NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARDS

CONTOUR BUFFER STRIPS
(Acres)
CODE 332

DEFINITION

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

PURPOSE

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

- Reduce sheet and rill erosion
- Reduce transport of sediment and other water-borne contaminants down slope
- Increase water infiltration

CONDITIONS WHERE PRACTICE APPLIES

This practice applies on all sloping cropland, including orchards, vineyards and nut crops.

For orchards, vineyards and nut crops use practice standard 331, Contour Orchard and Other Fruit Areas.

Where the width of the buffer strips will be equal to or exceed the width of the adjoining crop strips, the practice Stripcropping (code 585) applies.

CRITERIA

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

The width of the cropped strip shall be designed to accommodate some multiple of full equipment width.

No plants listed on the noxious weed list of the state will be established in a buffer strip cropping system.

Buffer strips shall not be used as travel lanes for livestock or equipment.

Buffer Strips are not a part of the normal crop rotation, and shall remain in the location they were originally established until they need to be renovated or re-established.

Field Borders: When concentrated water flows will develop or where up and down hill farming of end rows will result in a soil loss exceeding tolerable soil loss levels, establish and maintain field borders in perennial herbaceous vegetative cover. Field borders shall be sufficient width to accommodate turning farm equipment without additional end rows.

Row Grade. When the row grade of any crop strip reaches the maximum allowable design grade, a new baseline shall be established up or down slope from the last buffer strip and used for the layout of the n ext crop strip.

Arrangement of Strips. A crop strip shall occupy the area at the top of the hill, unless unusually complex topography requires vegetating 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 terraces so that the buffer strip boundaries will parallel the terraces as closely as possible. The buffer strip shall be located immediately upslope from the terrace channel or the storage area of the water and sediment control basin.

Additional Criteria to Reduce Sheet and Rill Erosion
Minimum Row Grade, The cropped strips shall have sufficient row grade to ensure that runoff water does not pond and cause unacceptable crop damage.

Row grades for soils with slow to very slow infiltration rates (soil hydrologic groups C or D), or for crops sensitive to ponded water conditions for periods of less than 48 hours, shall be designed with positive row drainage of not less than 0.2 percent sloping towards a stable outlet.

NRCS-Minnesota
September 2007

Maximum Row Grade. The maximum row grade shall not exceed:

- One-half of the up-and-down hill slope percent used for conservation planning, or
- 2%

Whichever is less.

Up to 3% row grade is allowed for a maximum of 150 feet as crop rows approach a stable outlet.

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

Width of Strips. The minimum width shall be:

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

Buffer strip widths shall be increased as needed to keep the width of the cropped s trips uniform.

Cropped strips shall be of uniform width between buffer strips and shall not exceed the lesser of the width listed in the table below or 50% of the slope length (L), used for the erosion calculation.

% Land Slope	Cropped Strip Width
1-2%	180 ft
3-5%	150 ft
6-8%	120 ft
9-15	105 ft
>16%	90 ft

Cropped strip widths shall be adjusted downward to accommodate equipment widths.

Vegetation. Buffer strips designed to reduce sheet and rill erosion shall be established to permanent vegetation consisting of grasses, legumes, or grass legume mixtures.

Species established shall be adapted to the site, and tolerant of the anticipated depth of sediment deposition. Develop contour buffer strip seed mixtures from Table 1.

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

The stem density for grass plantings shall be at least 50 stems per square foot, and for legume plantings shall be greater than 30 stems per square foot.

Additional Criteria to reduce the Transport of Sediment and Other Water-Borne Contaminants Downslope

Minimum Row Grade. The cropped strips shall have sufficient row grade to ensure that runoff water does not pond and cause unacceptable crop damage.

Maximum Row Grade. The maximum row grade within the crop strips shall not exceed:

- One-half of the up-and-down hill field slope used for conservation planning, or
- 2%

whichever is less.

Up to 3% row grade is allowed for a maximum of 150 feet as crop rows approach a stable outlet.

Vegetation. Buffer strips designed for this purpose shall be established to permanent sod-forming vegetation with stiff, upright stems.

Width of strips: Buffer strips for this purpose shall be at least 15 feet wide. The buffer strip widths shall be increased as needed to keep the width of the cropped strips uniform.

The maximum width of cropped strips shall be one-half of the field slope length or 150 feet, whichever is less. Cropped strip width shall be designed to account for some multiple of full equipment width.

Arrangement of Strips: In addition to the buffer strips established on the hillside, a buffer strip will be established at the bottom of the slope. This strip shall be two times the width of the narrowest buffer strip in the system.

Additional Criteria to Increase Water Infiltration

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

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 buffer strips are most effective on slopes ranging from 2 to 10%. 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 of about 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 when the slope length on the cropped strips is between 100 and 400 feet long. On slopes longer than 400 feet, the volume and velocity of overland flow exceeds the capacity of the contour ridges to contain them. Increasing residue cover and roughness will change the vegetative cover-management conditions and decrease overland flow velocities, thus increasing the slope length at which this practice is effective. Increasing roughness alone is not sufficient to produce this effect.

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 in-row grade limits.

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

Design and install the cropped strip layout to best facilitate operation of all machinery used on the strips. Whenever possible, layout cropped strips to have multiples of full implement widths used for the farming operation and an even number of trips across the field. Where adjustments are required to maintain in-row grade within design limitations, install odd area correction strips. Keep these adjustment areas to a minimum by adjusting entire field layout.

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. Considering grade limits, whenever possible, run strip boundaries parallel with fence lines or other barriers. Account for uncropped access road widths when they must traverse the field by adjusting strip boundaries on either side accordingly.

When harvest of buffer strip vegetation as a forage crop is an objective, delay harvest operations until after the early critical erosion period(s). Complete harvest operations in time to permit adequate regrowth of vegetation prior to a killing frost.

Wildlife Food and Cover. The following management activities may be carried out to enhance 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 of concern.
- Add native forbs to the seeding mixture to increase habitat diversity.
- 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.
- Mow between August 1st and September 1 to protect nesting wildlife and to allow for regrowth before the growing season ends.

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. The plans shall include, as a minimum:

- A seeding plan using form MN-CPA-003 indicating the species to be established in the buffer strips
- Percent land slope used for conservation planning
- The minimum and maximum allowable row grade for the contour system
- The designed width of the buffer strips

- .A sketch map or photograph of the field showing:
  - The approximate location of the baselines used to establish the system
  - The location of stable outlets for the system

This and other pertinent information shall be recorded on specification sheets, job sheets, in practice narratives in conservation plans, or other acceptable documentation.

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 of contour 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 contour buffer strips as needed to maintain stand density.

Mow turn strips and waterways annually after August 1st.

Manage pesticide applications to avoid spray application and/or drift onto adjacent contour buffer strips. Spot seed or totally renovate buffer strip systems damaged by herbicide application after residual action of the herbicide is complete.

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

If sediment accumulates just below the upslope edge of the contour buffer strip to a depth of 6 inches or more, or vegetative ground cover falls below 65 percent in the contour buffer strip, relocate the contour buffer/cropped strip interface location.

Rotate cultivated strips and contour buffer strips so that a mature stand of protective cover is achieved in a newly established contour buffer strip immediately below or above the old contour buffer strip before removing the old contour buffer to plant an erosion-prone crop. Alternate repositioning of buffer strips to maintain their relative position on the hill slope.

Control invasion of undesirable plant species through timely mechanical or chemical treatments, or by using properly applied Prescribed Burning (338).

Renovate vegetated headlands or end row area as needed to keep ground cover above 65 percent. Renovation shall only include the immediate seedbed preparation and reseeding to a sod-forming crop with or without a nurse crop.

REFERENCES

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

Renard, K.G., G.R. Foster, G.A. Weesies, D.K. McCool, and D.C. Yoder, coordinators. 1997. Predicting soil erosion by water: A guide to conservation planning with the Revised Universal Soil Loss Equation (RUSLE).U.S. Department of Agriculture, Agriculture Handbook 703.

SPECIFICATIONS

TABLE 1: Species Components for Designing Contour Buffer Strip Seed Mixtures

Species	% of Mixture Permitted	Seeding Rate as Single Species - PLS Lbs/Ac	Plant Species Adaptability: Drought	Flooding[3]/	Salts[4]/	pH Range	Longevity[5]/
Introduced Grasses:							
Smooth Bromegrass[1]	0-100	14	Good	Fair	Good	5.5-7.5	Long
Timothy[2]	0-25	5	Poor	Good	Fair	5.5-7.5	Short
Tall Fescue[2]	0-50	8	Good	Fair	Good	5.5-7.5	Moderate
Tall Wheatgrass[2]	0-50	22	Poor	Good	Excel	6.5-8.5	Moderate
Intermediate Wheatgrass[2]	0-50	20	Fair	Fair	Fair	6.5-8.5	Moderate
Russian Wildrye*	0-33	10	Good	Fair	Good	6.5-8.5	Moderate
Native Grasses:							
Canada Wildrye	0-10	12	Fair	Fair	Good	6.5-7.5	Short
Slender Wheatgrass[2]	0-10	8	Good	Good	Excel	6.5-8.5	Short
Western Wheatgrass[2]	0-50	16	Good	Good	Excel	6.5-8.5	Long
Big Bluestem[2]	0-50	8	Fair	Good	Poor	5.5-7.5	Long
Indiangrass[2]	0-25	8	Fair	Fair	Poor	5.5-7.5	Long
Switchgrass[2]	0-100	5	Poor	Good	Fair	5.0-7.5	Long
Little Bluestem[2]	0-25	8	Good	None	Fair	5.0-7.5	Long
Sideoats Grama[2]	0-25	8	Good	None	Fair	5.0-7.5	Long
Legumes:							
Alfalfa[2]	0-50	12	Good	Poor	Fair	6.2-7.5	Moderate
Red Clover[2]	0-33	9	Fair	Poor	Poor	5.5-7.5	Short
Alsike Clover	0-25	2	Poor	Good	Poor	4.0-7.5	Short

[1] Smooth Bromegrass has a potential for invasiveness. Use should be avoided adjacent to existing native prairie, state wildlife areas or conservation easement areas or other sensitive areas where native prairie species have been planted or next to high quality wetlands.

[2] Variety selection is important for this species. Select an adapted variety using information from practice standard Conservation Cover (327) or current edition of Minnesota Varietal Trials of Selected Farm Crops.

[3] Flooding Ratings - None <1 Week; Poor 1-2 Weeks; Fair 2-4 Weeks; Good 4-6 Weeks; Excellent >6 Week.

[4] Soluble Salts Ratings - Poor 0-2 mmhos; Fair 3-4 mmhos; Good 5-7 mmhos; Excellent 8-16 mmhos.

[5] Longevity - Short 1-4 Years; Moderate 5-10 Years; Long >10 Years.

HOW TO USE TABLE 1:

Take the total seeding rate as a single species and multiply that number by the percent of the total seed mixture desired for each species in the planned mixture. The answer is the seeding rate for each species in the mixture. The result after all computations is the seed mixture planned. The percent values for all species in the mixture must total 100%. The composition for any single species can not exceed the permitted percent shown.

Example 1: Desired seeding mixture is alfalfa (40%), smooth bromegrass (40%), and tall fescue (20%). Seeding mixture would be alfalfa 4.8 lbs (12 lbs total X 40% = 4.8 lbs); bromegrass 5.6 lbs (14 lbs total x 40% = 5.6 lbs); and tall fescue 1.6 lbs (8 lbs total x 20% = 1.6 lbs). Total pounds of seed per acre would be 12 (4.8+5.6+1.6=12).

Example 2: Desired seeding mixture is switchgrass (50%); big bluestem (40%); and Indiangrass (10%). Seeding mixture would be switchgrass 2.5 lbs (5 lbs total X 50% = 2.5 lbs); big bluestem 3.2 lbs (8 lbs total X 40% = 3.2 lbs); and Indiangrass 0.8 lb (8 lbs total X 10% = 0.8 lb). Total pounds of seed per acre would be 6.5 pounds (2.5+3.2+0.8=6.5).