

NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

GRASSED WATERWAY

(No.)

CODE 412

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, and local laws and regulations.

Capacity. The minimum capacity shall convey the peak runoff expected from the 10-year frequency, 24-hour duration storm. Capacity shall be increased 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. At a minimum, the design capacity shall remove the water before crops are damaged; this capacity can be met by "B Curve" design discharge.

The “alternative” waterway design and job sheet is allowable for small drainage areas, subject to all these conditions:

- 25 acre maximum drainage area
 - Maximum waterway slope of 5%
 - Soil in waterway cross section is **not** designated easily erodible
 - Waterway dimensions (all cases): 32’ top width and 1’ depth
 - Structure at outlet limited to a rock pad with a 20’ minimum length and 2’ maximum grade change. Use the “Stone Center Waterway Details for Alternative Waterway Design” drawing.
 - However; when all above conditions are met, alternative waterway design is not applicable under any circumstances where a profile, or hydraulic head determination is required for the design calculations (examples):
 - Waterway requires structure with orifice at inlet, or structure exceeding 2’ overfall at outlet
 - Tile placed along waterway does not outlet at waterway outlet location
- In these cases, a complete design and engineering plan is required.

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.

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

Use the Engineering Field Tools (EFT) program to design waterways and document the design folder with EFT output.

Use the OH soil 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 spreadsheet or when the H1 horizon has been eroded at the waterway location

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. Accommodate the equipment anticipated to be used for maintenance and tillage/harvesting equipment that will cross the waterway in the designed width. 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 Outlets (620), stone center waterways or other suitable measures in waterway designs.

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. Grassed waterways shall be vegetated according to NRCS Conservation Practice Standard Critical Area Planting (342). Species selected shall be suited to the current site conditions and intended uses. Selected species will have the capacity to achieve adequate density, height, and vigor within an appropriate time frame to stabilize the waterway.

Establish vegetation as soon as conditions permit. Use mulch anchoring, nurse crop, rock, straw or hay bale dikes, fabric 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.

Seeding establishment is to follow requirements described in Section 4 of Appendix A

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

Stormwater Permit Exemption. All earthwork, seedbed preparation, seeding, and mulching (or other acceptable stabilization method such as mulch netting or erosion control blanketing) shall be completed within 14 days of the commencement of waterway construction.

When all construction and seeding activities cannot be completed within 14 days of the commencement of construction, the landowner is to be instructed to contact the Ohio EPA and submit a "Notice of Intent" application for coverage under Ohio EPA's NPDES general permit.

The State Resource Conservationist or State Conservation Engineer may grant an individual waiver of the 14-day completion requirement when unusual weather conditions impact the construction schedule. A waiver will not be granted when the initial intent of the landowner or contractor is not to complete all construction within 14 days.

CONSIDERATIONS

To improve water quality and reduce sediment deposition in the waterway, establish an increased width of vegetation on the waterway and add other sediment control measures above the waterway such as residue management.

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 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.

Add width of appropriate vegetation to the sides of the waterway for wildlife habitat.

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

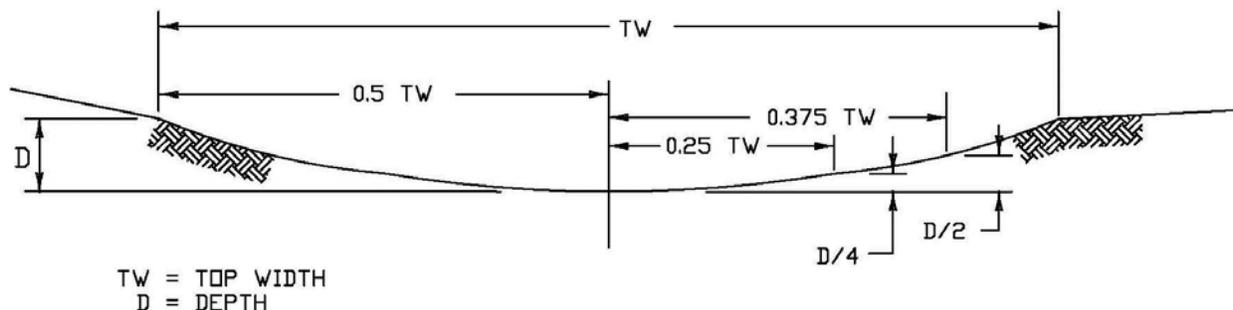
The soil loss from the watershed draining into the waterway should be evaluated when the sedimentation from upland erosion on land not controlled by the landowner/user will impair the proper functioning of the waterway.

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. As a minimum the plans and specifications shall include for all drawings (including alternative waterway job sheet):

- Utility notification procedure
- Plan view sufficient for contractor to locate site, and establish both upstream and downstream construction work limits (alternative design jobsheet may reference the conservation plan map when the location is obvious and NRCS provides pre-construction layout)
- Typical "Seven Point" cross section, as shown below, specifically showing the depth/width ratios for parabolic waterways



- Practice quantities that conform to USDA program contract quantities
- Profile(s) of the grassed waterway(s) and associated tile (when used). Include tile outlet and tile trench details when applicable
- Location and details of associated practices (such as blind inlets, tile, underground outlets lined outlets, grade control structures)
- Disposal requirements for excess soil material, including tile trench backfill.
- Site specific construction specifications that describe in writing the installation of the grassed waterway. Include specification for control of concentrated flow during construction, vegetative establishment, and grading of tile trench backfill.
- Vegetative establishment requirements including seeding interval following final grading and temporary cover when needed.

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.

- Documentation of landowner responsibilities for final restoration of areas outside the design waterway cross section (such as tile trenches or spoil spreading for positive drainage).
- Establish a maintenance program to maintain waterway capacity, vegetative cover, and outlet stability. Vegetation damaged by machinery, herbicides, or erosion must be repaired promptly. Specify vegetative height for compatibility with retardance values used for stability and capacity design.
- Protect waterway from concentrated flow by using diversion of runoff or mechanical means of stabilization such as silt fences, mulching, erosion control blanketing, haybale barriers, etc. to stabilize grade during vegetation establishment.
- Remedial grading adjacent to the waterway as required to address tile trench settlement and impairment of surface water flow into the waterway
- Minimize damage to vegetation or soil compaction by excluding livestock whenever possible, especially during wet periods. Permit grazing in the waterway only as prescribed in a written controlled grazing system plan.
- 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 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 need to be consistent with the vegetative cover 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>

NATURAL RESOURCES CONSERVATION SERVICE
CONSTRUCTION SPECIFICATION

GRASSED WATERWAY

(No.)

CODE 412

Erosion and Sediment Control

The contractor is responsible to use all appropriate Best Management Practices to minimize the likelihood of site erosion and offsite sediment transport. When final site stabilization cannot be completed within 14 days of the commencement of construction, an Ohio EPA NPDES permit may be required.

Ohio NRCS "General Guidance for Use of Erosion and Sediment Control Measures with Construction Activities" is attached for reference

All earthwork, seedbed preparation, seeding, and mulching (or other acceptable stabilization method such as mulch netting or erosion control blanketing) shall be completed within 14 days of the commencement of waterway construction.

When all construction and seeding activities cannot be completed within 14 days of the commencement of construction, the landowner is to be instructed to contact the Ohio EPA and submit a "Notice of Intent" application for coverage under Ohio EPA's NPDES general permit.

Site Preparation

All trees, brush stumps, rubbish, and other unsuitable material shall be removed from the site. Disposal method and site(s) will be shown on the plans.

Earth Fill

After the site preparation has been completed, all depressions, ditches and low areas within the waterway section that are below the design grade will be filled. Unless otherwise specified, all fill material will be obtained from within the waterway cross section and shall be free from brush, roots, sod, frozen soil, and rocks in excess of 6 inches. Fill will be placed in approximately uniform layers of not more than 9 inches in thickness and each layer will be compacted using the treads and tracks of the construction equipment. The fill material shall have adequate moisture so that when kneaded in the hand, it will form a ball that does not readily separate. When fill is required to maintain design depth, runoff that may be ponded behind the fill will be directed to drain back into the waterway at non-erosive velocity.

Excavation

The waterway shall be excavated to the dimensions shown on the plans, unless otherwise specified, all excavated material will be disposed of adjacent to the waterway and spread in such a manner to maintain positive drainage into the waterway.

Topsoil

When specified on the plan, stockpiling will preserve topsoil from the construction area. After all excavation is completed, topsoil shall be uniformly spread over the waterway to a uniform depth as specified on the plan. The design waterway depth must be built to within 0.1' tolerance following topsoil placement, finish grading, and seedbed preparation.

Vegetative Treatment

A seedbed shall be prepared by loosening and smoothing the soil as required to meet the design cross section. Unsuitable material that will interfere with seeding or maintenance shall be removed and disposed of. Seed, fertilizer, lime, mulch, and other requirements will be in accordance with the appropriate Conservation Practice Standards for Critical Area Planting, Code 342 and Mulching, Code 484, and the type and rates specified on the plans and specifications. Seeding will be completed within 14 days following the start of construction unless otherwise approved by NRCS.

Tile trenches should be mounded to assure the settled trench is not lower than the surrounding undisturbed soil. Following final trench settlement, the landowner is responsible to arrange for final grading or restoration with tillage equipment to assure positive non-erosive surface drainage into the waterway. Please contact the local NRCS office for assistance when needed.

Minimum As- Built Documentation Prior to NRCS certification (including alternative design)

- Constructed waterway length, and plotted profile (when included on original drawings)
- Representative cross sections surveyed for each reach (300' max spacing) including points beyond the design cross section (9-point section). Allowable construction tolerance of 0.1 ft. at each point
- Representative cross section for each reach plotted on as-built drawing
- As-built dimensions/ quantities of companion practices (such as blind inlets, tile, underground outlets lined outlets, grade control structures)
- Record of seed and fertilizer quantities
- As-built practice quantities that document USDA contract program quantities