

**NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD**

OPEN CHANNEL

(Ft.)
CODE 582

DEFINITION

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

PURPOSE

This standard may be applied as part of resource management system to support one or more of the following:

to provide discharge capacity to improve channel-floodplain function in order to reduce flooding damages;

to provide discharge capacity to reduce bed and bank erosion;

authorized water management purposes; and any combination of the above purposes.

CONDITIONS WHERE PRACTICE APPLIES

This standard applies to construction of new channels or modifications of existing streams or ditches.

It 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 are 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, downstream flooding, or sedimentation.

The standard also applies to Surface Drainage, Main or Lateral (608), having a drainage area greater than 1 mi² (2.59 km²). It

does not apply to Diversion (362), Grassed Waterways (412), Irrigation Field Ditch (388), Surface Drainage, Field Ditch (607), or Irrigation Canal or Lateral (320). This standard does not apply to short stream reaches that should be treated using Streambank and Shoreline Protection (580) or Channel Stabilization (584).

CONSIDERATIONS

Consider effects to the water budget, especially on volumes and rates of runoff, infiltration, evaporation, transpiration, and ground water recharge.

Consider effects on wetlands and/or associated wetlands. Wetland areas including any associated channel wetlands must be minimally affected or the impacts mitigated. There is no expedited minimal effect for Open Channel (582). If the channel is classified as U.S. Waters, approval (any required permits or other written permission) from the U.S. Corp of Engineers must be obtained. Indicators of U.S. Waters are blue lines or similar designations on U.S. Geological Survey 1:24,000 quadrangles.

Consider effects on erosion and the movement of sediment and soluble and sediment-attached substances in runoff during and immediately after construction.

Consider effects of the use of chemicals during vegetation control.

Consider effects of changes in channel vegetation on downstream water temperature.

Consider effects to the temporary and long-term visual quality of downstream waters.

CRITERIA

Laws and Regulations. This practice must conform to all federal, state, and local laws and

Conservation practice standards are reviewed periodically and updated if needed. To obtain the current version of this standard, contact your Natural Resources Conservation Service [State Office](#) or visit the [electronic Field Office Technical Guide](#).

regulations. Laws and regulations of particular concern include those involving water rights, land use, land disturbed by construction, pollution control, property easements, permits, wetlands, preservation of cultural resources, and endangered species.

Plan. Channel construction or modification shall be according to an approved plan prepared for the site. TR-25 shall be used as a guide in surveying, planning, and site investigations. 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 as appropriate by both the location of channel works and plantings.

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

Capacity. The design discharge shall be determined according to procedures applicable to the purposes to be served and according to related engineering standards and guidelines in handbooks. The design discharge may be established by considering peak flow, volume-duration removal rates, or a combination of the two, as determined by the topography, purpose of the channel, desired level of protection, and economic feasibility. For example, the project purpose may be to contain a specified frequency peak flow in the channel or to flatten the flow hydrograph to reduce the time and extent of flooding in the overbank area.

If the purpose of the channel modification is to reduce gully erosion in a cropped field and the channel slope is less than one percent, then

out of bank flow may be permitted if such flow will not cause excessive erosion. The minimum in such cases shall be the capacity required to remove the water before crops are damaged.

The water surface profile or hydraulic gradeline of the design flow may be determined using the Manning's equation for Class III or smaller jobs and HECRAS or similar programs for Class IV or larger designs.

Cross section. The required channel cross section and grade shall be determined by the plan objectives, the design discharge, the materials in which the channel is to be constructed, the vegetative establishment program, and the requirements for operation and maintenance. A minimum channel 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. Open channel design must meet the following conditions:

the channel neither aggrades nor degrades beyond tolerable limits;

the channel banks do not erode to the extent that the channel cross section is changed appreciably;

excessive sediment bars do not develop; and
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 ensure stability.

The TR-25 applicable stability design method shall be used in determining the stability of proposed channel improvements. Acceptable TR-25 stability methods include allowable velocity, tractive stress, and tractive power.

Channels must be stable under conditions existing immediately after construction (as-built conditions) and under conditions existing during effective design life (aged conditions). Channel stability for as-built conditions shall be determined for bankfull flow, design discharge, or 10-year frequency flow, whichever is smallest, but not less than 50 percent of design discharge. As applies to this standard, bankfull flow is the flow that results in a water surface at the top of the channel banks or the tops of dikes or continuous spoil banks that confine the flow for a significant length of a channel reach.

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 for the following conditions:

if the soil and site in which the channel is to be constructed are suitable for rapid establishment and support of erosion-controlling vegetation;

if the species of erosion-controlling vegetation adapted to the area and proven methods of establishment are known; and

if the channel design includes detailed plans for establishing vegetation on the channel side slopes.

Channel stability for aged conditions shall be determined for 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 discharge.

Stability checks that are flow related are not required for either as-built or aged conditions if the velocity is two 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 only being modified by clearing and snagging shall be determined for 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:

not confine or direct flows so as to cause instability when the discharge is greater than the bankfull flow;

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;

not hinder the development of travelways for maintenance;

leave the right-of-way in the best condition feasible, consistent with the project purposes and adjacent land uses;

direct water accumulating on or behind spoil areas to protected outlets; and

maintain or improve the visual quality of the site to the extent feasible.

Vegetation of channel. Vegetation shall be established on all channel slopes, berms,

spoil, and other disturbed areas according to the Natural Resources Conservation Service Practice Standard for Critical Area Planting (342).

PLANS AND SPECIFICATIONS

Plans and specifications for constructing open channels shall be in keeping with this standard and shall describe the requirements for properly installing the practice to achieve its intended purpose.

OPERATION AND MAINTENANCE (O&M)

Plan. An O&M plan must be prepared for each channel system. Minimum requirements for operation, maintenance, and replacement shall be consistent with the design objectives. This includes consideration of fish and wildlife habitat, quality of the landscape, water quality, mitigation features, methods, equipment, costs, stability, design life function, frequency, and time of year for accomplishing the work. Detailed provisions for operation and maintenance must be made if complex features, such as water-level-control structures and pumping plants, are required.

Maintenance access. Travelways for maintenance generally shall be provided as part of all channel work. This requirement may be met by providing reading access points to sections of the channel if this will permit adequate maintenance in conformance with the operation and maintenance plan.

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 places the channel itself may be used as the travelway. The travelway, including access points, must blend into the topography, the landscape, and adjacent land uses.

Safety. Open channels can create a safety hazard. Appropriate safety features and devices should be installed to protect people and animals from accidents such as falling or drowning.

REFERENCES

NRCS Technical Release 25 (TR-25)

Engineering Field Manual, Chapters 7 and 14

NRCS National Engineering Handbook (NEH), Section 5, Hydraulics