only when necessary, at low speed, and with implements fully raised.
- Consider over-seeding existing vegetation in the border with legumes for plant diversity and wildlife benefits.
- Rows of shrubs adjacent to field borders will often enhance the ability of the field borders to harbor beneficial insects, and may also provide additional wildlife benefits.
- When enhancement of wildlife habitat is a purpose, plantings that result in multiple structural levels of vegetation will maximize wildlife use.
- Overseed the forb content to increase plant diversity for pollinator and wildlife species.
- Native plants are best suited for wildlife and pollinator habitat enhancements. Use native plants if producer objectives allow it and site conditions are adapted. Include native plants that provide diverse pollen and nectar sources.
- To reduce nesting fatality, mow turn strips early to reduce nesting attractiveness.

Considerations for organic production

- Where genetic drift is a concern, use buffer vegetation to create a barrier between the pollen producing crop and the crop that must be protected or increase the distance between them so that cross-pollination is less likely.
- Organic producers may need to submit plans and specifications to their certifying agent for approval prior to installation of the field border, as part of the organic producer's Organic System Plan.

Considerations for design criteria

- Design border widths to comply with state and local regulations.
- To maximize multiple resource concerns, consider planting field borders around the entire perimeter of the field.
- To facilitate turning, consider sizing field borders at least 1.5 times as wide as the longest combination of farm equipment used on the field.
- To increase trapping efficiency, consider establishing a narrow strip of stiff-stemmed upright grass at the crop/field border interface.
- Diversions or waterways may be needed to break up or redirect concentrated water flows within the borders.
- Consider plants tolerant to sediment deposition and chemicals planned for application.
- Consider potential shading issues and plan species for those locations accordingly.

- Consider installing contour buffers, strip cropping, reduced tillage, or other conservation practices on adjacent cropland to reduce excessive sedimentation of field borders.

PLANS AND SPECIFICATIONS

Plans and specifications are to be prepared for the practice site. The following items should be recorded using the WI NRCS CPS Job Sheet 386, Field Borders:

- Field border widths and lengths based design criteria,
- field border location within the field or farm boundary,
- species to be used, and planting rate,
- site preparation,
- planting method and timing,
- liming or fertilizer requirements, and
- operation and maintenance requirements.

OPERATION AND MAINTENANCE

Field borders require careful management and maintenance for performance and longevity.

The following will be planned and applied as needed:

- Repair storm damage areas.
- Remove sediment accumulations at the field border and cropland interface.
- Shut off sprayers and raise tillage equipment to avoid damage to field borders.
- Shape and reseeding border areas damaged by chemicals, tillage, or equipment traffic.
- Fertilize, mow, harvest, and control noxious weeds to maintain plant vigor.
- Ephemeral gullies and rills that develop in the border will be filled and reseeded.
- Avoid vehicle traffic when soil moisture conditions are saturated.
- Avoid cover disturbance during nesting season.
- Do not use the field border as a hay yard or machinery parking lot for any extended period of time, especially if doing so will damage or impair the function of the field border.
- Maintain effectiveness of border by lining, fertilizing, mowing, disking and interseeding.
- Control noxious weeds.
- If compaction and vehicle traffic degrade field border, consider vertical tillage to increase infiltration prior to re-establishment. This shall be a rare occurrence.
- When managing for wildlife, maintenance activities that result in disturbance of vegetation should not be conducted during the primary nesting, fawning and calving seasons. Activities should be timed to allow for regrowth before the growing season ends whenever possible.
- Periodic removal of some products such as medicinal herbs, nuts, and fruits is permitted provided the conservation purpose is not compromised by the loss of vegetation or harvesting disturbance.
- Maintain records of the field border maintenance as needed by the land user.

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 field borders. This standard does not contain the text of federal, tribal, state, or local laws.

REFERENCES

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Sources of Organic and Untreated Non-GMO Seeds. National Sustainable Agriculture Information Service. http://attra.ncat.org/sorg/seeds.html

USDA, NRCS Wisconsin Field Office Technical Guide, Section IV, Conservation Practice Standards and Specifications.

USDA, NRCS Wisconsin Agronomy Technical Note 5, Establishing and Maintaining Native Grasses, Forbs and Legumes.

USDA, NRCS Wisconsin Agronomy Technical Note 6, Establishing and Maintaining Introduced Grasses and Legumes.

USDA, NRCS Wisconsin Biology Technical Note 8, Pollinator Biology and Habitat.

USDA, NRCS, Conservation Practice Job Sheet 386, Field Border.

USDA, NRCS, Wisconsin NRCS eFOTG Conservation Practice Standard Tree Planting (612).

USDA-AMS National Organic Program Regulations, 7 CFR Part 205. http://www.ams.usda.gov/AMSv1.0/nop

Wind Erosion Prediction System (WEPS) website: http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/technical/tools/weps/

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NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

FISH RACEWAY OR TANK

CODE 398
(NO.)

DEFINITION

A channel or tank with a continuous flow of water constructed or used for high-density fish production.

PURPOSE

A fish race way or tank provides:

- A facility containing flowing water of suitable temperature and quality for dependable production of fish.
- Allows for the manipulation of chemical, physical, and biological factors to enhance fish production.

CONDITIONS WHERE PRACTICE APPLIES

This standard applies to raceways or tanks that conduct flowing water to produce fish. It applies to earthen channels as well as channels and tanks constructed of concrete, concrete block, timber, rock, fiberglass, or other materials.

CRITERIA

General Criteria Applicable to All Facilities

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.

Design a facility to provide protection from flooding, sedimentation, and contamination by pollutants from outside sources.

Design raceway or tank dimensions based upon the available water and planned production level. Water Quantity. Maintain a water supply of sufficient volume to produce the desired species, either by gravity flow or by pumping. Generally, this amount would equate to two complete water exchanges per hour for a raceway length of 80 to 100 ft. Measure the water volume during periods of low flow.

Water Quality. Supply water free of harmful gases, minerals, silt, pesticides, and other contaminants. Conduct a water analysis before design and construction unless previous use or experience indicates the satisfactory water quality for the desired species. Table 1 provides an example of water quality requirements for trout and catfish. Unique water quality parameters may apply to other species.

Table 1. Water quality requirements

Quality parameter		Species	
		Trout	Catfish
Dissolved oxygen	Desirable minimum	8 ppm or > 5 ppm	5 ppm or > 3 ppm
Temperature (ºF)	Desirable min./max.	55 – 64 45 / 70	75 – 84 70 / 90
pH	Desirable min./max.	6.5 – 9.0 6.0 / 9.5	6.5 – 9.0 6.0 / 9.5
Carbon dioxide	Desirable min.*/max.	2 ppm or < 0 / 3 ppm	5 ppm or < 0 / 10 ppm

*Toxicity varies with dissolved oxygen concentration, temperature and pH.

Predator control. As needed, provide fences, screens, nets, wires, or other materials to prevent the loss of fish to predators. Place traps or other devices potentially harmful to humans, livestock, or pets in secure locations not normally accessible except through special effort. Wisconsin Department of Natural Resource may require a license or permit to perform such activities.

Waste management. Develop plans for treatment, storage, or use of waste generated or caused by the operation of fish raceways or tanks. Such components may include the construction of Wisconsin NRCS Conservation Practice Standard (WI NRCS CPS) 313, Waste Storage Structures; 359, Waste Treatment Lagoons; settling basins, or other facilities. Spread waste in accordance with WI NRCS CPS 590, Nutrient Management. Discharges into streams must meet State standards for the stream, based on size of the operation, and comply with National Pollutant Discharge Elimination System (NPDES) regulations.

Criteria Applicable to Linear Channel Raceways

Raceways generally consist of linear channels where water flows in at one end and exits at the other end. Linear channel raceways generally consist of two types:

- **Concrete or concrete block construction.** Design and construct raceways in accordance with NRCS National Engineering Manual (NEM), Part 536, Structural Design. When designing concrete or concrete block raceways, use the same design material for the bulkheads or check dams.
- **Earthen channels constructed with a trapezoidal or parabolic cross section**. Design raceways with a trapezoidal or parabolic cross section. Design bottom widths based on the volume of water available, but not less than 4 ft. Design side slopes 1:1 or flatter, depending on a slope stability analysis. Design and construct side slopes and bottoms of raceways with smooth and uniform surfaces to minimize dead water areas.

Grade. Wherever possible, design and construct raceways with a minimum bottom grade of 0.5 ft. per 100 ft. The raceway outlet will control the water surface grade.

Length. Determine the maximum length of each raceway section by site topography and need for reaeration of the water, but no more than 100 ft. For the design of raceway sections in series, install a bulkhead or check dam at the lower end of each section.

Width. Select the width of individual raceways considering the available water supply, harvesting equipment and operating and maintenance needs of the system.

Freeboard. The minimum difference in elevation between the water surface in the raceway and the top of the bulkhead, dike, or levee alongside the raceway is 0.5 ft.

Dikes and levees. Design a 6 ft.-minimum top width of an earthen dike or levee. Use 2:1 or flatter side slopes for portions of earthen dikes and levees above the water surface. Use a 14 ft.-minimum top width and 3:1 or flatter side slopes when using the top of the dike or levee as a road.

Bulkheads. Place structural or earthen barriers called bulkheads across raceway channels to create shorter sections, to establish and maintain the desired water levels, and to provide aeration of the water. In addition to serving as a barrier, they shall have an opening or throat section that allows complete drainage to the bottom of the raceway channel unless providing other drainage facilities.

Design bulkheads using earth, concrete, concrete block, rock masonry, steel or other durable metal, treated timber or a combination of these as follows:

- Provide a minimum top width of 4 ft. and side slopes of 2:1 or flatter for earthen bulkheads.
- Provide a minimum top width of 6 in. and a minimum bottom width of 8 in. for reinforced concrete bulkheads.
- Extend concrete, concrete block, rock masonry, or steel bulkheads used in earthen raceways at least 24 in. into the sides and bottom of the channel.
- Design the opening or throat section of bulkheads using concrete, concrete block, wood, or metal.
- Provide slots or grooves along the vertical face that allow installation of flashboards and screens.
- Fill openings and cores in concrete blocks with either concrete or a mortar mix.

Drains. Provide a pipe drain with a minimum diameter of 6 in. at the bottom of the bulkhead or provide for flashboard removal to allow complete drainage. Where possible, design each unit in a series to allow drainage independent of the other units.

Screens. Provide screens at the inlet of the system if necessary to exclude wild fish. Provide screens at each bulkhead between sections and at the exit end to prevent loss of fish. Place screens at least 6 to 8 in. upstream from the flashboards and extend screens at least 6 to 8 in. above the expected water level to prevent fish escape from jumping. Design screen openings based on the size range of fish requiring separation. Maintain water velocity through screens slow enough to prevent impinging of fish against the screen.

Aeration. Fit each bulkhead with a weir overfall such as flashboards in the opening or throat section of the bulkhead. Design the width of the weir or weirs equal to the bottom width of the raceway, but not less than 4 ft. where using flashboards to establish the desired water level. Design two or more weirs separated by rigid center sections when the width of the raceway exceeds 8 ft. To increase aeration as part of the design, arrange a splash board or series of boards to create successive splashes or place nozzles in the tank above the water surface. Set the weir crest at least 1 ft. above the downstream water surface elevation.

Criteria Applicable to Tanks

Tanks generally have a circular, rectangular, or oval shape. Water enters a tank through nozzles or jets in a manner that creates a rotary circulation within the tank and typically discharge through the tank center by means of a standpipe or bottom drain.

Construct tanks using concrete, metal, fiberglass, or other suitable material capable of providing the strength and durability for the anticipated use. Noncircular tanks must have an interior dividing wall to obtain proper circulation. Construct tank raceways at locations accessible to water supplies, management personnel, and feed and harvest equipment.

Water supply. Install jets, nozzles or similar devices that provide a tangential force to the water in the tank. Locate submerged nozzles above the tank bottom to minimize the uplift of waste particles. In the Northern Hemisphere, position nozzles to direct flow counterclockwise; in the Southern Hemisphere, position nozzles to direct flow clockwise.

Waste removal. Incorporate provisions for waste removal in the design. Provide bottom troughs, screens, or center-positioned drainpipe as part of the tank construction.

CONSIDERATIONS

Fish and wildlife

Consider the impacts of cultivated nonnative fish on endemic fish populations.

Vegetation

Stockpile topsoil for placement on disturbed areas to facilitate revegetation. Consider selecting and placing vegetation to improve fish habitat, wildlife habitat and species diversity.

Water quantity

Consider effects upon components of the water budget, such as:

- Effects on volumes and rates of runoff, infiltration, evaporation, transpiration, deep percolation, and groundwater recharge.
- Variability of effects caused by seasonal or climatic changes.
- Effects on downstream flows and impacts to environment such as wetlands, aquifers, and social and economic impacts to downstream uses or users.

Water quality

Consider the effects of:

- Erosion and the movement of sediment, pathogens, and soluble and sediment-attached substances that runoff carries.
- Short-term and construction-related effects of this practice on the quality of downstream watercourses.

- Water-level control on the temperatures of downstream water to prevent undesired effects on aquatic and wildlife communities.
- Wetlands and water-related wildlife habitats.
- Water levels on soil nutrient processes such as plant nitrogen use or denitrification.
- Soil water level control on the salinity of soils, soil water, or downstream water.
- Potential for earth moving to uncover or redistribute toxic materials.
- Movement of dissolved organic and inorganic chemicals downstream and towards groundwater recharge areas.

PLANS AND SPECIFICATIONS

Prepare plans and specifications that describe the requirements for applying the practice according to this standard. As a minimum, include:

- A plan view of the layout of the facility and appurtenant features.
- Typical profiles and cross sections of the facility and appurtenant features as needed.
- Structural drawings adequate to describe the construction requirements.
- Requirements for vegetative establishment and/or mulching, as needed.
- Safety features.
- Site-specific construction and material requirements.

OPERATION AND MAINTENANCE

Prepare an operation and maintenance plan for the operator.

As a minimum, include the following items in the operation and maintenance plan:

- Periodic inspections of all structures, earthen embankments, and other significant appurtenances.
- Prompt repair or replacement of damaged components.
- Prompt removal of sediment when it reaches predetermined storage elevations.
- Periodic removal of trees, brush, and undesirable species.
- Periodic inspection of safety components and immediate repair if necessary.
- Maintenance of vegetative protection and immediate seeding of bare areas as needed.

REFERENCES

American Society for Testing and Materials. Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System), ASTM D2487. West Conshohocken, PA.

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NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

HERBACEOUS WEED CONTROL

CODE 315
(AC.)

DEFINITION

The removal or control of herbaceous weeds including invasive, noxious, and prohibited plants.

PURPOSE

This practice may be applied as part of a conservation management system to support one or more of the following purposes:

- Enhance accessibility, quantity, and quality of forage and/or browse.
- Restore or release native or create desired plant communities and wildlife habitats consistent with the ecological site.
- Protect soils and control erosion.
- Reduce fine-fuels fire hazard and improve air quality.

CONDITIONS WHERE PRACTICE APPLIES

This practice may be applied on all lands except active cropland where removal, reduction, or manipulation of herbaceous vegetation is desired.

For weed control on cropland, see Wisconsin NRCS Conservation Practice Standard (WI NRCS CPS) 595, Integrated Pest Management.

This practice does not apply to removal of herbaceous vegetation by prescribed burning or land clearing to facilitate a land use change.

CRITERIA

General Criteria Applicable to All Purposes

Prior to developing herbaceous weed control alternatives, the site shall be evaluated for the presence of threatened and endangered species. Herbaceous weed control alternatives shall avoid impacts to identified threatened and endangered species.

Herbaceous weed control will be applied in a manner to achieve the desired control of the target species and protection of desired species. This will be accomplished by mechanical, chemical, burning, or biological methods either alone or in combination. When burning is used as a method, WI NRCS CPS 338, Prescribed Burning, shall apply.

NRCS will not develop biological or chemical treatment recommendations except for biological control utilizing grazing animals. WI NRCS CPS 528, Prescribed Grazing shall be used to ensure desired results are achieved and maintained.

NRCS may provide clients with current acceptable biological and/or chemical control references to achieve desired management objectives.

When herbicides are used, environmental hazards and site-specific application criteria listed on pesticide labels and contained in UW Extension and other pest management references shall be followed.

When herbicides are used, the product(s) shall be evaluated utilizing the Windows Pesticide Screening Tool (WIN-PST). Mitigation practices shall be implemented to address WIN-PST risk ratings of Intermediate or higher. See Wisconsin NRCS Conservation Planning Technical Note 2 for detailed instructions on the use of WIN-PST. Mitigation practices shall be implemented to address any identified environmental risks.

Herbaceous weed control will include post treatment measures as needed to achieve resource management objectives.

Livestock and people access will be controlled based on management methods applied and restrictions as listed on the chemical labels.

Manage and/or dispose of treated weed species in a manner that will prevent the spread of herbaceous weeds to new sites.

Additional Criteria to Enhance Accessibility, Quantity, and Quality of Forage and/or Browse
Herbaceous weed control will be applied in a manner to minimize negative impact to forage and/or other non-targeted plants. Timing and sequence of control shall be planned in coordination with specifications developed for WI NRCS CPS 528, Prescribed Grazing, and/or 511, Forage Harvest Management.

Additional Criteria to Restore or Release Native or Create Desired Plant Communities and Wildlife Habitats Consistent with the Ecological Site
Apply herbaceous weed control in a manner to protect the health and vigor of native or desired plant species.

Use applicable Ecological Site Description (ESD) State and Landscape Transition models or other NRCS approved references to develop specifications that are ecologically sound and defensible. Treatments must be congruent with dynamics of the ecological site(s)and the plant community shall have the capability to support the desired planned plant community. If an ESD is not available, base specifications on the best approximation of the desired plant community composition, structure, and function.

Treatments will be conducted during periods of the year when weed species are most vulnerable in order to promote successful restoration of the native or desired plant communities and maintain or enhance important wildlife habitat requirements.

Treatments shall be avoided when the activity can spread weed seed or significantly impact non-target plants and animals.

Treatments will be conducted during periods of the year that accommodate reproduction and other life-cycle requirements of resident wildlife, pollinator species, and threatened and endangered species.

Apply treatments using appropriate timing and methods that will maintain or enhance plant community composition and structure to meet the requirements of the targeted wildlife species.

Additional Criteria to Protect Soils and Control Erosion
Apply herbaceous weed control methods that will minimize soil disturbance and soil erosion.

Additional treatment, such as mulching, cover crop, or vegetative establishment appropriate to the site, shall be applied to protect soils and prevent erosion.

Additional Criteria to Reduce Fine-Fuels Fire Hazard and Improve Air Quality
Treat weed species in a manner that creates a native or desired plant community which reduces the potential for accumulating excessive fuel loads and increased wildfire hazards.

Apply treatment methods in a manner that minimize the potential for unintended impacts to air resources such as smoke and chemical drift.

CONSIDERATIONS

Consider using WI NRCS CPS 595, Integrated Pest Management, scouting concepts, weed treatment thresholds and evaluation guidance to support use of herbaceous weed control.

Consider soil erosion potential and difficulty of vegetation establishment when choosing a method of control that causes soil disturbance.

Consider the appropriate time period and duration for treatment. Some herbaceous weed control activities may require multiple years of treatment to achieve desired objective.

Consider impacts to wildlife food supplies, space, and cover availability when planning the method and amount of herbaceous weed control. Mosaic patterns may be most desirable.

For air quality purposes, consider using chemical treatment methods of herbaceous weed control that minimize chemical drift and chemical usage.

Consider mechanical methods of herbaceous weed control that minimize the release of particulate matter into the air.

Consider adjacent land uses before chemicals are used.

Chemical pesticide treatments may require state licenses.

PLANS AND SPECIFICATIONS

Prepare plans and specifications for each field or treatment unit according to the criteria included in this standard. At a minimum, the herbaceous weed control practice plan shall include the following:

1. Goals and objectives statement.
2. Plan map and soil map for the site.

3. Pre-treatment cover or location and density of the target plant(s) and the planned post-treatment cover or density and desired outcome described as an ecological state or narrative.
4. Maps, drawings, and/or narratives detailing or identifying areas to be treated, pattern of treatment (if applicable), and areas that will not be disturbed.
5. A monitoring plan that identifies what shall be measured (including timing and frequency) and the changes in the plant community (compare with objectives) that will be achieved.

Mechanical Treatment Methods

Plans and specifications will include items 1 through 5 above, and the following documentation:

- Type of equipment to use for management including pre and post treatment protocols for cleaning of equipment.
- Dates of treatment for effective management.
- Equipment operating instructions provided by the manufacturer (if applicable).
- Treatment techniques and procedures to be followed.

Chemical Treatment Methods

Plans and specifications will include items 1 through 5, above, and the following documentation:

- A copy of the acceptable chemical treatment references for containment and management of target species.
- Planned application dates, rates, formulation and techniques.
- Evaluation and interpretation of herbicide risks associated with the selected treatment(s) using WIN-PST, product label information and mitigation practices and techniques are implemented.
- Any special mitigation, timing considerations or other factors (such as soil texture and organic matter content) that must be considered to ensure the safest, most effective application of the herbicide.
- Reference to product label instructions and restrictions.

Biological Treatment Methods

Plans and specifications will include items 1 through 5, above, and the following documentation:

- A copy of the acceptable biological treatment references for the selected biological agent used to contain and manage the target species.
- Release date, kind, source, and number of agents.
- Timing, frequency, duration and intensity of grazing, browsing, or treatments with biocides/pests.
- Desired degree of grazing or browsing used for effective management of target species.
- Maximum allowable degree of use on desirable non-target species.
- Special mitigation, precautions, or requirements associated with the selected treatment(s).

OPERATION AND MAINTENANCE

Operation

Herbaceous weed control practices shall be applied using approved materials and procedures.

Operations will comply with all local, state, tribal, and federal laws and ordinances.

Success of the practice shall be determined by evaluating regrowth or re-occurrence of target species after sufficient time has passed to monitor the situation and gather reliable data. Length of evaluation periods will depend on the herbaceous weeds species being monitored, proximity of propagules (seeds, plant materials and roots) to the site, transport mode of seeds (wind or animals) and methods and materials used.

All methods of pest management activities must comply with federal and state regulations.

Compliance with the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA); and Worker Protection Standard (WPS) is required.

All methods of pesticide use must comply with the current product label and Wisconsin laws such as Administrative Code Chapters ATCP 29, Pesticide Use and Control; ATCP 30, Pesticide Product Restrictions; and ATCP 31, Groundwater Protection Program, administered by the Wisconsin Department of Agriculture, Trade and Consumer Protection(DATCP).

All incidents of accidental release of pesticides that may cause adverse environmental effects shall be reported to the Wisconsin Spill Hotline at 1-800-943-0003.

The operator will develop a safety plan for individuals exposed to chemicals, including telephone numbers and addresses of emergency treatment centers and the telephone number for the nearest poison control center. The National Pesticide Information Center (NPIC) telephone number in Corvallis, Oregon, may also be given for non-emergency information: 1-800-858-7384, Monday to Friday, 8:30 a.m. to 6:30 p.m. Central Time.

The National Chemical Transportation Emergency Center (CHEMTRAC) telephone number is 1-800-424-9300.

When applying herbicide products:

- Follow label requirements for mixing/loading setbacks from wells, intermittent streams and rivers, natural or impounded ponds and lakes, and reservoirs.
- Post signs, according to label directions and/or federal, state, tribal, and local laws, around fields that have been treated. Follow restricted entry intervals.
- Dispose of herbicide and herbicide containers in accordance with label directions and adhere to federal, state, tribal, and local regulations.
- Read and follow label directions and maintain appropriate Material Safety Data Sheets (MSDS). MSDS and herbicide labels may be accessed on the Internet at: http://www.greenbook.net/.
- Calibrate application equipment according to recommendations before each seasonal use and with each major chemical and site change.
- Replace worn nozzle tips, cracked hoses, and faulty gauges on spray equipment.
- Maintain records of plant management for at least two years. Herbicide application records shall be in accordance with USDA Agricultural Marketing Service's Pesticide Record-keeping Program and state-specific requirements.

Maintenance

Following initial application, some regrowth, re-sprouting, or re-occurrence of herbaceous weeds may be expected. Spot treatment of individual plants or areas needing re-treatment should be completed as needed when weed vegetation is most vulnerable to desired treatment procedures.

Review and update the plan periodically in order to incorporate new Integrated Pest Management technology; respond to grazing management and complex weed population changes; and avoid the development of weed resistance to herbicide chemicals.

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 herbaceous weed control. This standard does not contain the text of federal, tribal, state, or local laws.

REFERENCES

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Evers, R.A., and R.P. Link. 1972. Poison Plants of the Midwest and Their Effects on Livestock. Special Publication 24, University of Illinois – College of Agriculture, Urbana, IL.

Hamilton, G.W., and J.R. Mitchell. 2001. Poisonous Plants in Pastures. University of New Hampshire Cooperative Extension Service, Durham, NH. Available at http://extension.unh.edu/resources/representation/Res_ource000623_Rep645.pdf.

DeWolf , G. and M. Hondalus. 1988. Common Massachusetts plants poisonous to horses. University of Massachusetts Cooperative Extension Service, Amherst, MA.

USDA, NRCS Wisconsin Field Office Technical Guide (FOTG), Section IV, Practice Standards and Specifications.

USDA, NRCS Wisconsin Job Sheet 315 Herbaceous Weed Control

USDA, NRCS Wisconsin Conservation Planning Technical Note 2, Companion Document to NRCS FOTG Standard 595, Pest Management.

University of Wisconsin Extension Publication A3690, Protecting Wisconsin's Resources through Integrated Weed Management.

University of Wisconsin Weed Science Research, http://ipcm.wisc.edu/Publications/WeedSciencepubli_cations/tabid/116/Default.aspx.

Wisconsin Administrative Code, Department of Agriculture, Trade and Consumer Protection, Chapter ATCP 29, Pesticide Use and Control.

Wisconsin Administrative Code, Department of Agriculture, Trade and Consumer Protection, Chapter ATCP 30, Pesticide Product Restrictions.

Wisconsin Administrative Code, Department of Agriculture, Trade and Consumer Protection, Chapter ATCP 31, Groundwater Protection Program.

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NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

MULCHING

CODE 484
(AC.)

DEFINITION
Applying plant residues, or other suitable materials produced off site to the land surface.

PURPOSE
This practice may be applied as part of a conservation management system to support one or more of the following purposes:

- Conserve soil moisture – Resource concern (INSUFFICIENT WATER –Inefficient moisture management).
- Reduce energy use associated with irrigation – Resource concern (INEFFICIENT ENERGY USE – Farming/ranching practices and field operations and INSUFFICIENT WATER – Inefficient moisture management).
- Provide erosion control – Resource concern (SOIL EROSION– Excessive bank erosion from streams shorelines or water conveyance channels, and/or SOIL EROSION – Concentrated flow erosion, and/or SOIL EROSION - Sheet, rill, & wind erosion).
- Facilitate the establishment of vegetative cover – Resource concern (DEGRADED PLANT CONDITION – Undesirable plant productivity and health).
- Improve soil health – Resource concern (SOIL QUALITY DEGRADATION –Organic matter depletion).
- Reduce airborne particulates – Resource concern (AIR QUALITY IMPACTS - Emissions of Particulate Matter - PM - and PM Precursors).

CONDITIONS WHERE PRACTICE APPLIES
This practice applies to all lands where mulches are needed. This practice may be used alone or in combination with other practices.

CRITERIA
General Criteria Applicable to All Purposes
The type of mulching material selected shall be based on cost, time of year, soils, percent slope, anticipated runoff velocities, and landscape position.

If the area to be mulched is to be seeded, see Wisconsin NRCS Conservation Practice Standard (WI NRCS CPS) 342, Critical Area Planting.

Mulch shall consist of either natural and/or artificial materials such as plant residue including straw, grass hay, wood chips, bark and wood fiber, gravel, or other equivalent manufactured materials to achieve the intended effect for the required time period.

The mulch material shall be evenly applied and, if necessary, anchored to the soil.

Mulch material shall be of a quality to meet the intended purpose.

Criteria for Site Preparation

Soil surface shall be prepared prior to the application of the mulch material in order to achieve desired purpose and to ensure optimum contact between soil and mulch. All areas to be mulched shall be reasonably smooth and free of rills, gullies, and debris.

Concentrated flow sources above the site where mulch is applied shall be diverted, or mulch designed to withstand anticipated runoff velocities shall be used.

Criteria for Materials

Mulch material shall be relatively free of disease, pesticides, chemicals, noxious weed seeds, and other pests and pathogens.

Criteria for Application

- Mulch application applies to both seeded and unseeded areas.
- Mulch shall be applied immediately after seeding or after final grading for unseeded areas.
- The mulch material shall be evenly applied.
- Manufactured mulches should be applied according to the manufacturer's specifications.
- Crimping (disking), wood cellulose fiber, tackifiers, netting, pinning, or other acceptable methods of anchoring will be used if needed to hold the mulch in place. Criteria are described in V.B. Mulch Anchoring Methods.

Mulch Application Rate

Table 1: Guide to Mulch Materials, Rates and Uses

Mulch Materials	Quality Standards	Application Rates		Depth of Application	Anchoring Method	Advantages/ Limitations
		Per 1000 ft.^{2}	per acre			
Organic Mulches						
Grass hay, small grain, straw	1. Air-dried 2. Free of undesirable seeds 3. Free of coarse material and moldy chunks 4. Grass hay should be 2/3 grass residue	75-100 lbs. or 2-3 bales	1.5-2.0 tons or 70-100 bales	Minimum surface coverage of 70% to 90% and 1 to 2 inches thick	*SEE NEXT PAGE	1. Good to use where mulch is needed up to three or more months 2. Most common mulch material used 3. Good for erosion control

Mulch Materials	Quality Standards	Application Rates		Depth of Application	Anchoring Method	Advantages/ Limitations
		Per 1000 ft.^{2}	per acre			
Organic Mulches						
Wood chips or wood bark	1. Green or air dried 2. Free of objectionable material 3. Chips or shavings from hardwood species are preferred	400- 450 lbs.	8-9 tons per acre and 80% ground cover	Minimum of 80% surface coverage	Anchoring is optional. Optional uses: Polypropylene plastic netting, peg and twine, pinning	1. Most effective as a mulch around ornamentals, small fruit and other nursery stock 2. May require 30- 40 lbs. of Nitrogen per ton of material to prevent nitrogen deficiency during decay
Wood cellulose fiber mulch	Made from natural wood fiber	50 lbs.	¾ ton to 1 ton	N/A	Anchoring is not required unless slopes exceed 3:1	1. Must apply with Hydro-mulcher 2. May be used to tack straw mulch

* Options for anchoring may include: 1.) Mulch anchoring tools or serrated disk to embed mulch 2-3 inches deep, 2.) Wood cellulose fiber (when used reduce hay or straw to a rate of 3000 lbs. per acre and wood cellulose fiber to 750 lbs./ac.), 3.) Nontoxic binding material (tackifier, soil stabilizer, etc.). Spray uniformly to mulch material. Rates shall be applied according to the manufacturer's recommendations, 4.) Polypropylene plastic or jute netting; applied over mulch according to manufacturer's recommendations.

Note: Straw mulch should be stabilized to prevent mulch from being transported by wind or water.

Mulch Materials	Quality Standard	Application Rates		Depth of Application	Anchoring Method	Advantages/ Limitations
		per 1000 ft.^{2}	per acre			
Fiber Blankets, Mats and Nettings*						
Excelsior wood fiber blanket	1. Interlocking web of excelsior wood fibers 2. 80% of fibers are 6" or longer	Cover area requiring protection.		N/A	** Follow manufacturer's recommendation for placement and anchoring of netting/matting specifications. Generally anchored at 6 inch spaces on heavy soils, 8 inches on friable soils, and 10 inches on sandy soils.	1. Intended for use in high water velocity conditions. 2. Used without additional mulch. 3. Effective for erosion control on steep slopes. 4. Can be used around tree and shrub plantings to suppress weed growth. 5. Must have good contact with the soil to minimize rodent habitation.

Mulch Materials	Quality Standard	Application Rates		Depth of Application	Anchoring Method	Advantages/ Limitations
		per 1000 ft.^{2}	per acre			
Fiber Blankets, Mats and Nettings*						
Chopped straw mat	½" layer of chopped straw knitted into polypropylene netting	See manufacturer's recommendation for placement and anchoring of netting/ matting specifications. 1.25 rolls per 1000 square feet or 55 rolls per acre or cover entire area to be protected.		N/A	** Follow manufacturer's recommendation for placement and anchoring of netting/matting specifications.	1. Effective on steep slopes. 2. No additional mulch needed.
Paper mat	Plastic netting interwoven with paper	See manufacturer's recommendation for placement and anchoring of netting/ matting specifications. Cover area to be protected.		N/A	** Follow manufacturer's recommendation for placement and anchoring of netting/matting specification.	Additional mulch is not necessary.

* On slopes, matting and/or netting placement/orientation is allowed up and down or perpendicular to the slope. In areas of concentrated flows, mats and nets shall be laid parallel to the direction of flow and spread evenly without stretching to allow maximum contact with the soil. Adjacent edges should overlap a minimum of 3 inches with the adjoining mat or net, or according to manufacturer's recommendations.

Mulch Materials	Quality Standards	Application Rates		Depth of Application	Anchoring Method	Advantages/ Limitations
		per 1000 ft.^{2}	per acre			
Inorganic Mulch						
Polypropylene plastic Use degradable net (WI DOT Class I Type A, Class II Type C)	2-4 millimeters.	Variable up to 50 ft. wide.		N/A	Soil and stones Do not use where concentrated flow exists	1. Use black for weed control 2. Effective for moisture conservation 3. Large areas should have slits or holes to let rainfall percolate 4. May need to remove if plastic does not degrade
Gravel	1. Washed 2. ¾ to 2" in diameter	8 cubic yds. per 1000 ft.^{2}		3/4 to 2-inch deep and 90% ground coverage	N/A	Use on short slopes 1. Use around woody plants and ornamentals 2. Use in areas subject to heavy traffic

Mulch Anchoring

- On slopes, mats and nets may be run either up and down or cross slope. In areas of concentrated flow, mats and nets shall be laid parallel to the direction of flow and spread evenly without stretching to allow maximum contact with the soil.
- Adjacent edges should be overlapped a minimum of 3 inches with the adjoining mats or nets or according to manufacturer's recommendations.
- Staples of 11 gauge or heavier will be used to hold the mats and nets in place. Staples shall be U-shaped with a 1-inch crown.
- Staple length shall be determined based on soil condition.

Soil Condition	Staple Length
Highly compacted soils	6 inches
Friable soils	8 inches
Loose or sandy soils	10 inches

- Lay downstream blankets first, working upstream. The netting side of the blanket shall be on the top side after installation. Mat and net edges and middles will be stapled according to manufacturer's recommendations.

Peg and Twine

- After mulching, divide the area into blocks approximately one square yard in size.
- Drive 4 to 6 pegs per block to within 2 to 3 inches of the soil surface. Anchor mulch by stretching twine between pegs in a crisscross pattern on each block. Secure twine around each peg with two or more turns. Drive pegs flush with soil surface to allow mowing. Use on areas without concentrated flow.

Trenching or Weights

- Bury upper edge of plastic in a trench 6 inches deep. Compact the soil over plastic in the trench. Use stones to hold plastic down in other places as needed. Use on small areas without concentrated flow.

Pinning

- Cut mulch into soil surface with square edge spade or a dull disk. Make cuts in contour rows. Use on small areas without concentrated flow.

Soil

- Small areas of mulch can be lightly covered with soil. The soil shall be free of stones and debris, and distributed over the mulch in a thin uniform layer. Use on small areas without concentrated flow.

Additional Criteria to Conserve Soil Moisture and Reduce Energy Use Associated with Irrigation

Mulch material applied to the soil surface shall cover at least 60 percent of the soil surface to reduce potential evaporation.

Additional Criteria to Provide Erosion Control and to Reduce Airborne Particulates
Mulch rate shall be determined using current erosion prediction technology to reach the soil conservation objective.

Nonporous, clear, infrared transmissible, and dark-colored material shall be used to raise soil and ambient air temperature below the mulch. Light-colored material will be used to cool soil and ambient soil temperature below the mulch. The mulch shall be applied to the desired soil and air temperature below the mulch can be achieved.

Additional Criteria to Facilitate the Establishment of Vegetative Cover
Mulch shall be applied at a rate that achieves a minimum of 70 percent ground cover to provide protection from erosion and runoff and allow adequate light and air penetration to the seedbed to ensure proper germination and emergence planting.

Additional Criteria to Improve Soil Health
Apply mulch materials with a carbon to nitrogen ratio (C:N) less than 30:1 so that soil nitrogen is not immobilized by soil biota. Mulch material with a C:N of less than 20:1 shall not be applied to an area of designed flow in watercourses.

The Soil Conditioning Index (SCI) shall be computed to assess soil quality impacts and to determine the type and rate of the mulching material for use. The computed SCI shall be of a positive value.

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:

- Consider mulching disturbed areas that will not have additional construction activity for 60 days, or completed sites that will not be permanently seeded for periods of 60 days or longer.
- Consider mulching of 100 percent of the treatment area.
- Consider application of mulch immediately after a precipitation event or watering to conserve soil moisture. Ensure soil under shallow rooted crops is moist, as these crops require a constant supply of moisture.
- Consider anchoring straw or hay mulch or keep mulch moist to prevent blowing in wind-prone areas.
- Consider the impact of mulch materials with a high water holding capacity and/or high impermeability to water droplets which may reduce the water availability to plants.
- Consider the potential of organic materials with C:N ratios of less than 20:1 to release reduce nitrogen to adjoining surface waters.
- Consider the potential for mulch to provide habitat for beneficial insects and provide pest suppression.
- Consider the mulch color impact on plant growth. Clear mulches allow profuse weed growth and may negate the benefits of soil warming. Black mulches provide effective weed control.
- Consider the potential for runoff from low permeability mulches (e.g., plastic) which may increase concentrated flow and erosion on un-mulched areas.

- Consider the potential for mulch to cause disease and pest problems. Keep mulch 3 to 6 inches away from plant stems and crowns where an identified risk is present. Additional weed control may be needed around the plant base area.
- Consider the potential for deep mulch to provide nesting habitat for ground-burrowing rodents that can chew extensively on tree trunks and/or tree roots. Use of a light mulch applied after the first cold weather may prevent rodents from nesting.
- Consider the use of biodegradable staples in locations where wire staples are determined to be a risk.

PLANS AND SPECIFICATIONS

The purpose, plans and specifications shall be prepared for each site. The information shall be recorded on specification sheets, WI Job Sheet 484 Mulching, in the conservation plan record of decisions or other acceptable means of documentation.

Documentation shall include the following:

- Conservation plan map of all sites;
- purpose of the mulch;
- type of mulch material used;
- percent cover and/or thickness of mulch material;
- rate of mulch application (tons/acre, lbs. / square foot);
- timing of application;
- site preparation;
- listing of netting, tackifiers, or method of anchoring; and
- operation and maintenance.

OPERATION AND MAINTENANCE

Mulched areas will be periodically inspected, and mulch shall be reinstalled or repaired as needed to accomplish the intended purpose.

Evaluate the effectiveness of the mulch (application, amount of cover provided, durability, etc.) and adjust the management or type of mulch to better meet the intended purpose(s).

Removal or incorporation of mulch materials as necessary after use shall be consistent with the intended purpose and site conditions.

Operation of equipment near and on the site shall not compromise the intended purpose of the mulch.

Prevent or repair any fire damage to the mulch material.

Properly collect and dispose of artificial mulch material after intended use.

Monitor and control undesirable weeds in mulched areas.

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 field borders. This standard does not contain the text of federal, tribal, state, or local laws.

REFERENCES

Agriculture and Agri-Food Canada. 2000. Plastic mulches for commercial vegetable production. Canada-Saskatchewan Irrigation Diversification Centre. Outlook, Saskatchewan.

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USDA, NRCS. 2002. National Agronomy Manual. 190-V. Washington, D.C.

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NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

RESIDUE AND TILLAGE MANAGEMENT, REDUCED TILL

CODE 345
(AC.)

DEFINITION

Managing the amount, orientation, and distribution of crop and other plant residue on the soil surface year round while limiting the soil-disturbing activities used to grow and harvest crops in systems where the entire field surface is tilled prior to planting.

PURPOSE

This practice may be applied as part of a conservation management system to support one or more of the following purposes:

1. Reduce sheet, rill, and wind erosion - Resource Concern (SOIL EROSION - Sheet, rill, and wind erosion).
2. Reduce tillage-induced particulate emissions - Resource Concern (AIR QUALITY IMPACTS - Emissions of Particulate Matter - PM - and PM Precursors).
3. Maintain or increase soil quality and organic matter content - Resource Concern (SOIL QUALITY DEGRADATION - Organic matter depletion).
4. Reduce energy use - Resource Concern (INEFFICIENT ENERGY USE - Farming/ranching practices and field operations).
5. Increase plant-available moisture - Resource Concern (INSUFFICIENT WATER - Inefficient moisture management).

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to all cropland.

This practice includes tillage methods commonly referred to as reduced (conservation/mulch) tillage where the entire soil surface is disturbed by tillage operations such as chisel plowing, field cultivating, tandem disking, or vertical tillage. It also includes tillage/planting systems with few tillage operations such as ridge till, hoe drills, air seeders, and certain "no till" drills that do not meet the STIR criteria for WI NRCS Conservation Practice Standard (WI NRCS CPS) 329, Residue and Tillage Management, No Till.

CRITERIA

General Criteria Applicable to All Purposes

Residue shall not be burned.

The water and wind erosion prediction model inputs shall reflect any removal of crop residue from the soil surface.

Residues shall be uniformly distributed over the entire field.

Minimum planned residue levels will be maintained from harvest until after planting of the next crop. Removing residue from the row area prior to or as part of the planting operation is acceptable.

The Soil Tillage Intensity Rating (STIR) value shall include all field operations that are performed during the crop interval between harvest of the previous crop and harvest or termination of the current crop (includes fallow periods).

The annual STIR value rating shall be no greater than 80, and no primary inversion tillage implements such as a moldboard plow shall be used.

Additional Criteria to Reduce Sheet/Rill and Wind Erosion

Soil loss estimates shall be calculated for the dominate critical soil map units using the current erosion prediction technology; Revised Universal Soil Loss Equation (RUSLE2), for sheet and rill erosion, or the Wind Erosion Prediction System (WEPS).

Use the current erosion prediction model to determine:

- Minimum amount of randomly distributed surface residue required,
- Time of year the residue needs to be present on the field,
- The amount of surface soil disturbance allowed to reduce erosion to the desired level. All practices on the management system will be reflected, and
- For ridge-till systems, plan ridge height and ridge orientation to manage runoff and to minimize erosion, ridges shall have a maximum row grade of 4 percent.

Additional Criteria to Reduce Tillage Induced Particulate Emissions

Reduce or modify tillage operations that create dust, especially during critical air quality periods.

Avoid tillage activities during periods when the soil is most vulnerable to wind erosion.

Adopt tillage practices that reduce particulate emissions.

Additional Criteria to Maintain or Increase Soil Quality and Organic Matter Content

An evaluation of the cropping system using the current approved Soil Conditioning Index (SCI) procedure shall result in a output value of zero or higher.

Additional Criteria to Increase Plant Available Moisture

A minimum of 60 percent residue shall cover the soil surface throughout the year to reduce evaporation from the soil surface.

Fall tillage operations shall leave the crop stubble in an upright position to trap snow, as outlined below. Maintain the planned crop stubble height during the time when significant snowfall is expected to occur:

- At least 10 inches for crops with a row spacing of less than 15 inches,
- At least 15 inches for crops with a row spacing of 15 inches or greater, and
- Maintain these heights over at least 50 percent of the field.

Fall tillage operations shall be conducted perpendicular to the direction of prevailing winds, during the time that significant snowfall is expected to occur.

Additional Criteria to Reduce Energy Use

Reduce the total energy consumption associated with field operations by at least 25 percent compared to the benchmark condition. Use the current approved NRCS tool for determining energy use to document energy use reductions.

CONSIDERATIONS

General Considerations

Removal of crop residue, such as baling or grazing, can have a negative impact. These activities should not be performed without full evaluation of impacts on soil, water, animal, plant, and air resources.

Reduced till may be practiced continuously throughout the crop sequence, or may be managed as part of a residue management system that includes other tillage methods such as no till. Soil Tillage Intensity Rating (STIR) should be used to define acceptable tillage methods for specific sites.

Production of adequate amounts of crop residue necessary for the proper functioning of this practice can be enhanced by selection of high residue producing crops and crop varieties in the rotation, use of cover crops and adjustment of plant populations and row spacing.

When providing technical assistance to organic producers, residue management, and tillage activities should be consistent with the USDA - Agricultural Marketing Service National Organic Program Standard.

Considerations for Improving Soil Organic Matter Content

Carbon loss is directly related to the volume of soil disturbed, intensity of soil disturbance, soil moisture content, and soil temperature at the time the disturbance occurs. The following guidelines can make this practice more effective:

- Shallow soil disturbance (1-3 inches) tillage practices.
- When deep soil disturbance is performed, such as by sub-soiling or fertilizer injection, make sure the vertical tillage slot created by these implements is closed at the surface.
- Minimize soil disturbance by planting with a single-disk opener, planter or no-till drill.
- Soil disturbance that occurs when soil temperatures are below 50° F release less CO_2 than operations done on warmer soils, thus reducing organic matter losses.

Considerations for Improving Soil Health/Quality

Producers can achieve major improvements in soil health by using the following activities/ practices:

- Use a diverse crop rotation, incorporating multiple crop types (cool-season grass, cool-season legume/forb, warm-season grass, warm-season legume/forb) into the crop rotation.

- Plant a cover crop after every annually tilled crop in the rotation to increase the time the roots are actively growing in the soil. Multi-species cover crop mixes provide greater benefits than single-specie cover crops.
- Implement management strategies to increase soil organic matter levels.
- Use undercutting tillage tools rather than burying tillage tools to enhance accumulation of organic material in the surface layer.
- Conduct soil-disturbing field operation when soil moisture is optimal, in order to maintain soil tilth, and reduce the need for additional tillage in the future.

Considerations for Increasing Plant Available Soil Moisture

Leave stubble taller than the minimum required height to increase the soil humidity close to the soil surface and reduce the rate of evaporative loss from the soil.

Leave stubble taller to trap more snow.

Variable height stubble patterns may be created to further increase snow trapping and storage.

Perform all field operations on the contour to slow overland flow and increase infiltration, which increases water storage in the root zone.

Considerations to Reduce Energy Use

The Soil Tillage Intensity Rating (STIR) for each crop interval between establishment and harvest should be less than or equal to 80.

Considerations for Wildlife Food and Cover

Avoid tillage and other soil and residue/stubble disturbing operations during the nesting season and brood-rearing period for ground-nesting species.

Leave crop residues undisturbed after harvest (do no shred, bale, or till) to maximize the cover and food source benefits to wildlife during critical winter months.

Leaving rows of un-harvested crops standing at intervals across the field or adjacent to permanent cover will enhance the value of residues for wildlife food and cover. Leaving un-harvested crop rows for two growing seasons will further enhance the value of these areas for wildlife.

PLANS AND SPECIFICATIONS

Specifications for establishment and operation of this practice shall be prepared for each field or treatment unit. The specifications shall identify, as appropriate:

1. Resource concern to be treated or the purpose for applying the practice.
2. Location map with planned crops identified.
3. Summary of all field operations or activities that affect:
    - Amount of residue produced for each crop
    - Amount of residue cover with all field operations reflected
    - Residue orientation
    - Disturbance of the soil surface including all disturbances
4. The amount of residue (pounds/acre or percent surface cover) required to accomplish the planned purpose, and the time of year it must be present.

5. The maximum STIR value allowed to accomplish the planned purpose, and the time of year soil disturbance is allowed.
6. The minimum Soil Conditioning Index (SCI) value required to accomplish the purpose.

Record specifications in the client's case for each field on the Wisconsin Job Sheet 345, Residue and Tillage Management, Reduced Till.

OPERATION AND MAINTENANCE

Evaluate/measure the crop residues cover and orientation for each crop to ensure the planned amounts and orientation are being achieved. Adjust management as needed to achieve planned residue amount and orientation.

If there are areas of heavy residue accumulation as a result of harvest equipment or movement by water or wind in the field, spread the residue prior to planting so it does not interfere with planter operation.

FEDERAL, TRIBAL, STATE AND LOCAL LAWS

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

REFERENCES

Job Sheet 345 Residue and Tillage Management, Reduced Till

Soil Conditioning Index Fact Sheet located in the Conservation Planning section of Wisconsin's NRCS web page.

Soil Tillage Intensity Rating Fact Sheet located in the Conservation Planning section of Wisconsin's NRCS web page.

USDA, Natural Resources Conservation Service, Wisconsin electronic Field Office Technical Guide, Section I, Soil Erosion Prediction Models.

USDA, Natural Resources Conservation Service, Wisconsin electronic Field Office Technical Guide, Section IV, Standards and Specifications.

USDA, Natural Resources Conservation Service, Tillage Equipment Pocket Identification Guide, 2005.

USDA, Natural Resources Conservation Service, Wisconsin Agronomy Technical Note WI-4, Estimates of Residue Cover Remaining After Single Operation of Selected Machines.

USDA, Natural Resources Conservation Service, Tillage Practice Guide, 2006.

Kuepper, George, 2001. Pursuing conservation tillage systems for organic crop production-ATTRA. http://attra.ncat.org/attra-pub/organicmatters/conservationtillage.html

Reicosky, D.C., M.J. Lindstrom, T.E. Schumacher, D.E. Lobb and D.D. Malo. 2005. Tillage-induced CO2 loss across an eroded landscape. Soil Tillage Res. 81:183-194.

Reicosky, D.C. 2004. Tillage-induced soil properties and chamber mixing effects on gas exchange. Proc. 16th Triennial Conf., Int. Soil Till. Org. (ISTRO).

RUSLE2 Users Reference Guide: http://fargo.nserl.purdue.edu/rusle2_dataweb/RUSLE2_Index.htm

Shaffer, M.J., and W.E. Larson (ed.). 1987. Tillage and surface-residue sensitive potential evaporation submodel. In NTRM, a soil-crop simulation model for nitrogen, tillage and crop residue management. USDA Conserv. Res. Rep. 34-1. USDA-ARS.

USDA, Natural Resources Conservation Service, National Agronomy Manual, 190-V. 4th Ed.

Wind Erosion Prediction System Users Reference Guide: http://www.weru.ksu.edu/

DEFINITIONS

Revised Universal Soil Loss Equation (RUSLE2) - Revised Universal Soil Loss Equation Version 2 is a soil erosion prediction tool. RUSLE2 calculates on a daily basis the effects of erosivity factor rainfall (R), erodibility factor (Soil K value), slope length (L), slope steepness (S), cover management which includes crop rotation and all associated tillage (C), and supporting conservation practices (P).

Soil Conditioning Index (SCI) – A relative measurement that estimates the consequences of cropping systems and tillage practices on the soils condition as it relates to CO_2 losses. The SCI is calculated using the RUSLE2 programs and WEPS. A SCI value greater than zero indicates a net improvement in soil organic matter.

Soil Tillage Intensity Rating (STIR) – A relative measurement that compares the effect of various tillage operations throughout the growing season and rotation. The STIR value takes into consideration the number of tillage operations, the degree of soil disturbance such as depth, speed, type of equipment, along with the overall amount of soil surface disturbed. The STIR value is calculated using the RUSLE2 program. A smaller STIR value indicates a decreasing amount of soil disturbance which relates to soil health concepts.

Wind Erosion Prediction System (WEPS) - A process-based, daily time-step, computer model that predicts soil erosion via simulation of the fundamental processes controlling wind erosion.

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NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

SATURATED BUFFER

CODE 604
(FT.)

DEFINITION
A subsurface, perforated distribution pipe is used to divert and spread drainage system discharge to a vegetated area to increase soil saturation.

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

- To reduce nitrate loading to surface water from subsurface drain outlets.
- To enhance or restore saturated soil conditions in riverine, lacustrine fringe, slope, or depression hydrogeomorphic landscape classes.

CONDITIONS WHERE PRACTICE APPLIES
This practice is applicable to crop land with a subsurface drainage system that can be adapted to discharge to a vegetated area.

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

This practice does not apply to drainage systems or underground outlet systems that have surface inlets which allow entry of soil and debris capable of plugging the distribution pipe(s).

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

CRITERIA
General Criteria Applicable to All Purposes
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.

Conduct geologic and soil investigations to confirm:

- Conditions, such as a restrictive layer or a water table, are present to create saturated conditions when water is diverted from the subsurface drainage system.
- The absence of pockets or layers of high conductivity soil which could provide preferential flow paths.

- A minimum of 0.75 percent organic carbon (1.2 percent organic matter) in the top 2.5 feet of soil.
- The absence of abandoned drain pipes or clay tile in the buffer area that could continue to drain the buffer.

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

Locate and design the system to maximize the amount of subsurface drainage water distributed to the potentially saturated soil zone. Ensure there are no adverse impacts to adjacent lands.

Avoid placing the distribution pipe along any channels incised deeper than 8 feet, unless a slope stability analysis shows an acceptable level of safety against saturated streambank failure.

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

Flow. Use an appropriate model, such as DRAINMOD, to estimate flow into and through the saturated buffer. If such a model is unavailable, use the following to calculate minimum buffer dimensions:

- Soil saturated hydraulic conductivity and average drain flow rate during the growing season to compute the length of distribution pipe required to provide adequate infiltration capacity for the required design flow.
- Soil drainable porosity, saturated hydraulic conductivity, and elevation difference along with the lateral distance that leached water will travel from the distribution pipe to reach an outlet, to determine the retention time in the buffer. Minimum hydraulic retention time for the drainage water in the saturated buffer is 3 hours.

Minimum design flow into the saturated buffer is 15 percent of the maximum capacity of the drainage system.

Water control structure. Design the water control structure using the criteria found in WI NRCS Conservation Practice Standard (WI NRCS CPS) Structure for Water Control (Code 587). Locate the water control structure where it is accessible for water table observation and for operation and maintenance.

Design the water control structure to maintain the design water table elevation over the distribution pipe during the management period based on expected flow rates from the subsurface drainage system.

Use nonperforated pipe for the overflow pipe for the greater of 20 feet or a distance sufficient to avoid draining the saturated soil zone around the water control structure.

Distribution pipe. Design the distribution pipe and overflow pipe according to the criteria found in WI NRCS CPS Subsurface Drain (Code 606). Ensure the capacity of the distribution pipe is larger than the available infiltration rate of the soil.

Situate the distribution pipes on a topographic contour or grade to facilitate uniform groundwater inflow to the saturated zone. Add additional water control structures as needed for flow uniformity. The maximum elevation difference between structures is three feet.

Vegetation. Vegetate the soil saturation area and any other disturbed areas to prevent erosion and to utilize nitrogen from the drain water.

Protect all disturbed areas from erosion within 14 days of construction by seeding or mulching. Refer to WI NRCS CPS Conservation Cover (Code 327), or Critical Area Planting (Code 342) for criteria on seed selection, seedbed preparation, fertilizing, and seeding. The area shall be planted to a mix of hydrophytic species suitable for wet soil conditions.

Additional Criteria to Reduce Nitrate Loading

To reduce nitrogen loading, the saturated buffer will create a shallow water table.

Ensure saturated conditions are within the high soil organic carbon region of the soil profile when adequate drain flows exist. Design the system to maintain a water table within 12 inches of the ground surface at the location of the distribution pipe.

Additional Criteria to Enhance or Restore Saturated Soil Conditions

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

CONSIDERATIONS

Consider using other practices and management systems in conjunction with this practice to achieve a reduction of nitrate-nitrogen levels. Examples include WI NRCS CPS Nutrient Management (Code 590), Cover Crop (Code 340), Drainage Water Management (Code 554), Denitrifying Bioreactor (Code 605), and Constructed Wetland (Code 656).

Consider adding an envelope around the drain to improve exit flow. Refer to criteria in WI NRCS CPS Subsurface Drain (Code 606).

For cost-effectiveness, consider locating the saturated buffer where it will intercept a subsurface drain outlet draining at least 15 acres.

Consider installing observation wells in the buffer midway between the distribution pipe and the stream bank or shoreline to facilitate water table documentation and sampling.

A saturated buffer may infiltrate less overland flow than a nonsaturated buffer.

Consider measures to reduce the potential for root plugging of distribution lines by woody species. Set planted trees back far enough that distribution lines will not be under the drip line of mature tree canopies. Plant herbaceous species in areas over distribution lines. If the riparian area is currently in trees, either clear the trees or establish an herbaceous zone outside the tree line for the water distribution area.

PLANS AND SPECIFICATIONS

At a minimum, include the following in the plans:

- A plan view of the layout of the water distribution system.
- Profile(s) of the existing drain, distribution pipe, and outlet channel.
- Details of required structure(s) for water level control.
- Vegetation establishment requirements.
- Construction specifications that describe site-specific installation requirements.

OPERATION AND MAINTENANCE

Develop an operation and maintenance plan following the applicable criteria in WI NRCS CPS Drainage Water Management (Code 554). Review this plan with the land manager. Specified actions include normal repetitive activities in the application and use of the practice (operation), and repair and upkeep of the practice (maintenance). At a minimum, include a description of the following:

- Planned water level management and timing.
- Inspection and maintenance requirements of the water control structure(s), distribution pipe(s), and contributing drainage system, especially upstream surface inlets.
- Periodic removal of invasive trees or shrubs to reduce distribution line plugging.
- If the site is to be monitored, include the monitoring and reporting requirements designed to demonstrate system performance and provide information to improve the design and management of this practice. At a minimum, record water levels (elevations) at the control structure, observation ports, and if used, observation wells. Record water levels biweekly when a water table is present and following precipitation events that result in high flows.

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Jaynes, D.B. and T. Isenhart. 2012. Re-saturating Riparian Buffers using Tile Drainage. Unpublished.

Jaynes, D.B. and T.M. Isenhart, 2014. Reconnecting Tile Drainage to Riparian Buffer Hydrology. Journal of Environmental Quality 43:631-638. doi: 10.2314/jeq2013.08.0331. Advances in Agronomy 92:75-162.

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NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

STRIPCROPPING

CODE 585
(AC.)

DEFINITION
Growing planned rotations of erosion-resistant and erosion susceptible crops or fallow in a systematic arrangement of strips across a field.

PURPOSE
This practice may be applied as part of a conservation management system to support one or more of the following purposes:

- Reduce water erosion – Resource Concern (SOIL EROSION - Sheet, rill, & wind erosion)
- Reduce wind erosion – Resource Concern (SOIL EROSION - Sheet, rill, & wind erosion)
- Reduce the transport of sediment and other water and wind borne contaminants – Resource Concerns (Excess nutrients in surface and ground waters and WATER QUALITY DEGRADATION – Pesticides transported to surface and ground waters)
- Protect growing crops from damage by wind-borne soil particles – Resource Concern (DEGRADED PLANT CONDITION – Undesirable plant productivity and health)

CONDITIONS WHERE PRACTICE APPLIES
This practice applies on cropland.

CRITERIA
General Criteria Applicable to All Purposes
- Soil erosion shall be equal to or less than Tolerable levels as calculated utilizing the appropriate approved soil erosion prediction model.
- Strips of crops susceptible to erosion shall be alternated with strips of erosion-resistant crops
- The alternating crop rotation shall be followed on each adjacent strip to achieve the desired conservation planning objective.
- The orientation shall be at angles as close as practical to perpendicular to the critical wind and water erosion vectors.

Number of Strips and Strip Width
- A stripcropping system shall consist of two or more equal width strips in an alternating sequence of erosion-susceptible and erosion-resistant crops.

- Strip width shall be determined by the current erosion prediction tool and will not exceed the critical slope length for contouring.
- Strip widths shall be multiples of the width of the planting equipment and not narrower than the widest implement used.
- Soil loss shall account for the effects of other practices in the conservation management system.
- A minimum of two full strips must be planned on the "L" (slope length).

Alignment of Strips

- Strip boundaries shall run parallel to each other and as close to the contour as practical.
- Irregular correction strips may occur between adjoining contour strip cropping layouts as needed to adjust for changes in the land form. Normally an odd shaped cropped area will occupy the top and bottom of the hill or along the edges of fields.
- Sod turn strips will be used when contours become too sharp to keep machinery on contour. Establish sod turn strips on sharp ridge tops and/or valleys. Turn strips will be wide enough to allow equipment to be lifted or turned to meet the same rows across the turn strip.

Minimum Row Grade

- The crop rows shall have sufficient grade to ensure that runoff water does not pond and cause unacceptable crop damage. Soils with very slow infiltration rates (hydrologic groups C and D) will have a minimum absolute row grade of 0.2 percent on slopes where ponding is probable.

Maximum Row Grade

- The maximum grade of rows shall not exceed 4 percent or one half of the up and down hill slope percent used for erosion prediction, whichever is less.
- Up to a 25 percent deviation is permitted within 150 feet of a stable outlet such as a grassed waterway, field border, or other stable outlet.
- When the row grade exceeds the maximum allowable design criteria, a new keyline shall be established and used for layout of the adjoining contour pattern. All tillage and planting operations will follow the established contour line.

Stable Outlets

- Surface water flow from contour strip crop rows must be delivered to a stable outlet. Stable outlets for ephemeral gullies or concentrated flow channels include areas with established critical area seeding, grassed waterways, terraces, diversions, or water and sediment control basins.
- Headlands and end rows shall be protected from erosion when:
    - o the contour strip-cropping layout delivers runoff water toward the headland/end row, and
    - o the contour strip-cropping layout row grade toward the end rows is steeper than 4 percent.

Note: Field borders where utilized to protect end rows shall be sufficient width to accommodate turning farm equipment without additional end rows.

Vegetative Cover

- Vegetation in a strip-cropping arrangement consists of an alternating pattern of row crops and forages or other erosion-resistant crops grown in a planned rotation. At least 50 percent of the rotation shall consist of an erosion resistant cover.
- No two adjacent strips shall be in an erosion-susceptible condition at the same time during the year. However, two adjacent strips may be in erosion-resistant cover at the same time. Stagger the crop rotation to achieve this goal.
- A vegetative cover shall be selected that is tolerant of the anticipated depth of sediment deposition.
- When the erosion-resistant strip is in permanent vegetation, the species established shall either be tolerant to herbicides used on the cropped strips or protected from damage by herbicides used on the cropped strips.

Additional Criteria to Reduce Soil Erosion from Water and Transport of Sediment and Other Waterborne Contaminants

- If it is not feasible to establish a contour strip layout utilizing multiple strip widths, the width of strips for the overall pattern shall be established utilizing a representative planning slope steepness and length that adequately protects the more erosive portions of the field.
- The need for additional water management practices shall be assessed when designing the strip width. Structural or management practices to supplement strip-cropping are required where ephemeral gullies can be expected to form within a cropped strip before reaching the vegetated strip due to excessive slope length or steepness.
- The row grade of the cropped strip shall be aligned as closely as possible to the contour to achieve the greatest erosion reduction possible. The grade along the upslope side of the vegetated buffer shall be the same as for the cropped strip directly above it.

Additional Criteria to Protect Growing Crops from Damage by Wind-borne Soil Particles

Orientation and Width of Strips

- The width of strips shall not exceed the width permitted by the crop tolerance to wind erosion during specific crop stage periods using current wind erosion prediction technology. Refer to crop tolerances as specified in the National Agronomy Manual or other accepted technical references. Increase strip width as defined by wind erosion prediction model.
- Evaluate the potential for incoming saltation and the sediment storage capacity of barriers during the design process. Design strips perpendicular to critical wind erosion direction for the susceptible period.

Note: Alternative practices that may be used to separate erosion-susceptible strips include cross wind ridges, herbaceous wind barriers, or windbreak/shelterbelt establishment.

CONSIDERATIONS

- Prior to design and layout, obstruction removal or changes in field boundaries should be considered, to improve the effectiveness of the practice and the ease of performing field operations across the slope.

- Prior to layout, inspect the field to find key points for commencing layout or getting a full strip width to pass by an obstruction or ridge saddle. Whenever possible, run the strip boundary parallel with fence lines or other barriers, as long as row gradient criteria are met. Account for access road widths when they must cross the field, and adjust the strip boundary on either side accordingly.
- Consider the need for water management practices (terraces, diversions, structures for water control) when surface water runoff flows downhill through two or more contiguous slope lengths (L).
- When this practice is used in combination with diversions or terraces, coordinate the strip layout with the diversion or terrace grade and spacing so that strip boundaries will parallel terraces wherever possible within the criteria for row grade. Where grass-back or narrow-base terraces are used or planned, allow for sufficient area to be occupied by the terrace during the strip layout so that the same strip width is maintained for all strips in the field.
- Retain as much crop residue as possible on the soil surface of the erosion susceptible strips by using residue management practices. When row crops maintain heavy residue most of the year, there is little sediment delivered to the protective cover strips.
- Wildlife and pollinator habitat can be enhanced by delaying mowing or forage harvest until after the nesting season. Also consider selecting species that provide habitat for pollinators and wildlife.
- To avoid wide fluctuations in acres of different crops each year, the conservation crop rotation on strip-cropped fields should contain equal years of row and forage crops and must be consistent with the farm enterprise crop needs.
- Strip cropping may need to be used in combination with other conservation practices to meet the goals of the resource management system.
- To capture and manage soil moisture, select crops, crop sequence, and varieties with sufficient density and cover to intercept runoff and/or blowing snow. Manage the height of standing residues to maximize snow trapping potential.
- Stable outlets may be necessary where runoff results in concentrated flow erosion. Acceptable stable outlets include grassed waterways, field borders, filter strips, water and sediment control basins, or underground outlets for terraces and diversions.
- When the erosion-resistant strip is living vegetation, the species established on non-organic operations, should either be tolerant to herbicides used on the cropped strips or protected from damage by herbicides used on the cropped strips.

PLANS AND SPECIFICATIONS

Specifications for installation, and maintenance of strip-cropping shall be prepared for each field according to the criteria described in this standard, and shall be recorded on specification sheets, job sheet 585 Stripcropping. Plans shall include:

- A statement of practice design objective determined by the client;
- the percent land slope and slope length (L) used to plan the practice;
- the minimum and maximum allowable row grades for the strip-cropping system;
- an estimate of before and after soil loss;
- the design width of strips;
- the actual width of strips as installed; and
- a sketch, plan map, and photograph of the field showing:

- the approximate location of the keyline(s) used to establish the system,
- the location of stable outlets and outlets and/or headlands needing treatment identified during the design of the contour buffer system, and
- the location of all existing or planned supporting conservation practices needed to control surface water runoff.

OPERATION AND MAINTENANCE

- Sediment accumulations along strip edges shall be smoothed or removed and distributed over the field as necessary to maintain practice effectiveness.
- Mow sod turn strips at least once a year to maintain vigorously growing vegetative cover and to control encroachment by woody vegetation.
- When headlands are in permanent cover, renovate as needed to keep ground cover above 65 percent. Maintain full headland width to allow turning of farm implements at the end of a tilled strip to double back on the same strip.
- If strip alignment is lost due to adjacent hay strips, the original strip alignment and width will be re-established before row crop strips are planted.
- Erosion-resistant strips in rotation shall be managed to maintain the planned vegetative cover and surface roughness during periods when wind erosion is expected to occur.
- The protective cover must be adequate to inhibit the initiation of wind erosion and the surface roughness will be sufficient to trap saltating soil particles originating upwind.

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 herbaceous weed control. This standard does not contain the text of federal, tribal, state, or local laws.

REFERENCES

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USDA, NRCS Wisconsin Field Office Technical Guide (FOTG), Section IV, Practice Standards and Specifications.

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DEFINITIONS

Contour – A line or tillage pattern established generally perpendicular to the field slope.

Erosion resistant – An erosion-resistant strip generally consists of dense grasses and/or legumes. Densely planted small grains such as oats, barley, or rye are also considered erosion resistant.

Erosion susceptible – Erosion-susceptible strips are generally defined as consisting of narrow or wide spaced row crops or fallow with less than 10 percent surface residue cover and little surface roughness during the period of time when erosion potential is the greatest.

Keyline – The baseline used for the establishment of a contour farming layout and is in the field on the most uniform area (mid-point) of the hillside slope segment to be protected.

Slope Length – Slope length, as defined by the currently approved sheet and rill soil erosion prediction technology, starts where downslope surface water flow begins to occur and ends where soil deposition occurs or runoff concentrates into ephemeral gullies or a concentrated flow channel.

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