Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

GRADE STABILIZATION STRUCTURE

CODE 410

(no)

DEFINITION

A grade stabilization structure is a structure used to control the grade in natural or constructed channels.

PURPOSE

The purpose of a grade stabilization structure is to stabilize grade, reduce erosion, or improve water quality.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies where channels require a structure to stabilize the grade or to control gully erosion.

CRITERIA

General Criteria Applicable to All Purposes

Plan, design, and construct this practice to comply with all federal, State, and local regulations. **The landowner shall obtain all necessary permits prior to construction or any land clearing activities.**

Set the crest of the inlet at an elevation that will stabilize the channel and prevent upstream head cutting.

Design earthen embankments and auxiliary spillways to handle the total capacity flow indicated in Tables 1 or 2 without overtopping any embankment. The foundation preparation, compaction, top width, and side slopes must ensure a stable earthen embankment for anticipated flow conditions.

Provide a minimum sediment storage capacity equal to the expected life of the structure, or provide for periodic cleanout.

Provide measures necessary to prevent serious injury or loss of life such as protective guardrails, warning signs, fences, or lifesaving equipment.

Seed or sod the exposed surfaces of earthen embankments, earth spillways, borrow areas, and other areas disturbed during construction in accordance with Connecticut NRCS Conservation Practice Standard (CPS) *Critical Area Planting (Code 342)*. If climatic conditions preclude the use of seed or sod, use Connecticut NRCS CPS *Mulching (Code 484)* to install inorganic cover material such as gravel.

Embankment dams

Low hazard dams that have a product of storage times the effective height of the dam of 3,000 ac-ft2 or more, those more than 35 ft in effective height, and all significant and high hazard dams must meet or exceed the criteria specified in Engineering Technical Release TR-210-60, Earth Dams and Reservoirs.

Low hazard dams that have a product of storage times the effective height of the dam of less than 3,000 ac-ft2 and an effective height of 35 ft or less must meet or exceed the requirements specified in Connecticut NRCS CPS *Pond (Code 378)*.

The effective height of the dam is the difference in elevation, in feet, between the auxiliary spillway crest and the lowest point in the original cross section along the centerline of the dam. If there is no auxiliary spillway, the top of the dam is the upper limit.

Storage is the capacity of the reservoir in acre- feet below the elevation of the crest of the lowest auxiliary spillway or the elevation of the top of the dam if there is no open channel auxiliary spillway.

Pond sized dams
If mechanical spillways are required, the minimum capacity of the principal spillway must convey the peak flow expected from a 24-hour duration design storm

of the frequency shown in Table 3, less any reduction from detention storage. For dams with effective height less than 20 ft, a stable auxiliary spillway with no overfalls, and good auxiliary spillway vegetation along its reentry into the downstream channel, the designer may reduce the principal spillway capacity to no less than 80 percent of the 2-year frequency, 24-hour duration storm. For dams with a storage capacity more than 50 acre-ft or criteria values exceeding those shown in Table 3, use the 10-year frequency, 24-hour duration storm as the minimum design storm.

Small pond sized dams
For dams with an effective height of less than 15 ft and 10-year frequency, 24-hour storm runoff volume less than 10 acre-ft, the designer may use the requirements of Connecticut NRCS CPS *Water and Sediment Control Basin (Code 638)*. Design the grade control structure to control the peak flow from the 10-year frequency, 24-hour duration storm without overtopping. If the combination of storage and mechanical spillway discharge will handle the design storm, an auxiliary spillway is not required.

Full-flow open structures
Design drop, chute, and box inlet drop spillways to the requirements in the National Engineering Handbook, Part 650, Engineering Field Handbook and other applicable NRCS publications and reports. Provide a minimum capacity to pass the peak flow expected from a design storm of the frequency and duration shown in Table 1, less any reduction from detention storage. If site conditions exceed those shown in Table 1, design the minimum principal spillway capacity for the 25-year frequency (24-hour duration) storm and design the minimum total capacity for the 100-year frequency (24-hour duration) storm. Structures must not create unstable conditions upstream or downstream. Install provisions for reentry of bypassed storm flows.

The ratio of the capacity of drop boxes to road culverts must meet the requirements of the responsible road authority or as specified in Table 1 or 2, as applicable, less any reduction from detention storage, whichever is greater. The drop box capacity (attached to a new or existing culvert) must equal or exceed the culvert capacity at design flow.

Island-type structures. Design the minimum capacity equal to the capacity of the downstream channel. Design the minimum auxiliary spillway capacity equal to that required to pass the peak flow expected from a 24-hour duration storm of the frequency shown in Table 1 for total capacity without overtopping the headwall extensions of the mechanical spillway. Make provision for safe reentry of bypassed flow as necessary.

Side-inlet, open weir, or pipe-drop drainage structures
Table 2 provides the design criteria for minimum capacity of open-weir or pipe structures used to lower surface water from field elevations or lateral channels into deeper open channels. Design the minimum principal spillway capacity equal to the design drainage curve runoff for all conditions. If site condition values exceed those shown in Table 2, use the 50-year frequency, 24-hour duration storm for minimum design of total capacity.

CONSIDERATIONS

Provide sufficient discharge to minimize crop damaging water detentionIn highly visible public areas and those associated with recreation, give careful consideration to landscape resources. Landforms, structural

materials, water elements, and plant materials should complement their surroundings visually and functionally. Shape excavated material and cut slopes to blend with the natural topography. Shape shorelines and create islands to add visual interest and wildlife habitat. Form and finish exposed concrete surfaces to add texture, reduce reflection, and to alter color contrast. Select sites to reduce adverse impacts or create desirable focal points.Consider the effect of the grade control structure on aquatic habitat. For channels supporting fish, consider the effect of the structure on fish passage.Structures must not create unstable conditions upstream or downstream. Treatments such as plunge pools, and channel and bank armament in contraction/expansion zones should be considered while planning and designing the structure.

Consider the potential downstream effects of failure of the grade control structure. Analyze both a sudden failure during typical flow conditions and a hydrologic failure during peak design storm (or larger) flow conditions).

Evaluate population and infrastructure at-risk in the breach inundation area. Further guidance can be found in Engineering Technical Release TR-210-60, Earth Dams and Reservoirs.

In natural channels, consider the effect of the grade control structure on fluvial geomorphic conditions.

Provide fences to protect structures, earth embankments, and vegetated spillways from livestock. Near urban areas, provide fencing as appropriate to control access and exclude traffic.

Table 1. - Design criteria for establishing minimum capacity of full-flow open structures.

Maximum drainage area for indicated rainfall in a 5-year frequency, 24-hour duration storm				Frequency of minimum design, 24-hour duration storm	
0 - 3 in.	3 - 5 in.	5+ in.	Vertical drop	Principal spillway capacity	Total capacity
——————————————*-acres*—————————————-			*ft*	*yr*	*yr*
1,200	450	250	0 - 5	5	10
2,200	900	500	0 - 10	10	25

Table 2. - Design criteria for establishing minimum capacity of side-inlet, open weir, or pipe-drop drainage structure.

Maximum drainage area for indicated rainfall in a 5-year frequency, 24-hour duration storm				Frequency of minimum design, 24-hour duration storm	
0 - 3 in.	3 - 5 in.	5+ in.	Vertical drop	Receiving channel depth	Total capacity
——————————————*-acres*—————————————-			*ft*	*ft*	*yr*
1,200	450	250	0 - 5	0 - 10	5
1,200	450	250	5 - 10	10 - 20	10
2,200	900	500	0 - 10	0 - 20	25

Table 3. - Design criteria for establishing minimum capacity of the principal spillway for dams with storage capacity of less than 50 acre-feet.

Maximum drainage area for indicated rainfall in a 5-year frequency, 24-hour duration storm			Effective height of dam	Frequency of minimum design, 24-hour duration storm
0-3 in.	3 - 5 in.	5+ in.		
——————————————*-acres*——————————————			*ft*	*yr*
200	100	50	0 - 35	2
400	200	100	0 - 20	2
400	200	100	20 - 35	5
600	400	200	0 - 20	5

PLANS AND SPECIFICATIONS

Prepare plans and specifications for installing grade stabilization structures that describe the requirements for applying the practice according to this standard. As a minimum, include the following items in the plans and specifications:

1. A plan view of the layout of the grade stabilization structure and appurtenant features.
2. Typical profiles and cross sections of the grade stabilization structure and appurtenant features as needed.
3. Structural drawings, as needed.
4. Seeding requirements, as needed.
5. Safety features.
6. Site specific construction requirements.

OPERATION AND MAINTENANCE

Prepare an operation and maintenance plan for the operator. As a minimum, include the following items in the operation and maintenance plan:

1. Require inspections periodically and after major storms of all structures, earthen embankments, spillways, and other significant appurtenances.
2. Require prompt repair or replacement of damaged components.
3. Require prompt removal of sediment when it reaches pre-determined storage elevations.
4. Require periodic removal of trees, brush, and invasive species.
5. Require periodic inspection of safety components and immediate repair if necessary.
6. Require maintenance of vegetative protection and immediate seeding of bare areas as needed.

REFERENCES

USDA Natural Resources Conservation Service. Engineering Technical Releases, TR- 210-60, Earth Dams and Reservoirs. Washington, DC.

USDA Natural Resources Conservation Service. National Engineering Handbook, Part 628, Dams. Washington, DC.

USDA Natural Resources Conservation Service. National Engineering Handbook, Part 650, Engineering Field Handbook. Washington, DC.