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WISCONSIN FIELD OFFICE TECHNICAL GUIDE
450-11-TECHNICAL GUIDE
FOTG NOTICE WI-81

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:

Aquatic Organism Passage (Code 396) – No revisions made. Date changed to bring the WI standard current.

Contour Buffer Strips (Code 332) – Updated to align with national standard.

Feed Management (Code 592) – Minor updates to bring the WI standard current.

Grassed Waterway (Code 412) – Minor edit to the criteria to evaluate the potential effect of waterways with velocities exceeding the critical velocity (super critical). Added consideration for using energy dissipating features when velocities exceeding the critical velocity are abruptly reduced to a subcritical velocity.

Irrigation Reservoir (Code 436) – No revisions made. Date changed to bring the WI standard current.

Mine Shaft and Adit Closing (Code 457) – No revisions made. Date changed to bring the WI standard current.

Obstruction Removal (Code 500) – No revisions made. Date changed to bring the WI standard current.

Pumping Plant (Code 533) – No revisions made. Date changed to bring the WI standard current.

Spoil Spreading (Code 572) – No revisions made. Date changed to bring the WI standard current.

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Remove the following outdated Standards and Specifications from any printed copies of the WI FOTG: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
- Aquatic Organism Passage (Code 396)
- Contour Buffer Strips (Code 332)
- Feed Management (Code 592)
- Grassed Waterway (Code 412)
- Irrigation Reservoir (Code 436)
- Mine Shaft and Adit Closing (Code 457)
- Obstruction Removal (Code 500)
- Pumping Plant (Code 533)
- Spoil Spreading (Code 572)

Natural Resources Conservation Service
8030 Excelsior Drive, Suite 200, Madison, WI 53717
www.wi.nrcs.usda.gov Phone: (608) 662-4422 Fax: (855) 819-6165

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

- Index
- Aquatic Organism Passage (Code 396)
- Contour Buffer Strips (Code 332)
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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/

JIMMY BRAMBLETT
State Conservationist

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NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

AQUATIC ORGANISM PASSAGE

CODE 396
(NO.)

DEFINITION
Modification or removal of barriers that restrict or impede movement of aquatic organisms.

PURPOSE
Improve or provide passage for aquatic organisms.

CONDITIONS WHERE PRACTICE APPLIES
All aquatic habitats where barriers impede passage of aquatic organisms.

FEDERAL, TRIBAL, STATE, AND LOCAL LAWS
Users of this standard shall comply with applicable federal, tribal, state and local laws, rules, regulations or permit requirements governing aquatic organism passage. This standard does not contain the text of federal, tribal, state, or local laws.

CRITERIA
Criteria Applicable to Planning and Evaluation
Evaluate sites for variations in stage and discharge, tidal influence, hydraulics, geomorphic impacts, sediment transport and continuity, and organic debris movement. Design passage features to account for the known range of variation resulting from this evaluation.

Mitigate undesirable channel plan or profile shifts resulting from the modification or removal of a passage barrier.

Plan and locate passage for compatibility with local site conditions and stream geomorphology, to the extent possible.

Avoid locating fishway entrances and exits in areas that will obstruct function, increase harassment or predation, or result in excessive operation and maintenance requirements.

Criteria Applicable to Design Requirements
Design passage to accommodate present and reasonably anticipated changes in watershed conditions.

Design passage structures according to known swimming and leaping capabilities of target species or a similar species with comparable swimming abilities. Utilize hydraulic computations to document how designs satisfy the physiological requirements of target organisms.

Design passage structures to mimic channel geometry and morphology referenced from an adjacent reach or analog stream when the swimming and leaping abilities of target species are unknown, or when a project will benefit multiple aquatic organisms.

Design and evaluate passage structures for hydraulic performance and structural integrity at the bankfull and 25-year peak flow events (at a minimum).

Design passage features to minimize or avoid energy deficits, physical stress, and harm to migratory organisms.

Design passage features to minimize or avoid excessive delays during migration periods.

Provide adequate attraction flow into a passage facility across the full range of discharge during which target species will move.

Use trash racks on culverts only if required or necessary. Ensure that trash racks are self-cleaning and/or easily maintained.

Select construction materials and methods that are non-toxic and are resistant to degradation.

Plan construction logistics, methods, and sequencing to minimize adverse effects to aquatic organisms, riparian areas, and instream habitat.

Dam removal projects will include a plan to stabilize and manage the downstream movement of accumulated sediment and identify bank stabilization measures where needed. The plan will include reestablishing the upstream channel and reconnecting it to the downstream channel using sound geomorphological principles.

CONSIDERATIONS

Considerations include additional design recommendations that are not required criteria, but may be used to enhance or avoid problems with the design and function of this practice.

Develop or adopt a quantitative method to identify and evaluate passage barriers (see References). Information derived from this method can assist planning and budgeting activities.

Consider removing a passage barrier before installing or retrofitting a new facility or structure. Complete or partial barrier removal usually provides better passage conditions, and is more economical than designing, constructing, operating, and maintaining many passage structures.

Culverts or bottomless arches designed using the stream simulation approach (USFS 2008) that incorporate natural streambed substrates throughout their length are preferred over other culvert configurations for passage purposes. Natural streambeds provide numerous passage and habitat benefits to many life stage requirements for fish and other aquatic organisms compared to man-made surfaces.

Design and locate features to improve or provide passage for as many different aquatic species and age classes as possible.

Retain as much riparian and streambank vegetation as possible during project access and construction activities to maintain shade, riparian continuity, and sources of nutrient and structural inputs for aquatic ecosystems. Where appropriate, consider removing access roads or trails and restoring native vegetation representative of the site.

Replacing or removing an existing instream structure may trigger channel adjustments (e.g., aggradation and/or degradation) upstream and/or downstream of the work site. Install grade controls or other slope modifications to mitigate adverse physical or ecological consequences (see Wisconsin NRCS Conservation Practice Standard (WI NRCS CPS), Channel Stabilization (584), and Grade Stabilization Structure (410)).

Analyze any potentially negative interactions, including hybridization, disease, competition, or predation, between target and aquatic nuisance species when passage is provided above a barrier. If serious consequences are likely, take steps to minimize adverse effects.

Consider the habitat requirements of other aquatic or terrestrial species that may be affected by a passage project. Some passage facilities may improve survival for terrestrial vertebrates by providing safe migration routes under roadways through the use of additional floodplain relief culverts.

Assess the amount of habitat upstream and downstream of a barrier to evaluate into project feasibility, cost effectiveness, and/or potential for connecting fragmented habitats. Using a watershed approach whenever possible provides a framework for project planning.

Fish passage facilities are often associated with water diversions or intakes that injure or kill aquatic species. Prevent fish entrainment, particularly juveniles, into diversions, penstocks, or pumps by installing screens.

Passage projects can affect water management practices such as diversion, power generation, or storage. Strive to balance aquatic organism passage with other water management objectives.

Consider upstream and larger watershed issues that may affect passage. Common solutions may include maintaining or restoring adequate instream flow and/ or other water quality parameters (e.g., temperature, dissolved oxygen).

Barrier removal, especially dams and road crossings, can significantly affect wetlands, flooding potential, existing infrastructure, and social and cultural practices. Evaluate and address the full range of impacts when planning or designing barrier removal projects.

Floodplain and water development often alter historic river channel pattern and location. Consider bypassing a barrier by restoring streamflow to former, stable natural channels.

Passage facilities can assist population recovery and management. Where applicable, consider local, state, or federal brood stock collection and species management initiatives when planning passage features.

In the case of low-water crossings, water quality impacts from vehicular pollutants and erosion caused by tire action can be severe. Where possible, reroute roadways or install hardened instream crossings (see WI NRCS CPS, Stream Crossing (578)).

PLANS AND SPECIFICATIONS

Provide site-specific plans for this practice. Plans will specify passage structure design, layout, and overall objectives, and include (at a minimum):

- Location map and plan view of site, description of design flows, and a short summary of operating criteria;
- Detailed construction drawings showing site existing and planned site conditions including elevations, typical profiles, and cross-sections of planned structures;
- Construction specifications describing materials, logistics (including erosion control), and timing;
- Guidance for post-construction evaluation and monitoring to assess structural integrity and compliance with design criteria.

OPERATION AND MAINTENANCE

Develop an operation and maintenance plan for all applications of this standard. Within the plan, provide for periodic inspection and corrective action should passage conditions become impaired because a structure is damaged or inoperable. Operation and maintenance items should include:

- Specifying what entity is responsible for the daily operation and maintenance of a passage structure.
- Annual, seasonal, and/or daily operating activities necessary to ensure proper function of the structure
- Checking a passage structure at regular intervals to ensure it is operating within design criteria.
- Cleaning trash racks and debris collectors or remove debris accumulations regularly.
- Adjusting gates, orifices, valves, or other control devices as needed to regulate flow and maintain a passage structure within operating criteria.
- Periodically checking staff gages or other flow metering devices for accuracy.
- Annually inspecting passage structures for structural integrity and disrepair.
- Inspecting gate and valve seals for damage.
- Replacing worn or broken stoplogs, baffles, fins, or other structural components.
- Removing sediment accumulations from within passage structure where applicable.

REFERENCES

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

Aquatic Nuisance Species Information. 2006. (per Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 [16 U.S.C. 4701]).

Bell, M.C. 1990. Fisheries Handbook of Engineering Requirements and Biological Criteria. United States Army Corps of Engineers, Fish Passage Development and Evaluation Program, Portland, OR. 290 p.

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Jungwirth, M., S. Schmutz, and S. Weiss, editors. 1998. Fish Migration and Fish Bypasses. Fishing News Books, Oxford, UK. 438 pp.

USDA, NRCS. 2006. Fish passage and screening designs. Technical Supplement 14-N to NEH-654 – Stream Restoration Design Handbook.

Taylor, R.N. and M. Love. 2003. Fish passage evaluation at stream crossings. Part IX in: California Stream Habitat Restoration Manual, 3rd edition, 1998. Prepared by G. Flosi, S. Downie, J. Hopelain, M. Bird, R. Coey, and B. Collins. Sacramento, CA. 100 electronic pp.

United States Forest Service (USFS). 2006. Low water crossings: Geomorphic, biological, and engineering design considerations. 0625 1808, SDTDC, San Dimas, CA.

USFS. 2008. Stream Simulation: An ecological approach to providing passage for aquatic organisms at road-stream crossings. 0877 1801P, NTDP, San Dimas, CA.

Washington Department of Fish and Wildlife (WDFW). 2000. Fishway guidelines for Washington State. Olympia, WA. 57 pp.

WDFW. 2000. Fish passage barrier and surface water diversion screening and prioritization manual. WDFW Habitat Program, Environmental Restoration Division, Salmon Screening, Habitat Enhancement and Restoration Section, Olympia, WA. 158 pp.

NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

CONTOUR BUFFER STRIPS

CODE 332
(AC.)

DEFINITION
Narrow strips of permanent, herbaceous vegetative cover established around the hill slope and alternated with wider cropped strips that are also farmed on the contour.

PURPOSE
This practice may be applied to achieve one or more of the following purposes:

- Reduce sheet and rill erosion.
- Reduce water quality degradation from the transport of sediment and other water-borne contaminants downslope.
- Improve soil moisture management through increased water infiltration.
- Reduce water quality degradation from the transport of nutrients downslope.

CONDITIONS WHERE PRACTICE APPLIES
This practice applies to all sloping cropland including orchards, vineyards, and nut crops.

It is most suitable on landforms with uniform slopes. The practice is more difficult to establish on undulating to rolling topography because of the difficulty of maintaining parallel strip boundaries across the hill slope or staying within row grade limits.

Where the width of the buffer strips will be equal to the width of the adjoining crop strips, Wisconsin NRCS Conservation Practice Standard (WI NRCS CPS), Stripcropping (585), applies.

CRITERIA
General Criteria Applicable to All Purposes
Surface flow from contoured crop rows must be delivered to a stable outlet.

Design the width of the cropped strip to accommodate some multiple of full equipment width.

Do not plant buffer strips with any plants listed on the noxious weed list of the state.

Do not use buffer strips as travel lanes for livestock or equipment.

Buffer strips are not a part of the normal crop rotation (however, they may be harvested or grazed), and will remain in place until they need to be renovated or re-established.

Row Grade. When the row grade of any crop strip reaches the maximum allowable design grade, establish a new baseline up or down slope from the last buffer strip for the layout of the next crop strip.

Arrangement of Strips. A crop strip will occupy the area at the top of the hill, unless unusually complex topography requires vegetation in this area in order to establish a farmable system.

When used in combination with terraces, diversions or water and sediment control basins, the layout of the buffer strips shall be coordinated with the grade and spacing of the other practices so that the buffer strip boundaries will parallel the practices as closely as possible. Locate the buffer strip immediately upslope from the terrace channel, or diversion, or the storage area of the water and sediment control basin.

General Criteria Applicable to Reduce Sheet and Rill Erosion

Where soil erosion is the primary resource concern, the practice shall be designed to achieve soil loss rates equal to or less than Tolerable levels as calculated using the approved soil erosion prediction model.

Row Grade. The row grade of the cropped strip shall be aligned as closely as possible to the contour to maximize erosion reduction. The grade along the upslope side of the vegetated buffer shall be the same as for the cropped strip directly above it. When the grade of any crop strip reaches the maximum allowable design grade, a new keyline shall be established and used for the layout of the next crop 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 could be a problem.

Maximum Row Grade. The maximum grade of rows shall not exceed 2 percent **OR** one half of the up and down hill slope percent used for erosion prediction, whichever is less. Up to a 3 percent row grade 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 buffer strip pattern. All tillage and planting operations will follow the established contour line.

Arrangement of Strips. Wide cropped strips shall be alternated on the contour with narrower vegetated buffer strips in a sequential pattern down the hill slope. Normally, an odd shaped crop area will occupy the area at the top and bottom of the hill in order to establish a farmable system.

The vegetated contour buffer strips are not part of the normal crop rotation and shall remain in permanent vegetative cover at the location they were originally established until they need to be renovated or re-established. They may be harvested for hay.

When used in combination with terraces, underground outlets, diversions, or water and sediment control basins, the layout of buffer strips shall be coordinated with the grade and spacing of the structural practice so that strip boundaries will parallel the practice wherever possible. When the buffer strip is applied in combination with a structural practice, it shall occupy the area immediately upslope from the terrace or diversion channel or the storage area of a water and sediment control basin.

Stable Outlets. Surface water flow from contour buffer strip crop rows must be delivered to a stable outlet. Stable outlets include grassed waterways, terraces, diversions, established field borders, or other stable sites.

End rows shall be protected from erosion.

Width of Strips. The minimum width will be:

- At least 15 feet wide for strips planted to grasses or grass-legume/forbs mixtures with at least 50 percent grass; and
- At least 30 feet wide when legumes/forbs are used alone or legumes make up more than 50 percent of the stand.

Increase buffer strip widths as needed to keep the width of the cropped strips uniform. The width of the individual buffer strips may vary to accommodate uneven slopes.

Cropped strips will be of uniform width between buffer strips and will not exceed 50 percent of the slope length (L), used for the erosion calculation.

Cropped strip width design shall be adjusted up or down to match the closest multiple of full equipment operating width (typically the planter) to avoid partial or incomplete passes.

Vegetation. Vegetation grown on buffer strips shall be established to permanent grasses, legumes, or grass-legume mixtures, adapted to the site.

Species established shall be adapted to the site and tolerant of anticipated depth of sediment deposition. Refer to Wisconsin Agronomy Technical Notes 5 for Prairie Establishment/Restoration Seeding Recommendations, and 6 for Cool Season Introduced Cover Recommendations. No plants listed on the noxious weed list of the state will be established in a buffer strip cropping system.

Additional Criteria to Reduce Water Quality Degradation from the Transport of Nutrients Downslope

Vegetation. Establish buffer strips to permanent sod-forming vegetation with stiff, upright stems.

Width of Strips. Buffer strips will be at least 15 feet wide. Increase the buffer strip widths as needed to keep the width of the cropped strips uniform.

The maximum width of cropped strips will be one-half of the field slope length or 150 feet, whichever is less.

Row Grade Criteria. Follow minimum and maximum criteria outlined in sheet and rill erosion.

Arrangement of Strips. In addition to the buffer strips established on the hillside, establish a buffer strip at the bottom of the slope. Make the bottom strip two times the width of the narrowest buffer strip in the system.

Additional Criteria to Improve Soil Moisture Management Through Increased Water Infiltration

Row Grade. The grade along the upper edge of the buffer strip shall not exceed 0.2 percent.

Width of Strips. The minimum width will be:

- At least 15 feet wide for strips planted to grasses or grass-legume/forb mixtures with at least 50 percent grass; and
- At least 30 feet wide when legumes/forbs are used alone or legumes/forbs make up more than 50 percent of the stand.

Increase buffer strip widths as needed to keep the width of the cropped strips uniform. The width of the individual buffer strips may vary.

Cropped strips will be of uniform width between buffer strips and will not exceed 50 percent of the slope length (L), used for the erosion calculation.

Vegetation. Establish buffer strips to permanent vegetation consisting of seed forming grasses that consist of legumes/forbs, grass-legume/forb mixtures.

The buffer strips will have at least 95 percent ground cover during periods when erosion is expected to occur on the cropped strips.

The stem density for grasses and grass-legume/forb mixtures will be at least 50 stems per square foot, and for pure legume/forb stands at least 30 stems per square foot.

Establish species that are adapted to the site and tolerant of anticipated depth of sediment deposition.

Additional Criteria to Enhance Pollinator Habitat

Add native forbs or flowering introduced species to the vegetated buffer strip seeding mix to increase habitat diversity.

Where pollinator habitat is an identified planning concern, do not harvest or mow the vegetated buffer during the growing season to maximize the flowering of legumes and forbs.

Refer to Wisconsin Biology Technical Note 8, Pollinator Biology and Habitat, for guidance on planning and establishing pollinator habitat.

CONSIDERATIONS

General. Several factors influence the effectiveness of contour farming to reduce soil erosion. These factors include: 10-year, 24-hour rainfall in inches; ridge height; row grade; slope steepness; soil hydrologic group; cover and roughness; and slope length. Cover and roughness, row grade, and ridge height can be influenced by management and provide more or less benefit depending on design.

Contour farming is most effective on slopes between 2 and 10 percent. This practice will be less effective in achieving the stated purpose(s) on slopes exceeding 10 percent and in areas with 10-year, 24-hour rainfall over 6.5 inches. The practice is not well suited to rolling topography having a high degree of slope irregularity because of the difficulty meeting row grade criteria.

This practice is most effective on slopes lengths between 100 and 400 feet. As slopes lengthen, the volume and velocity of overland flow are more likely to overwhelm the capacity of contour ridges and narrow buffer strips to contain them. Additional residue cover and other conservation techniques (including widening buffer strips) will decrease overland flow velocities, thus increasing the length of slope on which this practice is effective.

Contour buffer strips are more difficult to establish on undulating to rolling topography because of the difficulty of maintaining parallel strip boundaries across the hill slope or staying within row grade limits.

Areas of existing or potential concentrated flow erosion should be protected by conservation practices such as grassed waterways, water and sediment control basins, or diversion terraces.

Where contour row curvature becomes too sharp to keep equipment aligned with rows during field operations, increasing the buffer strip width can help avoid sharp ridge points. In drainage ways, establishing grassed waterways at least up to the point of sharp curvature can allow the equipment to be lifted and/or turned to meet the same rows across the turn strip.

Prior to design and layout, remove any obstructions or make changes in field boundaries or shape, where feasible, to improve the effectiveness of the practice and the ease of performing farming operations.

Prior to layout, inspect the field's position on the landscape to find key points for starting layout or getting the width of one set of strips (one cultivated and one buffer) to pass by an obstruction or ridge saddle.

Additional row markers consisting of field boundaries, hedgerows, fence lines, access lanes, terraces, etc. may be established as needed. Permanent vegetated buffer strips can serve as permanent contour or row markers to maintain design row grades during field operations.

Consider re-establishing the native plant community. Use native species that are appropriate for the identified resource concern and management objective. Consider vegetation that provides multiple benefits to improve other resources.

Food and Cover for Wildlife and Beneficial Organisms. The following management activities may be carried out to enhance benefits for pollinators, natural enemies of crop pests, and wildlife benefits as long as they do not compromise the effectiveness of the buffer strips:

- Plant herbaceous species that provide habitat enhancement for the wildlife species, pollinators, or other beneficial organisms of concern.
- Add native forbs to the seeding mixture to increase habitat diversity or to provide pollen and nectar for beneficial insects.
- Mow the buffer strips every other year or every third year depending upon geographical location. The standing cover provides early and late season nesting and escape cover for many species of wildlife displaced from adjacent disturbed areas.

- Delay mowing until after the nesting period of ground-nesting species, but mow early enough to allow for regrowth before the growing season ends.

To maximize nutrient interception, choose deep-rooted grasses that will efficiently remove nutrients that enter the soil profile within the buffer strip. Harvest hay regularly to remove surplus nutrients intercepted.

PLANS AND SPECIFICATIONS

Specifications for installation, operation, and maintenance of contour buffer strips shall be prepared for each field according to the Criteria, Considerations, and Operations and Maintenance described in this standard, and shall be recorded on the 332 Job Sheet, narrative statements in conservation plans, or other acceptable documentation. Plans shall include:

- A statement of practice design objective (soil loss to T or other level 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 contour buffer system;
- Benchmark condition estimate of before and after soil loss;
- The design width of vegetated buffer strips and cropped strips prior to any adjustment;
- The farm equipment type and width utilized to adjust cropped strip width (as necessary);
- The actual width of crop and vegetated buffer strips as installed;
- The seed mixture to establish the buffer strips; and
- A sketch, plan map, or photograph of the field showing:
    - The approximate location of the keyline(s) used to establish the system,
    - The location of stable outlets and outlets 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

Conduct all farming operations parallel to the strip boundaries except on headlands or end rows with gradients less than the criteria set forth in this standard.

Time mowing or harvest of buffer strips to maintain appropriate vegetative density and height for optimum trapping of sediment from the upslope cropped strip during the critical erosion period(s).

Fertilize buffer strips as needed to maintain stand density.

Mow or harvest sod turn strips and waterways at least once a year.

Spot seed or totally renovate buffer strip systems damaged by herbicide application after residual action of the herbicide is complete.

Redistribute sediment that accumulates along the upslope edge of the buffer strip/crop strip interface as needed. This sediment shall be spread evenly upslope over the cultivated strip when needed to maintain uniform sheet flow along the buffer/cropped strip boundary.

If sediment accumulates just below the upslope edge of the buffer strip to a depth of 6 inches or more, or stem density falls below specified amounts in the buffer strip, relocate the buffer/cropped strip interface location.

Cultivated strips and buffer strips shall be rotated so that a mature stand of protective cover is achieved in a newly established buffer strip immediately below or above the old buffer strip before removing the old buffer to plant an erosion-prone crop. Alternate repositioning of buffer strips to maintain their relative position on the hill slope. If an established buffer is removed, a equipment width will be added to one crop strip and subtracted from another.

Renovate vegetated headlands or end row area as needed to keep ground cover above 65 percent.

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

REFERENCES

USDA, NRCS Wisconsin Field Office Technical Guide (FOTG), Section I, Erosion Prediction.

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

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

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X. Zhou, M.J. Helmers, H. Asbjornsen, R. Kolka, M.D. Tomer, and R.M. Cruse. 2014. Nutrient Removal By Prairie Filter Strips in Agricultural Landscapes. Journal of Soil and Water Conservation. Jan/Feb 2014-Vol. 69, NO. 1.

DEFINITIONS

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

Keyline – A keyline is defined as the baseline used for the establishment of a contour farming layout. The keyline is typically laid out on the most uniform area of the hillside slope segment to be protected. The lower third of the slope segment is generally the most uniform landform. The keyline must be established to meet the minimum and maximum row grades required by the criteria. When it is not possible to maintain the required row grades on the keyline or upslope areas, establish a new keyline.

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. There may be a series of different slope grades and slope lengths down the hillside. Varying slope lengths and steepness may result in a number of different buffer spacings on the hillside.

NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

FEED MANAGEMENT

CODE 592
(NO. OF SYSTEMS AND AUs AFFECTED)

DEFINITION

Manipulating and controlling the quantity and quality of available nutrients, feedstuffs, or additives fed to livestock and poultry.

PURPOSE

- Improve feeding efficiency in a manner that facilitates and contributes to the conservation of natural resources.
- Reduce the quantity of nitrogen, phosphorus, sulfur, salts, and other nutrients excreted in the manure.
- Reduce the quantity and viability of pathogens in manure.
- Reduce odor, particulate matter, and greenhouse gas (GHG) emissions production from animal feeding operations.

CONDITIONS WHERE PRACTICE APPLIES

- Livestock and poultry operations with a whole farm nutrient imbalance, with more nutrients imported to the farm than are exported and/or utilized by cropping programs.
- Livestock and poultry operations that have a significant accumulation of nutrients in the soil.
- Livestock and poultry operations that land-apply manure and do not have a land base large enough to allow nutrients to be applied at rates recommended by soil test and utilized by crops in the rotation.
- Livestock and poultry operations seeking to improve nutrient use efficiencies.
- Livestock and poultry operations seeking to reduce manure pathogens.
- Livestock and poultry operations seeking to reduce odors and/or Greenhouse Gases (GHGs) from their manure.

CRITERIA

General Criteria Applicable to All Purposes

Sufficient nutrients shall be supplied to maintain the health, growth, production, performance, and reproduction of livestock and poultry.

The diets for specific species of animals shall be developed in accordance to recommendations from one of the following:

- The most current recommendations of the National Research Council (NRC).
- Recommendations of the University of Wisconsin.
- Science based standards developed by professional nutritionists of livestock and poultry production companies, feed companies, and/or feed suppliers accepted by NRCS.

Laboratory analysis shall be done on the formulated diet, or on the feed ingredients used to formulate the diet, to determine its nutrient content.

Feed and manure analyses shall be conducted by laboratories whose tests are accepted by the University of Wisconsin and the Wisconsin Department of Agriculture.

Data from analyzed feed ingredients and/or appropriate historic feed analysis information for the operation will be used for adjustments of ration formulation.

Diets and feed management strategies shall be developed by professional animal scientists, independent professional nutritionists, or other comparatively qualified individuals.

Diets shall be formulated to provide the quantities and correct relative ratios of available nutrients required by animal species to meet the goals for which the plan is being developed.

Adjustments to nutrient levels shall be provided to meet specific genetic potential environmental demands, and/or requirements to insure health, well-being, and productivity of the animal.

One or more of the following feed management practices and/or diet manipulation technologies shall be used to reduce N, P, other excreted nutrients, pathogens, odors, and/or GHGs, while maintaining the health, well-being and productivity of the animal by:

- Formulating diets closer to animal requirements.
- Reducing protein and supplementing with amino acids (non-ruminants).
- Manipulating the crude protein and energy (carbohydrate and fat) content of the diet to enhance the availability of amino acids (ruminants).
- Using highly digestible feeds and forages, as appropriate, in the diet.
- Using phytase and reducing supplemental phosphorus content of the diet (non-ruminants).
- Reducing the phosphorus content of the diet of ruminants when phosphorus is being overfed.
- Using scientifically supported and environmentally benign growth promotants and additives as allowed by law.
- Implement phase feeding.
- Implement split-sex feeding.
- Using other feed processing, management, or diet manipulation technologies that have demonstrated the ability to reduce manure nutrient content, pathogens, odors, or GHGs.

- When livestock are obtaining their diet by grazing pastures, as well as mechanically harvested and processed feeds, pasture forages will be tested for nutrient content and accounted for in the feed ration and balance of nutrients. All feeds, including grazed pasture will be included in an analysis for meeting the livestock's nutritional requirements and avoiding excess nutrients being fed. Forage tests will meet the University of Wisconsin acceptance and certification process.

Use scientifically supported and environmentally benign growth promotants and additives as allowed by law.

Use other feed processing, management, or diet manipulation technologies that have demonstrated the ability to reduce manure nutrient content, pathogens, odors, or GHGs.

CONSIDERATIONS

- Feed management can improve net farm income by feeding nutrients more efficiently.
- Consider nutrient requirements for production based upon stage of growth, intended purpose of the animal and the type of production (e.g., meat, milk, eggs) involved.
- Use management practices described in the NRCS Nutrient Management (Feed Management) Technical Notes for the specific animal species (see reference section).
- Consider different feed ingredients (e.g. by- products) and their potential impacts on the nutrient content of excreted manure.
- Consider the potential impact of feed management on the volume of manure excreted and on manure storage requirements.
- Consider the impact of feed management practices and diet manipulation on manure odors, pathogens, GHGs, dust, animal health and well-being even if one or more of these are not included in the client's objectives.
- Consider using concentrates and forages grown on the farm to minimize the quantity of nutrients imported to the farm, and to maximize the recycling of nutrients on the farm.
- Analyze freshly excreted manure to determine manure nutrient content and to estimate the impact of the feeding strategy.

PLANS AND SPECIFICATIONS

Plans and specifications for feed management shall be in keeping with the requirements of this standard. They shall describe the specific feed management practices and/or technologies that are planned for the operation.

The following components shall be included in the feed management plan:

- The type of technology, or technologies, and/or feeding practices that will be used on the operation.
- Feed analyses and ration formulation information prior to and after implementation of feed management on the operation and their intended outcome.
- The estimated, or measured nutrient content of the manure prior to the implementation of feed management on the operation.
- Records of any manure analysis that was done after the feeding strategy was implemented to determine manure nutrient content.
- Protocols for sampling and preserving feed ingredients, manure, and water, as applicable, prior to sending for analysis.

- The estimated impact that feed management will have on manure nutrient content.
- The expected impact on pathogen content, odor, and GHG reduction of manure.
- The quantities and sources of nitrogen and phosphorus that will be fed.
- Identification of the qualified feed management specialist who developed the plan.
- Guidance for how often the feed management plan shall be reviewed and potentially revised.

OPERATION AND MAINTENANCE

The producer/client is responsible for the operation and maintenance of the feed management plan. Operation and maintenance activities shall address the following:

- Periodic plan review to determine if adjustments or modifications are needed.
- Routine feed analysis to document the rates at which nitrogen and phosphorus were actually fed. When actual rates fed differ from or exceed the planned rates, records will indicate the reasons for the differences.
- Records shall be maintained to document plan implementation. As applicable, records include:
    - Feed analysis and ration formulation, including the record of ration formulation used prior to implementing the feeding strategy.
    - Records estimating the impact the feeding strategy is having on reducing manure nutrient content.
    - Manure analysis that was done after the feeding strategy was implemented to determine manure nutrient content.
    - Dates of review and person performing the review, and any recommendations that resulted from the review.
- Records of plan implementation shall be maintained for five years, or for a period longer than five years if required by other Federal, tribal, state, or local ordinances, program, or contract requirements.

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

REFERENCES

National Academy of Sciences Animal Nutrition Reports. http://dels.nas.edu/Agriculture/Animal-Nutrition/Reports-Academies-Findings

USDA-NRCS, and USDA-ERS. 2000. Manure Nutrients Relative to the Capacity of Cropland and Pastureland to Assimilate Nutrients. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/technical/nra/dma/?&cid=nrcs143_014126

USDA-NRCS. 2003. Nutrient Management Technical Note #1 – Effects of Diet and Feeding Management on Nutrient Content of Manure

USDA-NRCS. 2003. Nutrient Management Technical Note # 4 – Feed and Animal Management for Poultry.

USDA-NRCS. 2003. Nutrient Management Technical Note #2 – Feed and Animal Management for Beef Cattle.

USDA-NRCS. 2003. Nutrient Management Technical Note #3 – Feed and Animal Management for Swine (Growing and Finishing)

USDA-NRCS. 2003. Nutrient Management Technical Note #5 – Feed and Animal Management for Dairy Cattle

University of Wisconsin-Extension (UWEX) Publication A3769, Recommended Methods of Manure Analysis, 2003.

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

USDA, NRCS, Wisconsin Conservation Practice Standard 590 Nutrient Management

USDA, NRCS, Wisconsin Conservation Planning Technical Note WI-1, Companion Document to NRCS FOTG Standard 590, Nutrient Management.

USDA, NRCS, Wisconsin Job Sheet 592, Feed Management, Feed Management Documentation Worksheet and Checklist.

NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

GRASSED WATERWAY

CODE 412
(FT.)

DEFINITION
A shaped or graded channel that is established with suitable vegetation to convey surface water at a non-erosive velocity using a broad and shallow cross section to a stable outlet.

PURPOSE
- To convey runoff from terraces, diversions, or other water concentrations without causing erosion or flooding.
- To prevent gully formation.
- To protect/improve water quality.

CONDITIONS WHERE PRACTICE APPLIES
This practice is applied in areas where added water conveyance capacity and vegetative protection are needed to prevent erosion and improve runoff water quality resulting from concentrated surface flow.

CRITERIA
General Criteria Applicable To All Purposes
Plan, design, and construct grassed waterways to comply with all federal, state, tribal, and local laws and regulations.

Drainage areas must be treated to minimize sediment deposition to the grassed waterway.

Capacity. Design the waterway to convey the peak runoff expected from the 10-year frequency, 24-hour duration storm. Waterways which are components of waste management systems shall have a minimum capacity to convey the peak runoff from the 25-year frequency, 24 hour storm. Increase capacity as needed to account for potential volume of sediment expected to accumulate in the waterway between planned maintenance activities. When the waterway slope is less than 1 percent, out-of-bank flow may be permitted if such flow will not cause excessive erosion. Ensure that the design capacity, at a minimum, will remove the water before crops are damaged.

Peak discharge for all storms will be determined by the method outlined in NRCS National Engineering Handbook (NEH), Part 650 - Engineering Field Handbook (EFH), Chapter 2; or Technical Release 55 (TR-55).

The vegetative retardance used shall consider the types of grasses to be seeded and the type of management anticipated. The retardance used shall be in accordance with the EFH, Chapter 7, Table 7-4.

Capacity of waterways shall be based on vegetative retardance A, B, or C.

Stability. Determine the minimum depth and width requirements for stability of the grassed waterway using the procedures in EFH, Chapter 7, Grassed Waterways; the Agricultural Research Service (ARS), Agriculture Handbook 667, Stability Design of Grass-Lined Open Channels, or the Handbook of Channel Design for Soil and Water Conservation (SCS-TP-61).

Ensure that the vegetation species selected are suited to the current site conditions and intended uses. Select species that have the capacity to achieve adequate density, height, and vigor within an appropriate time frame to stabilize the waterway.

Stability of waterways shall be based on vegetative retardance C, D, or E.

Stability of waterways shall convey the peak discharge expected from the design storm without exceeding the allowable effective stress or permissible velocity.

Design velocities shall not exceed the values shown in Table 1.

Evaluate the potential effect of waterways with velocities exceeding the critical velocity (super critical).

Table 1

Waterway Slope Range (%)	Permissible Velocity[1]	
	Erosion Resistant Soils[2] (ft./sec.)	Easily Eroded Soils[3] (ft./sec.)
0-5	7	5
5.1-10	6	4
Over	5	3

[1]Use velocities exceeding 5 ft./sec only where good cover and proper maintenance can be obtained.
[2]Cohesive (clayey) fine-grain soils and coarse-grain soils with cohesive fines with a plasticity index of 10 to 40 (CL, CH, SC, and GC).
[3]Soils that do not meet the requirements for erosion-resistant soils.

Alignments. Except for short transition sections, flow in the range of 0.7 to 1.3 of the critical slope must be avoided unless the waterway is straight.

Velocities exceeding the critical velocity shall be restricted to straight reaches.

Use transition sections of at least 50 feet long to change channel dimensions.

Width. Keep the bottom width trapezoidal waterways less than 100 feet unless multiple, or divided waterway, or other means are provided to control meandering of low flows.

Side slopes. Keep the side slopes flatter than a ratio of two horizontal to one vertical (2:1). Reduce the side slopes as needed to accommodate the equipment anticipated to be used for maintenance and tillage/harvesting equipment so that damage to the waterway is minimized.

Depth. The capacity of the waterway must be large enough so that the water surface of the waterway is below the water surface of the tributary channel, terrace, or diversion that flows into the waterway at design flow.

The minimum designed depth of the waterway shall be 0.6 feet.

Provide 0.5 foot freeboard above the designed depth when flow must be contained to prevent damage. Provide freeboard above the designed depth when the vegetation has the maximum expected retardance.

Drainage. When needed to establish or maintain vegetation on sites having prolonged flows, high water tables, or seepage problems, use Wisconsin NRCS Conservation Practice Standards (WI NRCS CPS), Subsurface Drain (606), Underground Outlet (620), or other suitable measures in waterway designs.

Where drainage practices are not practicable or sufficient to solve these seepage problems, use WI NRCS CPS, Lined Waterway or Outlet (468) in place of WI NRCS CPS, Grassed Waterway (412).

All grassed waterways shall have stable inlet areas. The area downstream of bridges, culverts, or other structures shall be stabilized with durable lining materials if vegetation cannot be established.

Outlets. Provide a stable outlet with adequate capacity. The outlet can be another vegetated channel, an earthen ditch, a grade-stabilization structure, filter strip or other suitable outlet.

Grassed waterways that serve as terrace outlets shall be established with adequate vegetation prior to the terrace construction.

Crossings. Provide livestock and vehicular crossings as necessary to prevent damage to the waterway and its vegetation. Crossings shall be in accordance with the criteria contained in WI NRCS CPS, Stream Crossing (578), Access Road (560), or Trail and Walkways (575).

Vegetative Establishment. Establish vegetation as soon as possible using the criteria listed under "Establishment of Vegetation" in WI NRCS CPS, Critical Area Planting (342).

Establish vegetation as soon as conditions permit. Use mulch anchoring, nurse crop, rock or straw or hay bale dikes, fabric or rock checks, filter fences, or runoff diversion to protect the vegetation until it is established. Planting of a close growing crop, e.g., small grains or millet, on the contributing watershed prior to construction of the grassed waterway can also significantly reduce the flow through the waterway during establishment.

CONSIDERATIONS

Where environmentally-sensitive areas need to be protected from dissolved contaminants, pathogens, or sediment in runoff, consider establishment of an increased width of vegetation on the waterway above the flow area. Increasing the width of the waterway above the flow area will increase filtering of sediment and pathogens as well as increase infiltration of runoff and increase nutrient removal. Where sediment control is the primary concern, consider using vegetation in the waterway which can withstand partial burial and adding sediment control measures above the waterway such as residue management. Consider increasing the channel depth and/or designing areas of increased width or decreased slope to trap and store sediment to reduce

the amount of sediment that leaves a field. Be sure to provide for regular cleaning out of the waterway when trapping sediment in this manner.

Tillage and crop planting often takes place parallel to the waterway, resulting in preferential flow – and resulting erosion – along the edges of the waterway. Consider installation of measures that ensure that runoff from adjacent areas will enter the waterway. Measures such as directing spoil placement or small swales can direct this preferential flow into the grassed waterway.

Avoid areas where unsuitable plant growth limiting subsoil and/or substratum material such as salts, acidity, root restrictions, etc. may be exposed during implementation of the practice. Where areas cannot be avoided, seek recommendations from a soil scientist for improving the condition or, if not feasible consider over-cutting the waterway and add topsoil over the cut area to facilitate vegetative establishment.

Avoid or protect, if possible, important wildlife habitat, such as woody cover or wetlands when determining the location of the grassed waterway.

If trees and shrubs are incorporated, they should be retained or planted in the periphery of grassed waterways so they do not interfere with hydraulic functions. Medium or tall bunch grasses and perennial forbs may also be planted along waterway margins to improve wildlife habitat.

Waterways with these wildlife features are more beneficial when connecting other habitat types; e.g., riparian areas, wooded tracts and wetlands. When possible, select plant species that can serve multiple purposes, such as benefiting wildlife, while still meeting the basic criteria needed for providing a stable conveyance for runoff.

Water-tolerant vegetation may be an alternative to subsurface drains or stone center waterways on some wet sites.

Use irrigation in dry regions or supplemental irrigation as necessary to promote germination and vegetation establishment.

Wildlife habitat benefits can be provided by adding width of appropriate vegetation to the sides of the waterway. Care should be taken to avoid creating small isolated planting zones that could become population sinks where wildlife attracted to an area experience reproductive loss due to predation.

Consider including diverse legumes, forbs, and flowering plants such as milkweeds that provide pollen and nectar for native bees and other pollinators. In dry regions, these sites may be able to support flowering forbs with higher water requirements and thus provide bloom later in the summer

The construction of a grassed waterway can disturb large areas and potentially affect cultural resources. Be sure to follow state cultural resource protection policies before construction begins.

Consider using energy dissipating features when velocities exceeding the critical velocity are abruptly reduced to a subcritical velocity.

PLANS AND SPECIFICATIONS

Prepare plans and specifications for grassed waterways that describe the requirements for applying the practice according to this standard. This should include:

- A plan view of the layout of the grassed waterway.
- Typical cross sections of the grassed waterway(s).
- Profile(s) of the grassed waterway(s).
- Disposal requirements for excess soil material.
- Site specific construction specifications that describe in writing the installation of the grassed waterway. Include specification for control of concentrated flow during construction and vegetative establishment.
- Vegetative establishment requirements.

OPERATION AND MAINTENANCE

Provide an operation and maintenance plan to review with the landowner. Include the following items and others as appropriate in the plan:

- Establish a maintenance program to maintain waterway capacity, vegetative cover, and outlet stability. Vegetation damaged by machinery, herbicides, or erosion must be repaired promptly.
- Protect the waterway from concentrated flow by using diversion of runoff or mechanical means of stabilization such as silt fences, mulching, hay bale barriers and etc. to stabilize grade during vegetation establishment.
- Minimize damage to vegetation by excluding livestock whenever possible, especially during wet periods. Permit grazing in the waterway only when a controlled grazing system is being implemented.
- Inspect grassed waterways regularly, especially following heavy rains. Fill, compact, and reseed damaged areas immediately. Remove sediment deposits to maintain capacity of grassed waterway.
- Avoid use of herbicides that would be harmful to the vegetation or pollinating insects in and adjacent to the waterway area.
- Avoid using waterways as turn-rows during tillage and cultivation operations.
- Mow or periodically graze vegetation to maintain capacity and reduce sediment deposition. Mowing may be appropriate to enhance wildlife values, but must be conducted to avoid peak nesting seasons and reduced winter cover.
- Apply supplemental nutrients as needed to maintain the desired species composition and stand density of the waterway.
- Control noxious weeds.
- Do not use waterways as a field road. Avoid crossing with heavy equipment when wet.
- Lift tillage equipment off the waterway when crossing and turn off chemical application equipment.

REFERENCES

USDA, ARS. (1987). Stability design of grass-lined open channels. Washington, D.C.: U.S. Dept. of Agriculture, Agricultural Research Service.

USDA, NRCS (2007). National Engineering Handbook, Part 650, Engineering Field Handbook, Chap. 7, Grassed waterways.

Stillwater Outdoor Hydraulic Laboratory (1954). Handbook of Channel Design for Soil and Water Conservation SCS-TP-61 (Revised. ed.). Washington: United States Department of Agriculture, Soil and Conservation Service.

NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

IRRIGATION RESERVOIR

CODE 436
(AC.-FT.)

DEFINITION
An irrigation water storage structure made by constructing a dam, embankment, pit, or tank.

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

- Store water to provide a reliable irrigation water supply or regulate available irrigation flows.
- Improve water use efficiency on irrigated land.
- Provide storage for tailwater recovery and reuse.
- Provide irrigation runoff retention time to increase breakdown of chemical contaminants.
- Reduce energy use.
- Develop renewable energy systems (i.e., hydropower).

CONDITIONS WHERE PRACTICE APPLIES
This practice applies to irrigation water storage structures that meet one or more of the following criteria:

- The existing available water supply is insufficient to meet irrigation requirements during all or part of the irrigation season.
- Water is available for storage from surface runoff, stream flow, irrigation canals, or a subsurface source.
- A suitable site is available for construction of a storage reservoir.

This practice applies to planning and functional design of storage capacity, and inflow/outflow capacity requirements for irrigation storage reservoirs. Storage reservoirs shall be planned and located to serve as an integral part of an irrigation system.

This practice applies to reservoirs created by embankment structures or excavated pits to store diverted surface water, groundwater, or irrigation system tailwater for later use, or reuse.

The practice also applies to reservoirs created by embankment structures or excavated pits and tanks constructed of concrete, steel, or other suitable materials used to collect and regulate available irrigation water supplies to accomplish the intended purpose.

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.

Structure type selection (excavated pit, embankment, or tank) shall be based on a site specific assessment involving hydrologic studies, engineering and geologic investigations, available construction materials, and natural storage.

Storage Capacity. Design capacity computations shall be based on planned inflow volumes and rates over the storage period, and outflow volumes and rates required to meet planned irrigation system needs.

Structure storage capacity must provide sufficient volume to meet variations in water demand within the irrigation period.

Compute demand flow rates based on the consumptive use-time relationship using anticipated irrigation efficiencies, conveyance losses, and other uses such as leaching, frost control, seepage, and evaporation.

Irrigation storage reservoirs planned primarily to regulate irrigation flows shall have adequate capacity to provide design irrigation application flow rates.

Structure capacity shall provide adequate storage for inflow while maintaining sufficient water levels to insure proper operation of outlet works and provide uniform outflow rate during planned irrigation events.

Provide additional capacity as needed for sediment storage.

Foundation, Embankment, and Spillways. Earthen dams, embankments, pits, associated spillways, and appurtenant structures shall be designed to meet criteria in the applicable Wisconsin NRCS Conservation Practice Standard (WI NRCS CPS), Pond (378).

Seepage. Prevent excessive seepage losses by use of an appropriate method of sealing or lining.

Overflow Protection. Overflow protection shall be provided if overflow of the irrigation storage reservoir is possible.

Inlet and Outlet Works. Design conduit and open spillways according to guidelines in appropriate chapters of the NRCS National Engineering Handbook.

Provide inlet works when needed to prevent erosion or control flows into the irrigation storage reservoir. Inlet works may consist of a direct pumping system, conduit, grassed channel, lined channel, chute, head gates, valves, or other appurtenances necessary to safely convey and control water entering the structure.

Outlet works shall be provided for controlled withdrawal, transfer, or release of irrigation water. Outlet works may consist of a direct pumping system or a conduit from the storage reservoir to an area of use. The capacity of the outlet works shall be adequate to provide the outflow rate needed to meet irrigation system demands.

Design and install specialized inlet or outlet works when needed to avoid entraining or impinging aquatic organisms.

Additional Criteria Applicable to Storage for Tailwater Recovery and Reuse

Capacity. When energy sources for tailwater pump back systems are subject to interruption and safe emergency bypass areas cannot be provided, or tailwater discharges violate local or state regulations, tailwater storage requirements shall, as a minimum, include a volume adequate to store all tailwater runoff from a single irrigation set.

Additional Criteria Applicable to Irrigation Runoff Retention Time to Increase Breakdown of Chemical Contaminants

Capacity. Where additional storage or flow regulation are required to provide adequate retention time for breakdown of chemicals in runoff waters, storage facilities shall be sized accordingly. Allowable retention times shall be site specific to the particular chemical of concern.

Additional Criteria Applicable to Reduce Energy Use

Provide analysis to demonstrate reduction of energy use from practice implementation.

Reduction of energy use is calculated as average annual or seasonal energy reduction compared to previous operating conditions.

Additional Criteria Applicable to Develop Renewable Energy Systems

Renewable energy systems shall meet applicable design criteria in NRCS and/or industry standards, and shall be in accordance with manufacturer's recommendations. Hydropower systems shall be designed, operated, and maintained in accordance with the Microhydropower Handbook, Sections 4 and 5, as appropriate.

CONSIDERATIONS

When planning this practice, the following items should be considered where applicable:

- Potential energy savings resulting from regulation of irrigation flows, tailwater reuse, improved pumping plant efficiency, or management changes.
- Planting of critical areas at the completion of construction to protect the structure and borrow areas, and prevent erosion.
- Effects of soil physical and chemical properties, as well as potential soil limitations, relating to embankment construction, compaction, stability, bearing strength, pool area seepage, and soil corrosivity. Refer to soil survey data as a preliminary planning tool for assessment of pool and borrow areas, and conduct
- On-site soil investigations during the final planning stage.
- Perimeter fences to prevent human and animal access, and emergency escape facilities to minimize human safety hazards.
- Construction-related effects on air quality and on water quality of downstream water courses.
- Potential for earth moving construction to uncover or redistribute toxic materials or on-site invasive species.
- Development of water budgets, to quantify sources of inflow (precipitation and withdrawals), and outflow (evapotranspiration and losses).
- Impacts on downstream flows or aquifers that could affect other water uses or users.

- Impacts on the quantity of downstream flows, which could have undesirable environmental, social, or economic effects.
- Impacts of erosion, sediment, soluble contaminants, seeds or vegetative materials of invasive species, and contaminants attached to sediment in runoff.
- The movement of dissolved substances to ground water.
- Effects of water temperature changes on aquatic and wildlife communities.
- Timing of vegetation-disturbing maintenance activities, to avoid grassland bird nesting seasons.
- Impacts on wetlands or water-related wildlife habitats.
- Impacts on the visual quality of water resources and the landscape.
- Impacts on cultural resources.
- Performing periodic water quality analysis to evaluate salinity, nutrients, pesticides, and pathogens.
- Opportunities to include variety in vegetation for embankment stabilization or revegetation maintenance, that would provide pollinator forage from early spring to late fall.

PLANS AND SPECIFICATIONS

Plans and specifications for constructing irrigation storage reservoirs shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purposes.

Plans and specifications for constructing earthen irrigation storage reservoirs shall be based on criteria found in WI NRCS CPS, Pond (378).

Plans and specifications for tanks constructed of non-earthen materials shall be based on construction and materials specifications for WI NRCS CPS, Watering Facility (614).

OPERATION AND MAINTENANCE

An Operation and Maintenance plan shall be prepared for landowner or operator use. The plan shall provide specific instructions for operating and maintaining facilities to ensure they function properly. The plan shall include the following provisions:

- Periodic cleaning and regrading of water storage facilities to maintain functionality.
- Periodic inspection, removal of debris, and repair if needed of trash racks and inlet and outlet structures to assure proper operation.
- Routine maintenance of mechanical components in accordance with manufacturer recommendations.
- Periodic inspection and maintenance of embankments and earth spillways to repair damage or control erosion and undesirable vegetation.
- Periodic removal of sediment from traps or storage facilities to maintain design capacity and efficiency.
- Periodic Inspection or testing of all pipelines and pumping plant components and appurtenances, as applicable.

REFERENCES

McKinney, J.D., et al. Microhydropower Handbook, IDO-10107, Volumes 1 & 2. U.S. Department of Energy, Idaho Operations Office.

NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

MINE SHAFT AND ADIT CLOSING

CODE 457
(NO.)

DEFINITION

Closure of underground mine openings by filling, plugging, capping, installing barriers, gating, or fencing.

PURPOSE

- Reduce hazards to humans and/or animals.
- Maintain or improve access and/or habitat for wildlife.
- Protect cultural resources.
- Reduce subsidence problems.
- Reduce the emission of hazardous gases.
- Reduce or prevent contamination of surface and ground water.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to the investigation, design and treatment of locations where shafts, subsidence pits, or adits of underground mines are open or where prior closures can be modified to accomplish one or more of the above purposes.

This practice may be associated with surface treatment to reclaim the area surrounding the mine opening.

FEDERAL, STATE, AND LOCAL LAWS

Users of this standard should be aware of potentially applicable federal, state and local laws, rules, regulations or permit requirements governing mine shaft and adit closings. This standard does not contain the text of federal, state, or local laws.

CRITERIA

General Criteria Applicable to All Purposes

Fences or gates shall be used where it is essential to occasionally enter or gain access to shafts or adits.

Fences, gates or other closure techniques that maintain or enhance bat and other wildlife habitat shall be considered where habitat exists. Where bats or other wildlife inhabit the mine, and wildlife friendly closures are not feasible, an exclusion plan for the bats or other wildlife shall be written and implemented.

Fencing, gates, caps, and walls shall be used only where periodic inspection and maintenance is ensured through a maintenance agreement with a responsible government entity, landowner, or organization.

1. Safety.
   Teams consisting of a minimum of two persons each are required to conduct searches for concealed shafts and adits, leaving their specific schedule with others. Safety barriers, ropes, safety belts, gas detectors, and other equipment must be used as necessary during site reconnaissance, surveying, and foundation investigation activities.

   If hazardous gas is present, a person with United States Mine Safety and Health Administration (MSHA) certification for underground work shall be on site to monitor safety during the site investigation and practice installation.

   During construction, a collapse zone shall be established, clearly marked with fencing and warning notices, and no person shall enter this zone without wearing proper safety equipment.

   Bumper blocks or other devices must be used to keep machinery and trucks from falling into shafts and subsidence pits. If possible, equipment blades and buckets shall be larger than the opening being filled.

   If explosives or items that resemble explosives are found, do not handle them and report the findings to the local MSHA office.

   At the completion of the closing, filled or plugged shaft or adit locations shall be marked in the field and an affidavit of mine closing shall be recorded with the local register of deeds to reduce the risk of future development over the shaft or adit.

2. Report.
   A site investigation report shall document the following information:

   - Geology and groundwater conditions at the site,
   - Access conditions into mine,
   - Risks to life and property associated with the mine,
   - Equipment and trash within mine,
   - Presence of hazardous gases,
   - Presence of acid mine drainage,
   - Mine history including mine plan if available,
   - Inventory of plant or animal species using the mine, and
   - Potential for surficial changes due to water table variation.

3. Design References.
   Agricultural Engineering Note 1, Treatment of Abandoned Mine Shafts and Adits, contains guidance on investigation, safety, design and construction and is to be used as a procedural guide with this standard. Agricultural Engineering Note 1 was developed specifically for coal mines and all information does not apply to other types of mines.

   Guidance for enclosures and gates for bat conservation purposes is found in the Bat Conservation International publication, Bats and Mines.

Additional Criteria for Fences and Gates

Fences or gates shall be constructed to keep unauthorized persons out and shall be located where subsidence or caving will not break their integrity. Where applicable, fences and gates shall be designed to maintain or improve habitat and access for bats and other wildlife.

Fences or gates shall be made of steel, concrete, masonry, or "anti-intruder" chain link and barbed wire fences or a combination of these materials.

Additional Criteria for Designed Filling or Sealing

Shafts and adits shall be cleaned of all trash, debris, metal, timber, wire and other materials that could hinder an effective designed filling or sealing.

All materials removed shall be disposed of by burning or burying at approved sites or transported to approved landfills.

The finished surface of the filled or plugged shaft or adit shall be graded to provide free drainage away from the opening and vegetation established in accordance with NRCS standards.

Stockpiled soil or rock materials shall be protected from erosion until used.

1. Designed Filling.
   Shafts or adits shall be filled to about 3 feet from the surface with a designed filter consisting of nonacid-forming, free-draining materials or polyurethane foam.

   The remainder of the shaft or adit shall be filled with earth materials including a minimum of 3 feet of clay compacted in 9-inch lifts or other impervious materials that would retard the passage of water or gas. Shaft openings shall be overfilled 10 percent of the depth of the shaft, or 3 feet, whichever is less to allow for settlement.

   Subsidence pits that are open, active, and/or passing a significant quantity of water require a designed filter of nonacid-forming, free-draining material. Sufficient soil covering shall be placed to sustain planned vegetation.

   Subsidence pits that are closed, inactive, and not passing a significant quantity of water shall require only backfilling with suitable soil material. Sinkhole openings shall be overfilled 10 percent of the fill depth, or 3 feet, whichever is less to allow for settlement.

2. Sealing with Plugs.
   Shafts shall be closed with plugs only if another practical solution is not available. Installed below the ground surface, plugs are used where the shaft is to be filled to the surface but the shaft below is to remain open.

   Plugs shall be constructed of reinforced concrete designed to support anticipated loads. The reinforced concrete shall be placed on firm bedrock. Plugs may be designed to be watertight and gastight or to allow drainage and venting of gases.

   The shaft above the plug shall be filled to about 3 feet from the surface with a designed filter consisting of nonacid-forming, free-draining materials or polyurethane foam.

   The remainder of the shaft above the plug shall be filled with earth materials including a minimum of two layers of clay, approximately 2 feet thick, or other impervious materials that would retard the passage of water or gas. Shaft openings shall be overfilled 10 percent of the depth of the shaft above the plug to allow for settlement.

   The finished surface of the plugged shaft shall be graded to provide free drainage away from the opening and vegetation established in accordance with NRCS standards.

3. Sealing with Caps and Walls.
   Caps and walls shall be constructed of reinforced concrete or steel beams and grates or solid steel plates to completely close shaft or adit openings.

   Caps and walls shall be designed with sufficient strength to support anticipated loads and shall be securely anchored.

   The cap, wall, fittings, access holes, and vent pipe shall be reasonably vandal proof. The surface of a cap over a shaft must be raised not less than 1 foot above the surrounding terrain to provide good visibility and positive drainage away from the cap installation.

4. Sealing with Barriers.
   Barriers shall be constructed to restrict humans and animals from entering adits, and may be used to prevent lateral spreading of backfill material and to support fill used to cover adit openings.

   Barriers shall be constructed of stones, crushed rock, quarry-run rock, gravel or similar nonacid-forming, free-draining materials.

   The minimum filled length of the barrier shall be three times the maximum adit height or width within the barrier section, whichever is greatest.

   Concrete or masonry wall may be used to support the barrier. Barriers not supported by concrete or masonry walls shall have 3 horizontal to 1 vertical or flatter slopes.

   Barriers at the ground surface shall be covered with soil materials to a minimum vertical thickness of 4 feet and vegetation shall be established in accordance with NRCS standards.

   Where needed, a permanent drainage system using pipe or rock toes shall be installed through this covering. Traps to prevent air or gas passage shall be used where necessary.

5. Sealing with Dams.
   Dams are constructed to prevent water flow into or out of adits.

   Dimensional requirements are those stated for barriers in the previous section.

   The fill shall be essentially watertight and designed to support anticipated structural and hydraulic loads. Designed filters shall be incorporated to prevent piping of the fill material.

CONSIDERATIONS

Consider the following for maintaining or enhancing bat and other wildlife habitat:

- Species using the mine.
- Seasons and purpose mine is used by bats or other wildlife.
- Effects on airflow and temperature of the mine caused by a closure. Small changes in environment can have significant negative or positive effects on suitability for bat use.

PLANS AND SPECIFICATIONS

Plans and specifications for closing shafts and adits shall be in keeping with this standard and shall describe the requirements for applying the practice to the specific site to achieve its intended purpose or purposes.

OPERATION AND MAINTENANCE

Barriers, fences, gates, and caps are to be maintained to accomplish their purpose.

A site-specific operation and maintenance plan shall be developed for all gated, fenced, and capped closures. Regular inspections shall take place and prompt repair and follow-up shall be carried out. Additional maintenance activities shall be outlined in the maintenance plan.

REFERENCES

Bats and Mines by Merlin D. Tuttle and Daniel A.R. Taylor, Bat Conservation International, Inc., 1998 Revision.

USDA, NRCS, Agricultural Engineering Note 1**,** Treatment of Abandoned Mine Shafts and Adits, January 1981.

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

NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

OBSTRUCTION REMOVAL

CODE 500
(AC.)

DEFINITION

Removal and disposal of buildings, structures, other works of improvement, vegetation, debris, or other materials.

PURPOSES

The purpose of this practice is to safely remove and dispose of unwanted obstructions in order to apply conservation practices or facilitate the planned land use.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies on any land where existing obstructions interfere with planned land use development, public safety or infrastructure. This standard is not intended for the removal of obstructions from aquatic environments.

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

CRITERIA

The following criteria apply to all purposes:

- Rock piles, boulders, stones, fences, hedge rows, abandoned buildings and structures, trash, and similar obstructions that would interfere with planned use and development shall be removed.
- All debris such as broken concrete and masonry, structural steel and wood, stones, stumps, slash, and sterile or toxic soil material shall be disposed of so that they will not impede subsequent work or cause damage to off-site or other areas.
- Dispose of inorganic materials such as rock piles, boulders, stones, concrete or masonry structures, and metal or concrete fence posts by reusing, removal, or burial at approved locations.
- Dispose of organic materials such as wooden fence posts, woody vegetation, and woody building materials by removal to an approved landfill or recycling center, burial at an approved location or burning. If burning is used, implement appropriate smoke management to protect public health and safety.

- When removing buildings, ensure that all utilities, such as gas and electric, have been shut off and disconnected from the structure before beginning demolition.
- Reshape and regrade all areas disturbed by the obstruction removal so that they blend with the surrounding land features and conditions. Any foundations or below-ground portions of the obstruction that remain in place or buried materials shall have sufficient soil cover to meet the requirements of the planned land use. Compact fill areas according to site-specific requirements.
- All required gully shaping shall be performed to specified dimensions and grades. Gully fills shall be compacted to the required density.
- Revegetate or otherwise protect from erosion disturbed areas as soon as possible after construction according to Wisconsin NRCS Conservation Practice Standard (WI NRCS CPS), Critical Area Planting (342).
- Historically or archaeologically significant and scenic values shall be identified and preserved as appropriate.
- The removal of obstructions can expose toxic or polluted materials. If toxic or polluted materials are expected to be found during the obstruction removal, specify appropriate handling and disposal criteria in the plans and specifications.
- When removing obstructions that contain chromated copper arsenate (CCA) treated wood, do not burn the wood. Burning of CCA treated wood can release toxic amounts of arsenic into the air and ash that are very harmful to human and animal health. CCA treated wood should be buried in an approved landfill.

VI. CONSIDERATIONS

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

- The recycling or reuse of materials should be considered as the first option for disposal of materials from obstruction removal. Most woody debris can be recycled into mulch or other products. Recycling or other environmentally friendly options exist for the disposal of many other materials as well.
- Demolition activities can generate large amounts of dust. Where necessary, use dust suppression techniques such as spraying water on the removal site to suppress dust.
- Obstruction removal can result in the disturbance of large areas that are subject to erosion during the demolition process. Where necessary include provisions in the plans to control erosion and off-site sedimentation.
- Obstruction removal often involves heavy equipment working in environmentally sensitive areas. Ensure that servicing and refueling of equipment is done in a manner that minimizes spills and volatilization.
- Demolition of structures and the removal of debris can be a hazardous undertaking. This is especially true for the removal of downed and tangled trees. This type of work should be done by well qualified personnel with proper equipment following appropriate safety procedures.
- Rock piles or stone fences should be removed from crop fields.
- Consider the use of native species for re-vegetation of disturbed areas.

PLANS AND SPECIFICATIONS

Prepare plans and specifications for obstruction removal that describe the requirements for applying the practice according to this standard. Plans and specifications for this practice can be included in the plans and specifications for the practice it supports. As a minimum the plans and specifications shall include:

- A plan view showing the location of the obstruction removal site,
- Details and location for the disposal of materials from the obstruction removal,
- Details of how the site will be stabilized after construction, and
- Construction specifications that describe in writing, site-specific requirements for the obstruction removal.

OPERATION AND MAINTENANCE

An Operation and Maintenance Plan shall be developed that is consistent with the purpose of this practice, intended life of the components, and criteria for design.

REFERENCES

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

U. S. Department of Labor. Occupational Safety and Health Administration. Safety and Health Regulations for Construction, 29 CFR 1926. U. S. Washington, DC.

NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

PUMPING PLANT

CODE 533
(NO.)

DEFINITION

A facility that delivers water at a designed pressure and flow rate. Includes the required pump(s), associated power unit(s), plumbing, appurtenances, and may include on-site fuel or energy source(s), and protective structures.

PURPOSE

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

- Delivery of water for irrigation, watering facilities, wetlands, or fire protection;
- Removal of excessive subsurface or surface water;
- Providing efficient use of water on irrigated land;
- Transfer of animal waste as part of a manure transfer system;
- Improvement of air quality; and/or
- Reduce energy use.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies where conservation objectives require the addition of energy to pressurize and transfer water to maintain critical water levels in soils, wetlands, or reservoirs; transfer wastewater; or remove surface runoff or groundwater.

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

CRITERIA

The following criteria apply to all purposes.

General. The efficiency of units, type of power, quality of building, automation features, and other accessories installed shall be in keeping with the economic and environmental value of the system to accomplish the conservation objectives.

Criteria for the design of components not addressed in NRCS practice standards shall be consistent with sound engineering principles.

Capacity. The capacity of the pumping facility shall be adequate for the intended use. Livestock water requirements shall be in accordance with Wisconsin NRCS Conservation Practice Standard (WI NRCS CPS), Watering Facility (614).

Pump Requirements. The capacities, range of operating lifts, and general class and efficiency of equipment shall be determined by appropriate technical means.

The size and number of pumps and their performance shall be determined on the basis of the conservation system requirements in order to meet the intended purpose.

The total head shall be determined for critical operating conditions, taking into account all hydraulic losses.

Selection of pump materials shall be based on the physical and chemical qualities of the material being pumped and manufacturer's recommendations.

Power Units. Power units shall be selected on the basis of availability of fuel or power costs, operating conditions, conservation needs, and objectives, including the need for automation and other site-specific objectives. The power unit shall be matched to the pump and be capable of operating the pump efficiently and effectively within the range of operating conditions.

The power unit shall be sized to meet the horsepower requirements of the pump, including efficiency, service factor, and environmental conditions.

Electric power units may include line power, photovoltaic panels, and wind or water powered turbines.

Electrical wiring shall meet the requirements of the National Electrical Code.

Renewable energy power units shall meet applicable design criteria in NRCS and/or industry standards, and shall be in accordance with manufacturer's recommendations.

Frequency Drives. The owner shall inform the electric power provider that a Variable Frequency Drive will be installed prior to installation, and be responsible for following requirements of the electric power provider.

The Variable Frequency Drive shall be protected against overheating.

The Variable Frequency Drive control panel shall provide the read out display of flow rate or pressure.

Photovoltaic panels. The photovoltaic array shall be sized based on average data for the location and the time of year pumping occurs, according to manufacturer's recommendations. The photovoltaic array shall provide the power necessary to operate the pump at the design flow rate, with the appropriate service factor considering a minimum panel degradation of 10 years. Fixed arrays shall be oriented to receive maximum sunlight. Panel tilt angle shall be based on the location latitude and time of year for power requirements. Panels shall be mounted securely to resist movement by environmental factors.

Windmills. Pumping units shall be sized according to pumping lifts and capacities, as specified by the manufacturer. The diameter of the mill shall be based on the stroke length and the average wind speed. Towers shall be proportioned to the mill diameter, with adequate height for efficient and safe operation.

Hydraulic Rams. Hydraulic rams shall be of a size and capacity which shall meet the minimum pumping rates and volumes at the maximum anticipated total head and shall be installed in accordance with the manufacturer's recommendations. Adequate bypass facilities shall be provided to prevent erosion or unstable conditions resulting from the hydraulic ram operation.

Backflow prevention shall be incorporated when pumping from wells.

Suction and Discharge Pipes. To prevent cavitation, suction and discharge pipes shall be designed to account for suction lift, net positive suction head, pipe diameter and length, minor losses, temperature, and altitude. The size of suction and discharge pipes shall be based on hydraulic analysis, operating costs, and compatibility with other system components.

Appurtenances such as gate valves, check valves, pressure reducing valves, pressure gages, pipe connections, and other protective devices, shall be included to meet the requirements of the application.

Screens, filters, trash racks, or other devices shall be installed as needed to prevent the intake of sand, gravel, debris, or other objectionable material into the pump. Intake screens shall be designed according to applicable Federal and State guidelines, to avoid entrainment or trapping of aquatic organisms.

Backflow prevention devices shall be included according to Federal, State, and Local laws, to prevent contamination of water sources connected to the pumping plant.

Building and Accessories. Pumps shall be securely mounted on a solid foundation such as pilings or concrete. Foundations shall be designed to safely support the loads imposed by the pumping plant and appurtenances. Sheet piling or other measures shall be used, as required, to prevent piping beneath the foundation.

Where buildings are necessary to protect the pumping plant, provisions shall be included for adequate ventilation and accessibility for equipment maintenance, repairs, or removal.

Suction bays or sumps shall be designed to prevent the introduction of air at the intake.

The discharge bay or the connection to the distribution system shall meet all hydraulic and structural requirements.

Structures and equipment shall be designed to provide adequate safety features to protect operators, workers, and the public from potential injury. Drive shaft covers shall be required on all exposed rotating shafts.

Additional Criteria Applicable to Providing the Efficient Use of Water on Irrigated Land

Provisions for the connection of flow and pressure measurement devices shall be included in power plant system design.

Additional Criteria Applicable to the Improvement of Air Quality

Replacement pumping plants shall have lower total emissions of oxides of nitrogen and fine particulate matter, compared to the unit being replaced.

New, replacement, or retrofitted pumping equipment shall utilize a non-combustion power source, or cleaner-burning technologies or fuels.

Additional Criteria Applicable to Reduce Energy Use

For fossil fuel or electrical grid power sources, pumping plant installations shall meet or exceed the Nebraska Pumping Plant Performance Criteria, if applicable. Refer to NRCS National Engineering Handbook, Part 652, National Irrigation Guide, Table 12-2.

CONSIDERATIONS

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

- Freezing weather conditions must be considered in the design of the pumping plant.
- Consider the minimum water storage needed for livestock systems to satisfy the watering demands in a timely manner.

- Consider effects on downstream flows, aquifer recharge volumes, or existing wetland hydrology.
- Consider effects on surface or groundwater by leaked or spilled fuels and lubricants.
- The operation and maintenance of a pumping plant can involve the use of fuels and lubricants that when spilled may adversely affect surface or ground water quality. Consider measures to protect the environment from potential spills. In some cases, secondary containment of spilled fuel may be required by Federal and State laws or regulations.
- Pumping plants are often constructed in flood-prone areas or can be subject to other unexpected natural events. Consider how the pumping plant may be protected from extreme natural events and the consequences of damage or failure.
- Include protective sensors to detect low or stopped flow, or pressures that are too high or too low.
- The visual appearance of buildings or structures associated with the pumping plant should be compatible with the surrounding environment.
- When installing new or replacing existing combustion equipment, non-combustion and renewable energy sources, such as solar, wind, and water, should be considered.

PLANS AND SPECIFICATIONS

Plans and specifications for constructing pumping plants shall be in accordance with this standard and describe the requirements for properly installing the practice to achieve its intended purpose. As a minimum, the plans and specifications shall include the following:

- A plan view showing the location of the pumping plant in relationship to other structures or natural features.
- Detail drawings of the pumping plant and appurtenances, such as piping, inlet and outlet connections, mounting, foundations, and other structural components.
- Written specifications that describe the site specific details of installation.

OPERATION AND MAINTENANCE

An Operation and Maintenance plan specific to the facilities installed shall be prepared for use by the landowner or responsible operator. The plan shall provide specific instructions for operating and maintaining facilities to ensure the pumping plant functions properly. The plan shall include provisions to address the following as a minimum:

- Inspection or testing of all pumping plant components, appurtenances, safety features, and secondary containment facilities as applicable.
- Proper startup procedures for the operation of the pumping plant.
- Routine maintenance of all mechanical components (power unit, pump, drive train, etc.) in accordance with the manufacturer's recommendations.
- When applicable, the power unit, fuel storage facilities, and fuel lines should be frequently checked for fuel or lubricant leaks and repaired as needed.
- Periodic checks and removal of debris as necessary from trash racks and structures to assure adequate capacity reaches the pumping plant.
- Periodic removal of sediment in suction bays to maintain design capacity and efficiency.
- Inspect and maintain antisiphon devices, if applicable.

- Routinely test and inspect all automation components of the pumping plant to assure they are functioning as designed.
- Inspect and maintain secondary containment facilities, if applicable.
- Procedures to protect the system from damage due to freezing temperatures.
- Periodic inspection of all safety features, to ensure proper placement and function.
- Prior to retrofitting any electrically powered equipment, electrical service must be disconnected and the absence of stray electrical current verified.

REFERENCES

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

NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

SPOIL SPREADING

CODE 572
(AC.)

DEFINITION
Disposal of surplus excavated materials.

PURPOSES
To dispose of excess soil from construction activities in an environmentally sound manner that minimizes soil erosion, protects water quality, and fits with the land use and landscape.

CONDITIONS WHERE PRACTICE APPLIES
This practice applies to sites where spoil material is available from excavation of channels, drainage ditches, irrigation canals, or other construction sites and where it is desirable and economically feasible to achieve one or more purposes.

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

CRITERIA
General Criteria
Spoil shall be spread over a designated area according to an approved plan.

Locate spoil spreading areas as close as practical to the excavation area to minimize haul distance. Spread spoil in relatively uniform layers,maintaining positive drainage away from the spoil. Do not spread spoil when the ground or spoil is frozen or excessively wet unless site-specific design considerations indicate frozen or wet conditions will not have adverse effects.

Location and placement of spoil shall be such as to avoid unnecessary destruction of riparian vegetation or wetlands.

Spoil spreading for other construction sites shall be in accordance with the standard and specification of the applicable conservation practices and shall be shaped to a designed form that blends visually with the landscape.

Excessively rocky, infertile, or otherwise unproductive spoil material shall not be spread directly on crop production areas. The topsoil from the productive area shall be stripped and stockpiled prior to spoil spreading and reapplied following spoil spreading operations.

Spoils that are known or suspected to be contaminated with toxic substances must be tested to determine the nature and toxicity of the contamination. Based upon the evaluation, develop a plan to remove and dispose of the spoil in an environmentally sound manner.

Placement Adjacent to Channels

For spoil spreading along channels or ditches, surfaces of spoil shall not be steeper than 4:1(4 horizontal to 1 vertical) on the landside and 3:1on the channel side if a berm is established between the edge of the channel and the spoil. The berm width shall be a minimum of 8 feet. If the spoil is spread to the edge of the channel, the channel side slope of the spoil shall be shaped to join the side slope of the ditch bank so that loose spoil will not roll or wash into the channel or ditch.

The spoil shall be placed so as not to endanger the stability of the ditch bank and shall not exceed 3 feet in height above the natural ground surface. The finished surface shall slope away from the edge of the channel or berm as feasible.

Provisions shall be made for the diversion or safe passage of surface water concentrating on the landside of the spoilbanks along channels or ditches, or canals.

Sod chutes, rock chutes, corrugated metal pipes,drop spillways, or other means shall be used to lower surface water concentrating on the landside of spoilbanks into the ditch.

Establishment of Vegetation

All spoil areas not used for cropland shall be seeded in accordance with Wisconsin NRCS Conservation Practice Standard (WI NRCS CPS), Critical Area Planting (342).

CONSIDERATIONS

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

- Consider effects on the water budget, especially on runoff, infiltration, deep percolation, and groundwater recharge.
- Consider effects of spoil placement on erosion and sediment delivery.
- Consider the potential effect of dissolved substances, including toxics from the spoil, to enter surface or groundwater.
- Consider effects on the visual quality of landscape or water resources.
- Consider effects on fish and wildlife habitat.
- Consider effects on adjacent wetlands.
- Consideration should be given to using spoil for direct or indirect human benefits such as blocking views, deflecting or redirecting wind or snow, and other uses.

PLANS AND SPECIFICATIONS

Prepare plans and specifications for spoil spreading that describe the requirements for applying the practice according to this standard. Plans and specifications for this practice may be incorporated into the plans and specifications for the practice it serves. As a minimum, the plans and specifications shall include:

- A plan view showing the location of the spoil area,
- Lift thickness for spoil placement,
- The maximum and/or minimum slopes for spoil areas,
- Typical cross sections of spoil areas,
- The maximum and/or minimum height of spread spoil above the existing ground surface,
- An estimate of quantities, and
- Construction specifications that describe in writing the site-specific installation requirements for the spoil spreading.

OPERATION AND MAINTENANCE

An Operation and Maintenance Plan (O&M) shall be developed that is consistent with the purpose of this practice, intended life of the components, and criteria for design.

The minimum requirements to be addressed in a written O&M plan include:

- Inspection of the spoil areas within six months after spreading and periodically thereafter,
- Fill or repair of any excessive rills or gullies in the spoil,
- Reestablishment of vegetation as necessary on the repaired areas,
- Mowing of the vegetation as necessary to maintain a dense, vigorous stand, and
- Control of undesirable species and/or noxious weeds as necessary.

REFERENCES

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