

SOIL CONSERVATION SERVICE

FILTER STRIP

Definition

A strip or area of vegetation for removing sediment, organic matter, and other pollutants from runoff and waste water.

Scope

This standard establishes the minimally acceptable requirements for design and operation and maintenance of filter strips for removing sediment, organic matter, and other pollutants from runoff or waste water. It does not apply to field borders (386).

This standard does not apply to filter strips used for industrial or human wastes.

Purpose

To remove sediment and other pollutants from runoff or waste water by filtration, deposition, infiltration, absorption, decomposition, and volatilization, thereby reducing pollution and protecting the environment.

Conditions Where Practice Applies

This practice applies: (1) on cropland at the lower edge of fields or above conservation practices such as terraces or diversions, or on fields adjacent to streams, ponds, and lakes; (2) in areas requiring filter strips as part of a waste management system to treat polluted runoff or waste water when bedrock and/or ground water are more than two feet below the ground surface; and (3) on forest land where filter strips are needed as part of a forestry operation to reduce delivery of sediment into waterways.

Planning Considerations

Evaluate type and quantity of pollutant, slopes and soils, adapted vegetative species, time of year for proper establishment of vegetation, necessity for irrigation, visual aspects, fire hazards, and other special needs. Prevent erosion where filters outlet into streams or channels. If filter strips are to be used in treating waste water or polluted runoff from concentrated livestock areas, the following must be considered:

1. Adequate soil drainage to ensure satisfactory performance.
2. Provisions for preventing continuous or daily discharge of liquid waste unless the area is adequate for infiltrating all daily applied effluent. Temporary storage should be considered to prevent discharge to the filter strip more frequently than once every 3 days.
3. Enough rest periods to maintain an aerobic soil profile. Storage or alternating filter strips may be desirable.
4. Reduced effectiveness of filter strips under snow or frozen conditions.
5. An adequate filter area and length of flow to provide the desired reduction of pollutants. A serpentine or switchback channel can be used to provide greater length of flow.
6. Provisions for excluding roof water and unpolluted surface runoff.
7. Slopes less than 5 percent are more effective; steeper slopes require a greater area and length of flow.
8. Provisions for mowing and removing vegetation to maintain the effectiveness of the filter area. While not generally recommended, controlled grazing may be satisfactory when the filter area is dry and firm.
9. The need for a level-lip weir, gated pipe, sprinklers, or other facilities to distribute flow uniformly across the top of the filter strip and maintain sheet flow through the strip.

Filter strips by themselves will not meet the "no discharge" requirement applicable to livestock operations requiring permits under the National Pollutant Discharge Elimination System. More stringent pollution abatement measures may also be necessary where receiving waters must be highly protected.

Design Criteria

Filter strips for sediment and related pollutants.

These criteria apply to filter strips on cropland at the lower edge of fields, on fields, on pastures, or in manure spreading areas adjacent to streams, ponds, and lakes, and above conservation practices such as terraces or diversions.

The length of flow through vigorous vegetation shall be at least 10 feet for slopes of less than one percent and proportionately up to at least 25 feet for 30 percent slopes.

Filter strips for runoff from concentrated livestock areas.

These criteria apply to filter strips for feedlot and barnyard runoff.

Runoff estimates will be based on the 10-year, 24-hour rainfall. The following values of rainfall and runoff may be used:

Rainfall = 4.0 inches

Runoff Curve No.	Runoff (inches)
85	2.5
90	2.9
95	3.4
98	3.8

The suggested runoff curve numbers are 90 for unpaved lots and 95 for paved lots.

The peak discharge from the lot area can be determined from Table 5-3, Tabular Discharges for Type II Storm Distribution (csm/in), Technical Release No. 55, (TR-55) Urban Hydrology for Small Watersheds, or by using other approved hydrology methods. Peak discharges in table WI-1 in the Agricultural Waste Management Field Manual (AWMFM), Chapter 12, may be used for the respective lot sizes and runoff curve numbers.

Flood routing procedures described in the Engineering Field Manual, pages 11-55b and 11-55c or TR-55 may be used when applicable.

A settling basin or low velocity channel shall be provided between the waste source and filter strip when more than fifty 1,000-pound animal units are confined. Such facilities should be considered for use with all filter strips.

Sediment and/or manure storage must be considered for all settling basins. The additional storage capacity, based on frequency of cleaning, shall be provided for manure and other solids settled within the basin. The solids storage volume shall be based on the number of head, percent of time on the lot, and a minimum of 10 days between cleanings. The minimum daily volume of solids per animal shall be: (1) 1,400# dairy cow--1.85 cubic feet; (2) young dairy stock--1.0 cubic foot; (3) 1,000# beef cattle--1.2 cubic feet. The stock shall be considered to be on the lot at least 25 percent of the time.

A constructed settling basin, if needed, shall have sufficient capacity, as a minimum, to store 65 percent of the peak inflow rate from a 10-year, 24-hour storm for a duration of 15 minutes. Any basin outflow shall be disregarded in computing minimum storage.

A low velocity channel may be used as a settling basin. It shall be a minimum of 150 feet long. The 10-year, 24-hour peak discharge shall be passed at a velocity of 0.5 feet per second or less (Manning's $n = 0.025$) and a flow depth of 0.5 feet or less. Provisions shall be provided for removing settled solids from the channel as necessary to maintain proper functioning.

A filter strip may be a relatively uniform grass area or grass waterway. Minimum dimensions shall be based on the peak outflow from the concentrated waste area or settling facility based on a 10-year, 24-hour rainfall.

Grass area (overland) filter strips shall be generally on the contour and sufficiently wide to pass the design flow at a depth of 1.0 inches or less. Flow length shall be sufficient to provide at least 20 minutes (1,200 seconds) of flow-through time for a 0.5" flow depth and 755 seconds for a 1-inch flow depth. Flow-through time equals the filter strip length divided by the average flow velocity. Manning's equation with a "n" value of 0.3 shall be used to determine the average flow velocity. Table WI-3 from Chapter, 12, AWMFM, can be used for minimum filter strip lengths for 0.5-4.0 percent filter strip slopes.

Tables WI-1 and WI-2 in Chapter 12, AWMFM can also be used for filter strip design if applicable.

When lot runoff is allowed to directly enter the filter strip (no settling basin), the filter strip length will be increased to 150 percent of the minimum filter length.

Grass channel (channelized) filter strips shall be designed to convey the design flow at a depth of 0.5 feet or less with a Manning's "n" value of 0.25. The cross section of constructed channels shall be trapezoidal. Figures WI-1 through WI-8 from Chapter 12, AWMFM can be used to determine the flow depth and velocity and volumes of flow for various channel widths and slopes up to 2.5 percent. Flow-through time shall be a minimum of 40 minutes (2,400 seconds) for channel slopes of 2.5 percent or less. The flow-through time shall be increased 900 seconds for each 1 percent increase above 2.5 percent (i.e., 3.0 percent slope = 2,850 seconds, 3.5 percent slope = 3,300 seconds).

Foreign water runoff from adjacent acres shall be diverted from the filter area where possible.

Grass species and shape of channel shall be such that grass stems will remain upright during design flow.

Filter strips for controlled overland flow treatment of liquid wastes.

These criteria apply to filter strips for waste water from milk parlors, milking centers, waste treatment lagoons, food processing plants, and animal waste storage facilities.

Grass area (overland flow) filter strips shall be installed on natural or constructed slopes of 2 to 6 percent. They shall have minimum flow lengths of 100 feet on 2 percent slopes and proportionately up to 300 feet on 6 percent slopes. Weekly waste water application rates should not exceed 6 in. and should be only 1 or 2 inches for highly concentrated wastes. Daily application times should not exceed 6 hours, and should be decreased to 2 hours for more concentrated wastes such as that from animal waste storage facilities. Filter strips should be rested at least 2 days each week.

Filter strips on forest land.

These criteria apply to filter strips for runoff as part of a forestry operation to reduce delivery of sediment into waterways.

As a guide, the length of flow through undisturbed forest floor should be at least 25 feet for slopes of less than one percent and proportionately up to at least 65 feet for 30 percent slopes and at least 150 feet for 70 percent slopes. Longer flow lengths should be used as contributing drainage areas increase.

Establishing Vegetation.

Seedbed preparation and grass mixtures shall be as stated in "Critical Area Planting" (342) in the Wisconsin Technical Guide. Equipment shall not be operated on the filter strip when the soil is wet. Compacting the soil will tend to reduce the infiltration rate and tracks or depressions will tend to channelize water flow.

Operation and Maintenance.

Development of rills and small channels within filter areas must be minimized. Needed repairs must be made immediately to reestablish sheet flow. A shallow furrow on the contour across the filter can be used to reestablish sheet flow. Vegetation must be maintained in a vigorous condition. If livestock have access to the filter area, it must be fenced to control grazing.

The lot shall be cleaned or scraped frequently to reduce the amount of sediment leaving the lot area. The manure shall be stacked or stored at a location so that runoff from the storage area does not enter the filter area unless provided for in the design.

The settling basin shall be cleaned as soon as possible after any storm event that causes a significant amount of sediment deposition. Storing accumulated sediment deposits and cleaning the basin during a runoff event can cause large concentrations of pollutants to enter the upstream portion of the filter strip. These large concentrations can damage the vegetation and possibly increase the downstream pollution potential.

The filter system should not be operated daily due to possible anaerobic conditions developing in the soil. Two or more filters may be needed in some cases.

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Vegetation when cut must be removed from the filter strip. When the vegetation is left on the filter area, the effluent leaving the filter will frequently have a higher pollution potential.

Plans and Specifications

Plans and specifications for filter strips shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose.

Design Documentation Requirements

Location map, upstream drainage area, lot area, storage volumes and capacities (manure and/or solids, and water), discharge from lot or settling basin, filter strip length, width and slope, seeding requirements.

Construction (As Built) and/or Certification Documentation Requirements

Weir or orifice measurements, profile and cross section of completed construction, slope, length, statement regarding adequacy of vegetation.

FILTER STRIP SPECIFICATIONS

Engineering Specifications

All trees, stumps, brush, rocks, and similar materials that can interfere with installing the filter strip shall be removed. The materials shall be disposed of in a manner that is consistent with standards for maintaining and improving the quality of the environment and with proper functioning of the filter strip.

The filter strip shall be shaped to the grade and dimensions shown on the plan or as staked in the field.

Fills of more than six inches shall be built up by spreading the soil in layers. Grading operations shall not be performed under soil moisture conditions that will result in excessive damage to soil structure.

After cuts and fills have been completed, the surface shall be smoothed to remove minor irregularities. All grading work shall be finished in accordance with the design and to tolerances specified.

If necessary, topsoil shall be stockpiled and spread to the required grade and thickness. Excess spoil shall be disposed of in areas where it does not interfere with the required flow characteristics of the filter strip.

Vegetative Specifications Guide

Specify methods of seedbed preparation; adapted plants; planting dates and rates of seeding or sprigging; need for mulching, use of a stabilizing crop, or mechanical means of stabilizing; and fertilizer, soil amendment, and weed control requirements for maintenance.