



## 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.

Foster, G. R., Revised Universal Soil Loss Equation, Version 2 (RUSLE2), Science Document, USDA-ARS, Washington DC, 2005.

USDA, NRCS, Revised Universal Soil Loss Equation Version 2 (RUSLE2) Wisconsin web site: <http://www.wi.nrcs.usda.gov/technical/consplan/rusle.htm> l.

Renard, K. G. Foster, G. A. Weesies, D. K. McCool, and D. C. Yoder, Coordinators. Predicting Soil Erosion by Water: A Guide to Conservation Planning with the Revised Soil Loss Equation (RUSLE), USDA, Agriculture Handbook 703, 1997.

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.

*In accordance with Federal civil rights law and U.S. Department of Agriculture (USDA) civil rights regulations and policies, the USDA, its Agencies, offices, and employees, and institutions participating in or administering USDA programs are prohibited from discriminating based on race, color, national origin, religion, sex, gender identity (including gender expression), sexual orientation, disability, age, marital status, family/parental status, income derived from a public assistance program, political beliefs, or reprisal or retaliation for prior civil rights activity, in any program or activity conducted or funded by USDA (not all bases apply to all programs). Remedies and complaint filing deadlines vary by program or incident. Persons with disabilities who require alternative means of communication for program information (e.g., Braille, large print, audiotape, American Sign Language, etc.) should contact the responsible Agency or USDA's TARGET Center at (202) 720-2600 (voice and TTY) or contact USDA through the Federal Relay Service at (800) 877-8339. Additionally, program information may be made available in languages other than English. To file a program discrimination complaint, complete the USDA Program Discrimination Complaint Form, AD-3027, found online at [How to File a Program Discrimination Complaint](#) and at any USDA office or write a letter addressed to USDA and provide in the letter all of the information requested in the form. To request a copy of the complaint form, call (866) 632-9992. Submit your completed form or letter to USDA by: (1) mail: U.S. Department of Agriculture, Office of the Assistant Secretary for Civil Rights, 1400 Independence Avenue, SW, Washington, D.C. 20250-9410; (2) fax: (202) 690-7442; or (3) email: [program.intake@usda.gov](mailto:program.intake@usda.gov). USDA is an equal opportunity provider, employer, and lender.*