Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

GRASSED WATERWAY

CODE 412

(ac)

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

The purpose of this practice is to—

- 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, and local laws and regulations.

Design and construct grassed waterways and place spoil to ensure surface water enters the waterway without causing flow parallel to the waterway and that water is not ponded adjacent to the waterway.

Capacity

Design the waterway to convey the peak runoff expected from the 10-year frequency, 24-hour duration storm. Increase capacity as needed to account for potential volume of sediment expected to accumulate in the waterway between planned maintenance activities.

Out-of-bank flow in short sections of a reach is allowable to facilitate alignment or to minimize grade changes as long as positive drainage to the waterway is maintained, non-erosive flow will continue along the watercourse re-entering the waterway prior to reaching the outlet, and no crops are damaged.

When the waterway slope is less than 1 percent, out-of-bank flow may be permitted if such flow will not cause excessive erosion. For this condition, use the “B-curve” design discharge as the minimum capacity. Ensure that the design capacity, at a minimum, will remove the water before crops are damaged.

Stability
Determine the minimum depth and width requirements for stability of the grassed waterway using the procedures in the NRCS National Engineering Handbook, Part 650, Engineering Field Handbook, Chapter 7, Grassed Waterways or Agricultural Research Service (ARS) Agriculture Handbook 667, Stability Design of Grass-Lined Open Channels. The Engineering Field Tools (EFT), Waterway Design Tool software may be used to design waterways while meeting these requirements.

Use the Ohio Soils – Allowable Stress spreadsheet to select soil properties/ erodibility factor used in EFT. If the design depth extends 25 % or more in to the H2 Horizon, use the H2 erodibility factor for design. Use professional judgment and/ or assistance from soil scientist when soil properties differ from the spreadsheet or when the H1 horizon has been eroded at the waterway location.

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

Width
Keep the bottom width of trapezoidal waterways less than 100 feet unless multiple or divided waterways 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. 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. Use 6:1 as steepest slope to daylight parabolic shape.

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.

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 help or keep vegetation established on sites having prolonged flows, high water tables, or seepage problems, include Subsurface Drains (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 conservation practice Lined Waterway or Outlet (468) in place of Grassed Waterway (412).

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.

Cultural Resources
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.

Vegetative Establishment
Establish vegetation as soon as possible using the criteria listed under “Establishment of Vegetation” in the conservation practice standard Critical Area Planting (342) and/or Appendix A .

Permanent or temporary soil stabilization shall be applied to denuded areas within 7 days after final grade is reached on any portion of the site. Temporary soil stabilization shall be applied within 7 days to denuded areas that are <u>not</u> at final grade but that will remain undisturbed for more than 14 days.

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.

Provide livestock and vehicular crossings as necessary to prevent damage to the waterway and its vegetation

Additional Criteria for Small Waterways (Alternative design)

Areas meeting the following criteria may be shaped to a parabolic cross section with a minimum top width of 32 feet and minimum depth of 1.0 feet. The 10-year, 24-hour capacity need not be calculated for these areas. The area will be seeded the same as any grassed waterway.

- A maximum drainage area less than 10 acres and a maximum waterway slope of 7% for all soils, or
- a maximum drainage area less than 25 acres, a maximum waterway slope of 5% with soils designated erodible, erosion resistant or very erosion resistant; and
- The elevation change at the outlet is less than 2.0 feet and a stable outlet can be provided with a rock pad 22 feet wide and a minimum length of 20 feet; and
- A subsurface drain, if required, has its outlet at the same location as the grassed waterway; and
- Hydraulic calculations are not needed for surface inlets (e.g., orifices) or other structures or appurtenances.

CONSIDERATIONS

Small areas within cropland and areas upslope from a grassed waterway may need to be shaped and seeded to control minor gully erosion. Areas treated in this manner will normally be small furrow sized ephemeral gullies. Large gullies usually indicate the need for more extensive design considerations.

Side slopes steeper than 6:1 may be difficult to cross.

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 take 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 subsurface, subsoil, substratum material that limits plant growth 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 ameliorating 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 species of vegetation 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.

Provide livestock and vehicular crossings as necessary to prevent damage to the waterway and its vegetation.

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 or other forbs that provide pollen and nectar for native bees. 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 soil loss from the watershed draining into the waterway should be evaluated when the sedimentation from upland erosion on land not controlled by the landowner/user will impair the proper functioning of the waterway.

The waterway should not be constructed until a suitable stable outlet is in place, consideration of upstream erosion control is in place or appropriate land use and/or management changes have been made to reduce the erosion to an acceptable level.

PLANS AND SPECIFICATIONS

Prepare plans and specifications for grassed waterways that describe the requirements for applying the practice according to this standard. Requirements for all drawings prepared by NRCS/SWCD as well as by others (Professional Engineer or Registered Architect) are contained in the National Engineering Manual (NEM) Part 541- Drafting and Drawings. As a minimum the plans and specifications shall include:

- Plan view of system layout, including the location and details of associated practices (such as blind inlets, tile, underground outlets lined outlets, grade control structures)
- Profiles showing existing and proposed centerline grade, low bank, with upstream and downstream planned elevations, grade break stations and elevations. (Not required for alternative designs.)
- Design width and depth for each reach, and typical parabolic “Seven Point” cross-section (optional to show typical cross-section with data table). Include side slope to daylight entrenched parabolic section.
- Trapezoidal cross-section showing top width (TW), bottom width (BW), hydraulic depth (D), and side slopes.
- Profile and location of subsurface drains; typical backfill/cross-section details.
- Surface inlet details and outlet details for drain.
- Details for stable outlet or associated grade stabilization structure as applicable.
- Seeding, fertilizing, and mulching requirements; erosion control mat/blanket details when applicable.
- Quantities and bill of materials.
- 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.

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.

- Landowner responsibilities for final restoration of areas outside the design waterway cross section including remedial grading adjacent to the waterway as required to address tile trench settlement and/or impairment of surface water flow into the waterway
- 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, 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 vegetation within waterway cross section to maintain capacity and reduce sediment deposition. Mowing heights must be consistent with the vegetative cover value used in the design. Mowing frequency in adjacent buffer areas can be modified as appropriate to enhance wildlife values.
- 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. Agriculture Handbook 667.

USDA, NRCS. 2007. National Engineering Handbook, Part 650, Engineering Field Handbook, Chap. 7, Grassed waterways

NRCS Engineering Field Tools (EFT) design software:
http://eft.nrcs.usda.gov/EFT/web/eft/index.html(accessed 11/14/2018)