

NATURAL RESOURCES CONSERVATION SERVICE CONSERVATION PRACTICE STANDARD

Open Channel (FT) No. 582

Definition

Constructing or improving a channel either natural or artificial, in which water flows with a free surface.

Purpose

To provide discharge capacity required for flood prevention, drainage, other authorized water management purposes, or any combination of these purposes.

Conditions Where Practice Applies

This practice applies to all open channel construction or modification.

It also applies where stability requirements can be met, where the impact of the proposed construction on water quality, fish and wildlife habitat, forest resources, and quality of the landscape is evaluated and the techniques and measures necessary to overcome the undesirable effects are made part of any planned work, where an adequate outlet for the modified channel reach is available for discharge by gravity flow or pumping, and where excavation or other channel work does not cause significant erosion, flooding, or sedimentation.

Federal, State, and Local Laws¹

Design and construction activities shall comply with all federal, state, and local laws, rules, and regulations governing pollution abatement, health, and safety. The owner or operator shall be responsible for securing all required permits or approvals and for performing in accordance with such laws and regulations. NRCS employees are not to assume responsibility for procuring these permits, rights, or approvals, or for enforcing

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laws and regulations. NRCS may provide the landowner or operator with technical information needed to obtain the required rights or approvals to construct, operate, and maintain the practice.

Permits may be required from the following agencies:

- 1. West Virginia Department of Health***
- 2. West Virginia Department of Agriculture***

Planning Considerations

Water Quantity

1. Effects on components of the water budget, especially on volumes and rates of runoff and infiltration.

Water Quality

1. Effects of erosion and the movement of sediment and soluble and sediment-attached substances in runoff during and immediately after construction.
2. Effects of the use of chemicals during vegetation control.
3. Effects of changes in channel vegetation on downstream water temperature.
4. Potential for temporary and long-term effects on the visual quality of downstream waters.

Design Criteria

NRCS-WV, TG-IV, October 1996

Plan. Channel construction or modification shall be according to an approved plan prepared for the site. TR-25 shall be used in surveys, planning, and site investigations for channel work. Design criteria in TR-25 shall be followed, using the procedure best adapted to site conditions.

In selecting the location and design of channels, careful consideration shall be given to minimizing water pollution, damage to fish and wildlife habitat, and to protecting forest resources and the quality of the landscape. In considering requirements for construction and operation and maintenance, selected woody plants must be preserved. The overall landscape character, prominent views, and fish and wildlife habitat requirements must be considered.

Planned measures necessary to mitigate unavoidable losses to fish or wildlife habitat shall be included in the project. The quality of the landscape shall be maintained by both the location of channel works and plantings, as appropriate.

The alignment of channels undergoing modification shall not be changed to the extent that the stability of the channel or laterals thereto is endangered.

Capacity. The capacity for open channels shall be determined according to procedures applicable to the purposes to be served and according to related engineering standards and guidelines in handbooks. The water surface profile or hydraulic gradeline for design flow shall be determined according to guidelines for hydraulic design in TR-25. The "n" value for aged channels shall be based on the expected vegetation, along with other retardance factors, considering the level of maintenance prescribed in the operation and maintenance plan prepared with the owners or sponsors. The required capacity may be established by considering volume-duration removal rates, peak flow, or a combination of the two, as determined by the topography, purpose of the channel, desired level of protection, and economic feasibility.

Runoff from a given drainage area may be estimated using procedures in Technical Release 55, Chapter 2 of the Engineering Field Handbook, or Section 4 of the National Engineering Handbook.

Cross Section. The required channel cross section and grade shall be determined by the plan objectives, the design capacity, the materials in which the channel is to be constructed, the vegetative establishment program, and the requirements for operation and maintenance. A minimum depth may be required to provide adequate outlets for subsurface drains, tributary ditches, or streams. Urban and other high-value developments through which the channel is to be constructed must be considered in the design of the channel section.

Channel stability. Characteristics of a stable channel are:

1. The channel neither aggrades nor degrades beyond tolerable limits.
2. The channel banks do not erode to the extent that the channel cross section is changed appreciably.
3. Excessive sediment bars do not develop.
4. Gullies do not form or enlarge because of the entry of uncontrolled surface flow to the channel.

All channel construction and modification (including clearing and snagging) shall be according to a design that can be expected to result in a stable channel that can be maintained at reasonable cost. Vegetation, riprap, revetments, linings, structures, or other measures shall be used if necessary to insure stability.

The method applicable to site conditions in TR-25 shall be used in determining the stability of proposed channel improvements.

Bankfull flow is the flow in a channel that creates a water surface at or near the normal ground elevation, or the tops of dikes or continuous spoil banks that confine the flow for a significant length of a channel reach.

Channels must be stable under conditions existing immediately after construction (as-built condition) and under conditions existing during effective design life (aged condition). Channel stability shall be determined for discharges under these conditions as follows:

1. As-built condition-Bankfull flow, design discharge, or 10-year frequency flow, whichever

is smallest, but not less than 50 percent of design discharge.

The allowable as-built velocity (regardless of type of stability analysis) in the newly constructed channel may be increased by a maximum of 20 percent if:

- a. The soil and site in which the channel is to be constructed are suitable for rapid establishment and support of erosion-controlling vegetation.
- b. Species of erosion-controlling vegetation adapted to the area and proven methods of establishment are known, and
- c. The channel design includes detailed plans for establishing vegetation on the channel side slopes.

2. Aged condition-Bankfull flow or design discharge, whichever is larger, except that it is not necessary to check stability for discharge greater than the 100-year frequency.

Stability checks that are flow related are not required if the velocity is 2 ft/s (0.6 m/s) or less.

For newly constructed channels in fine-grained soils and sands, the "n" values shall be determined according to procedures in Chapter 6 of TR-25, and shall not exceed 0.025. The "n" value for channels to be modified by clearing and snagging only shall be determined by reaches according to the expected channel condition upon completion of the work.

Appurtenant structures. The channel design shall include all structures required for proper functioning of the channel and its laterals, as well as travelways for operation and maintenance. Inlets and structures needed for entry of surface and subsurface flow into channels without significant erosion or degradation shall be included in the channel design. The design also shall provide for necessary flood gates, water-level-control devices, bays used in connection with pumping plants, and any other appurtenances essential to the functioning of channels and contributing to attainment of the purposes for which they are built. If needed, protective structures or treatment shall be used at junctions between channels to insure stability at these critical locations.

The effect of channel work on existing culverts, bridges, buried cables, pipelines, irrigation

flumes, and inlet structures for surface and subsurface drainage on the channel and laterals thereto shall be evaluated to determine the need for modification or replacement.

Culverts and bridges that are modified or added as part of channel projects shall meet reasonable standards for the type of structure and shall have a minimum capacity equal to the design discharge or state agency design requirements, whichever is greater. Capacity of some culverts and bridges may need to be increased above the design discharge.

Disposition of spoil. Spoil material from clearing, grubbing, and channel excavation shall be disposed of in a manner that will:

1. Not confine or direct flows so as to cause instability when the discharge is greater than the bankfull flow.
2. Provide for the free flow of water between the channel and flood plain unless the valley routing and water surface profile are based on continuous dikes being installed.

Travelways for maintenance.

Travelways for maintenance shall be provided as a part of all channel improvement. A travelway shall be provided on each side of large channels if necessary for use of maintenance equipment. Travelways must be adequate for movement and operation of equipment required for maintenance of the channel. The travelway may be located adjacent to the channel on a berm or on the spread spoil. In some situations the channel itself may be used as the travelway.

Erosion Control During Construction.

Provisions shall be made to consider and include temporary measures for control of erosion during construction. such measures may be mechanical and/or vegetative.

Vegetative Protection. All spoil, channel banks and other disturbed areas shall be vegetated with permanent plant species.

Plans and Specifications

Plans and specifications shall be in keeping with this standard and shall describe the

requirements for proper installation of the practice to achieve its intended purpose.

Specifications may be developed from NEH-20 Series, 700 Series, or other material, as appropriate.

Remove of trees and brush will be done in such a manner as to avoid damage to other trees and property. Special attention will be given to protecting and maintaining key shade, food, and den trees and to stabilization of disturbed areas.

Channels shall be excavated to the line and grades shown on the drawings. The excavated surfaces shall be reasonably smooth. Excavation shall be done in a manner which will not restrict flow in existing channels.

Material excavated from the channel shall be disposed of in the locations and in the manner shown on the drawings. In reaches involving realignment of existing channels, the upstream ends of segments of the old channel that are cut off by the new alignment shall be filled to ground level unless otherwise specified.

Spoil will be placed in a manner to maintain the stability of the streambanks and with consideration of the existing and future land use of the adjacent area.

All refuse shall be burned or buried or disposed in such a way as to have the least detrimental effect on the environment. When buried, all roots, brush, stumps, stones, and similar material shall be placed a minimum of 18 inches below the elevation of the finished grade.

All work shall be done in such a manner that erosion and air and water pollution will be minimized and held within legal limits. This shall be done by:

1. Placing spoil in a location to prevent its sloughing or washing into the channel or water course.
2. Keeping chemicals, fuel, lubricants, sewage and waste materials out of channel and drainage ways.

3. Limiting the use of excavating equipment to areas outside the channel and drainage ways except to those few times when no other alternative is possible.

4. *Establishing vegetation on all disturbed areas as soon as possible after exposure or disturbance, especially channel banks.*

Operation and Maintenance

An operation and maintenance plan shall be developed for the channel. The plan shall outline the minimum maintenance necessary to ensure the channel functions for its design life.

As a minimum, the plan shall address the following:

1. Annual inspections and inspections after each major storm occurrence to assess the need for repair.
2. Removal of debris, accumulations, and sediment deposits.
3. Liming, fertilizing, and mowing of vegetation to maintain a healthy growth.
4. *Repair of damaged structures.*
5. Repair of eroding areas by revegetating or mechanical treatment such as riprap.

¹*Bold italics is information added to the National standard by West Virginia.*