



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

¹Use velocities exceeding 5 ft./sec only where good cover and proper maintenance can be obtained.

²Cohesive (clayey) fine-grain soils and coarse-grain soils with cohesive fines with a plasticity index of 10 to 40 (CL, CH, SC, and GC).

³Soils 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.

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