NRCS Natural Resources Conservation Service

September 2010

Filter Strip (393)
Washington: Conservation Practice Specification Guide

Purpose of Specification Guide

This specification provides guidance for effective planning, design and installation of the Conservation Practice Standard: Filter Strip 393. The guidance may include reference information, examples and other considerations to assist with effective application of the practice according to site-specific conditions. Site specifications for the design, installation, operation and maintenance of the practice shall be prepared for each treatment area in accordance with criteria in the Conservation Practice Standard 393, the Conservation Practice Job Sheet and the guidance included in this document. The completed Job Sheet with practice specifications shall be reviewed with and provided to the client.

Filter Strip Definition: A strip or area of herbaceous vegetation that removes contaminants from overland flow.

Purposes:

Reduce suspended solids and associated contaminants in runoff.
Reduce dissolved contaminant loadings in runoff.
Reduce suspended solids and associated contaminants in irrigation tail water.

Inventory and Evaluation: A thorough site evaluation is needed to design a Filter Strip properly.
Site and management information needed to plan and design a Filter strip

1. Use Conservation Plan map to delineate and identify:
    a. individual fields
    b. sensitive water resource areas
    c. "contributing areas" of runoff
2. Define the "flow path" distance (ft) down slope from point of runoff initiation to the sensitive resource.
3. Document the shape of the slope and slope percentage along the flow path.
4. Document the soils that are present within the contributing area and along the flow path.
5. Document the land use management record using Rusle2 for the "contributing area".
    a. Crops and rotations with Yield, Field operations and applications with dates.
6. Document the climate record from Rusle2 database to use for the site.
7. Document the sources and intensity of the potential contaminants from the contributing area.
8. Document the benchmark resource assessments and evaluation for each Field
9. Document the crop production and conservation planning objectives of the client.
10. Document the resource concerns and purposes for design of conservation practices.

Filter strips are established where environmentally-sensitive areas need to be protected from sediment, other suspended solids and dissolved contaminates in runoff. In many cases, a filter strip area by itself may not eliminate the resource concerns. Filter strips are normally established as part of a conservation management system to address the soil, water, air, plant, animal, and human needs as related to the land manager goals and objectives.

It is important to consider conservation crop rotation, nutrient and pest management, crop residue management, agricultural waste utilization, and other supportive conservation practices, when designing a filter strip. Filter strips can also provide forage production and improve farm aesthetics. They are most effective in providing conservation benefits when used in combination with other agronomic or structural practices.

Specification:

Filter Strip 393 site placement, design and vegetation characteristics shall meet general criteria and the specific criteria associated with the intended purpose(s). Filter Strip site placement, Design and vegetation characteristics meet all local, state, Tribal and Federal regulations and permits that apply.

Filter Strip Vegetation

Perennial vegetation species that are adapted to the site are used for the purposes: Reduce suspended solids and associated contaminants in runoff and Reduce dissolved contaminant loadings in runoff. Plant species selected for a filter strip area are sod-forming rhizomatous species. When bunch forming species are included in the mix, try to limit them to occupy < 15% of the Filter Strip area.

Additional criteria, besides being well adapted for the site conditions and climate, selected species are able to withstand partial burial from sediment deposition and selected species are tolerant of herbicides used in the contributing runoff area that may move with runoff into the filter strip area.

Annual species that are adapted to the site are used for the purpose: Reduce suspended solids and associated contaminants in irrigation tail water. This purpose applies to gravity, furrow and flood irrigated fields. Examples include Wheat, Barley, triticale and rye. Additional criteria for this purpose include planting dates and establishment of the vegetation prior to the first irrigation. The seeding rate and method is designed to provide an established plant spacing that does not exceed 4 inches.

Plant materials Technical Note 1 Provides information in Washington for adapted species and mixes as well as links to information regarding plant characteristics and access to PLANTS database information (http://plants.usda.gov/ and vegetation establishment methods. The PM Tech note1 is located in Washington eFOTG Section I, reference lists; technical notes by discipline; Plant materials. http://efotg.sc.egov.usda.gov/efotg_locator.aspx?map

Establishment of Filter Strips can benefit and enhance wildlife habitat. Vegetation species can be included that provide wildlife food and cover as long as the primary water quality functions of the Filter Strip are maintained. Delay mowing of filter strip areas until after nesting season.

Plants listed as Noxious Class A-C in Washington are not established or left unmanaged in Filter Strips. The current list of noxious weeds, identification and management techniques in Washington are located on the Washington Noxious Weed Control Board website. Washington NWCB

Filter strip site location and dimensions:

- Concentrated flow shall be dispersed before it enters the filter strip.
- Overland flow entering the filter strip shall be a uniform sheet flow.
- The maximum gradient at the leading edge of the filter strip shall be (one-half of the up-and-down hill slope percent, immediately upslope from the filter strip, up to a maximum of 5%).
- The leading edge of the filter strip needs to be (perpendicular to water flow down slope along the flow path)
- The filter strip shall be located immediately down slope from the source area of contaminants.
- Slope of the “contributing area” immediately upslope from the Filter Strip is not less than 1%.
- For treatment of furrow irrigation tail water, the furrows do not extend into the filter strip area and water is distributed as sheet flow prior to entering into the Filter Strip area.

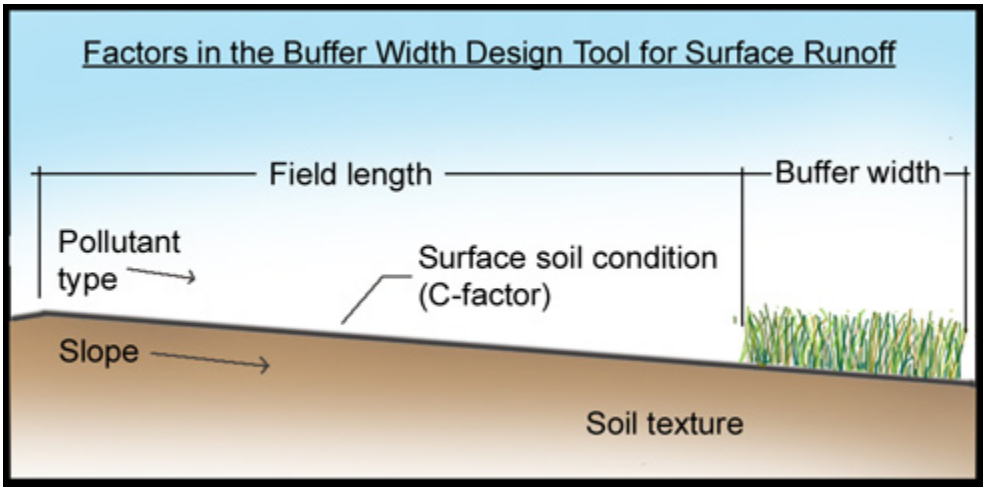
Minimum Filter Strip Widths (Flow path distance through Filter Strip) (Filter Strip 393)

To Reduce Suspended Solids and Associated Contaminants	20 ft
To Reduce Dissolved Contaminants in Runoff	30 ft
To Reduce Suspended Solids and Associated Contaminants in Irrigation Tail water	20 ft

Further information to help determine the appropriate Filter Strip width and design for site specific conditions and potential contaminant loadings is located at: Buffer Guidelines Website provides useful information concerning Buffer design as it relates to contaminants and a Buffer width design tool is available for use. The tool or process is located in section 1.19.

The following diagram illustrates the factors used by the Buffer width design tool. Management practices can be implemented on the contributing area to manage the sources (such as Nutrient management and Integrated Pest management), Slope (upslope grass buffers or terraces to shorten slope length) and surface soil condition (management activities such as aeration or practices such as residue and tillage management).

Buffer Width Design Tool for Surface Runoff

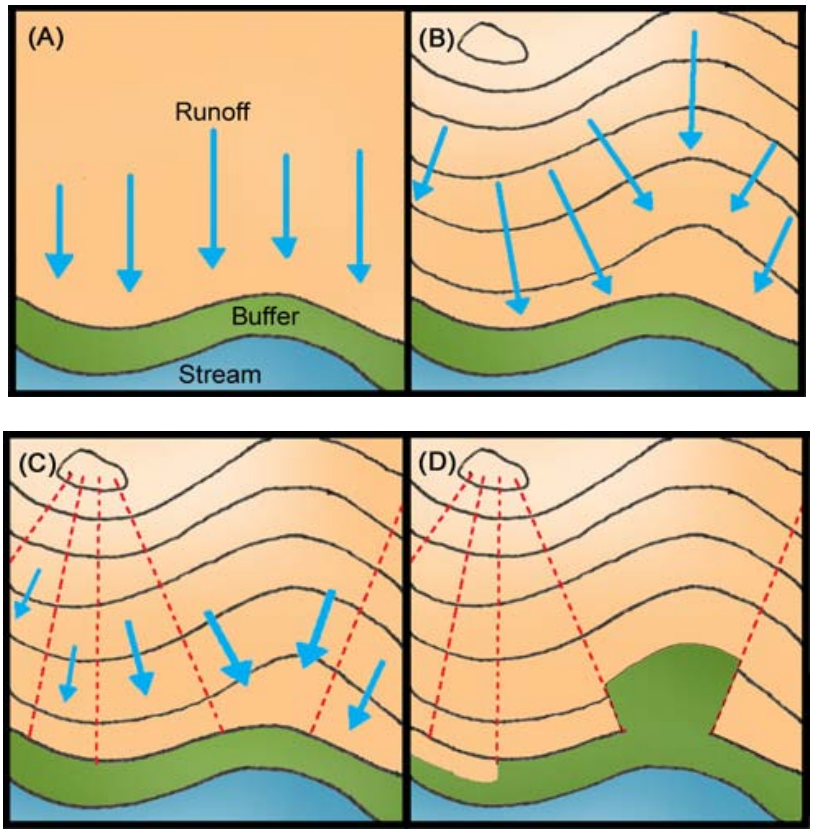


The tool is designed to quickly generate estimates of design width for a broad range of site conditions. Adjustments are made for land slope, soil texture, field size, and soil surface condition. The tool can be used for sediment, sediment-bound pollutants, and dissolved pollutants.

Another important topic on Buffer width design concerns variable width design due to the fact that most contributing areas are irregular slopes, with variable Flow Path distances and the resulting runoff generated is normally not one direction. A discussion of variable width Filter Strips is located at the same Buffer Guidelines website: Buffer Guidelines in section 1.7: Variable Buffer width.

1.7 Variable Buffer Width

Buffers may have a fixed width where uniform runoff occurs (A). However, runoff is often non-uniform and flow is either diverging or converging due to topography, tillage practices, and other factors (B). A fixed-width buffer will be less effective in these situations. Instead, buffer width should be variable by widening and narrowing the buffer as runoff loads and buffer site conditions vary.



Runoff areas and corresponding buffer locations to which they flow can be mapped (C). Buffer width can then be modified to account for differences in runoff loads (D). Buffers will need to be wider for upslope runoff areas that are larger and contribute greater loads.

The ratio of the upslope runoff area (contributing area) to Filter Strip area can be used when calculating estimated Life Spans for designed filter strips (Agronomy Tech Note 2). The ratio of areas is useful for uniform slopes and where the Flow path is uniform across the contributing area. The linear ratio of flow path length to filter strip width (distance through Strip) provides the same ratio value but is useful for non-uniform contributing areas and flow paths associated with a particular Filter Strip. Trapping efficiency and Life span can be calculated for several Flow paths and filter strip widths within a single contributing area for a filter strip. When Filter Strip 393 is used to rduce contaminants in irrigation tailwater, the filter strip is reestablished each year, so the it is not designed for a 10 yr life span.

Filter Strip Life Span Calculation

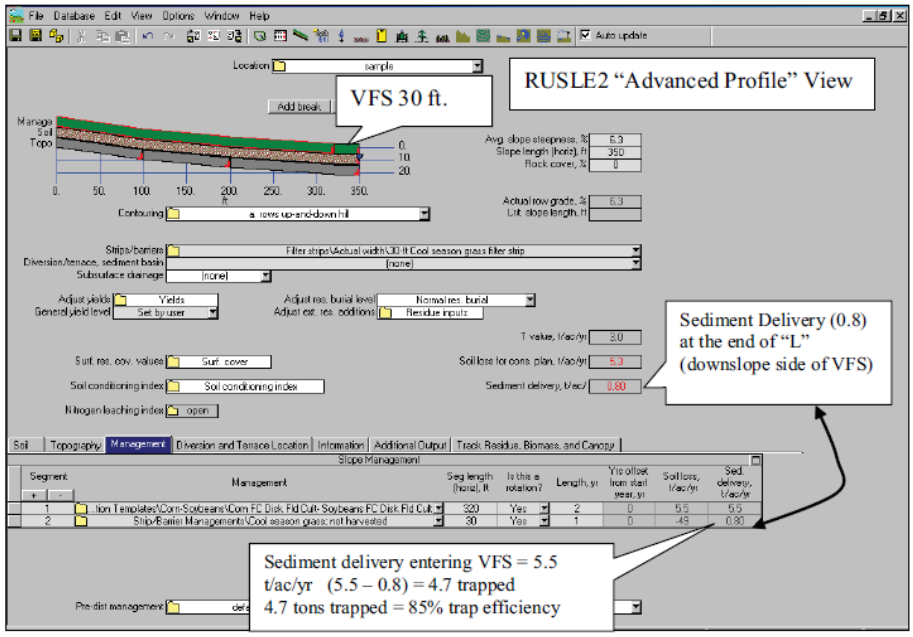
When the Filter Strip vegetation and layout is determined, Rusle2 and Agronomy Technical Note 2 are used to calculate a trapping efficiency and estimated life span of the filter strip. All filter strips are designed for a minimum 10 yr life span based on this procedure.

The management record for the contributing area is used in Rusle2 with the other inventory items collected for the site. Use the advanced worksheet profile template for site inputs to compare erosion and sediment loss estimates for the slope with and without a filter strip at the bottom of the slope.

The filter strip of perennial vegetation used to reduce sediment and contaminant loadings to a sensitive resource area is designed to have a 10-year life span, The procedure for determining Filter Strip Life span is provided in the nationally developed Agronomy Technical Note No. 2: Using RUSLE2 for the Design and Predicted Effectiveness of Vegetative Filter Strips (VFS) for Sediment. Technical note is available at http://directives.sc.egov.usda.gov and by selecting Technical notes, Ecological sciences and then Agronomy, or at http://www.nrcs.usda.gov/technical/agronomy.html. A spreadsheet tool is also available for calculations and is located at the same websites.

The procedure is based on the sediment delivery estimated by RUSLE2 and the sediment trapping efficiency of the VFS. The ratio of the Contributing Area to Filter Strip Area is used to estimate the life span of the installed filter strip. The straight line distance of the Flow path distance compared to Filter Strip width is an efficient calculation of this ratio if the Flow path distance is representative of the entire contributing area.

Figure 3 RUSLE2 profile view using the "advanced" RUSLE2 template option.

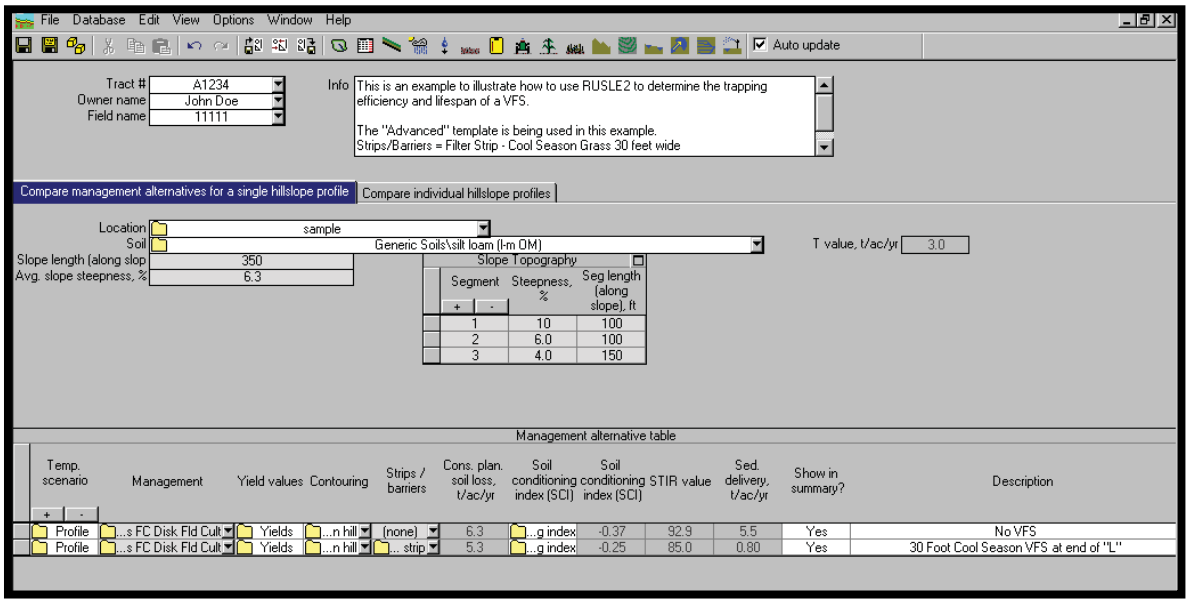


Agronomy Technical Note No. 2, June 2007 3

Filter Strip Life Span Example calculations using Rusle2: Example:
Model estimate sediment delivery to Filter Strip 5.5
Model estimate sediment through installed Filter strip = 0.8.
Trapping efficiency calculated as (5.5 – 0.8) = 4.7 Trapped.
4.7 T/ac trapped / 5.5 T/ac delivered = 85%.

Example continued:
Slope segment lengths and ratio are needed to calculate Life Span
For the example: Flow Path = 320 ft and Filter strip width = 30 ft.
Ratio 320 / 30 = 10.2 : 1

Using the 85% efficiency table from Agronomy Tech Note 2, the Life Span estimate is calculated.
The appropriate Row (T/ac sediment delivery to Filter Strip = 5.5) and appropriate column (Flow Path to Filter Strip width ratio=10:1) are selected
The intersecting cell in body of the table estimates Life span in Years of approximately 22 years..



A separate example calculation from Agronomy Technical Note 2: Example:

- **Sediment Delivery = 5 tons/acre/year;**
- **Sediment Leaving the VFS = 1.25 tons/acre/year**
- **Trapping Efficiency = 75% (.75)**
  - **(Sediment Delivered to VFS (5) – Sediment Leaving VFS 1.25) /Sediment Delivered to VFS (5)**
- **Ratio of Contributing Area (16 ac) to VFS area (0.8 acre) = 20 (16 / 0.8 = 20)**
- **5 t/ac/yr X 21.74 ft3/ton = 108.7 ft3/ac/yr**
- **108.7 ft3/ac/yr X .75 Trapping Eff. X 20 Ratio = 1630.6 ft3/ac/yr in VFS**
- **(1630.6 ft3/ac/yr in VFS / 43,560 ft2/ac) X 12 = 0.449 inches/yr Accumulated Sediment**
- **6.0 inches (Maximum Accumulation) / 0.449 in/yr**
- **Accumulated Sediment = 13.4 years to accumulate 6.0 inches of sediment in the VFS.**
- **(This would be an acceptable system for a minimum life span of 10 years)**

It is recommended that the EXCEL Spreadsheet, noted above, be used to calculate years available for the design of VFS for the purpose of sediment removal. The spreadsheet allows actual figures to be entered and reduces the need to perform calculations to determine trapping efficiency and the ratio of contributing area to VFS area.

Other critical design components for a VFS being designed to remove sediment

1. The leading edge of the VFS must be laid out as close to the contour as possible to minimize flow paralleling the VFS. This may require the VFS that varies in width to keep the leading edge on the contour.

2. The slope entering the VFS must be at least 1% to allow runoff to enter the VFS. Slopes less than 1% will cause runoff and sediment to back up into the contributing area and not enter the VFS.

3. VFS are not effective to treat concentrated flow. Concentrated flows need to be converted to overland flow before being routed through the VFS. Care must be taken to calculate the sediment delivery and the contributing area to VFS ratio from the concentrated flow area.

4. A dense vegetation with stems less than one (1) inch apart is required to achieve treatment for sediment, nutrients, pathogens, and pesticides. This will generally require a much higher seeding rate than field borders or hay/pasture plantings.

References

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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.

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USDA-NRCS, 2007. Agronomy Technical Note 2: Using RUSLE2 for the Design and Predicted Effectiveness of Vegetative Filter Strips (VFS) for Sediment. http://www.nrcs.usda.gov/technical/agronomy.html

USDA-NRCS, 2007. Filter Strip Life Span Design for Sediment workbook. http://www.nrcs.usda.gov/technical/agronomy.html

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