STANDARD

STRUCTURE FOR WATER CONTROL (No.)

Definition

A structure in an irrigation, drainage, or other water management system that conveys water, controls the direction or rate of flow, or maintains a desired water surface elevation.

Scope

This standard applies to the structures normally installed in a well-planned irrigation or drainage system, wildlife facility or other water management system for the conveyance, flow control, or level regulation of water. It does not apply to structural components of irrigation pipelines or to subsurface drains or grade-stabilization structures (410).

Purpose

To control the stage, discharge, distribution, delivery, or direction of flow of water in open channels or water use areas. Also used for water quality control, such as sediment reduction or temperature regulation. These structures are also used to protect fish and wildlife and other natural resources.

Conditions Where Practice Applies

This practice applies wherever a permanent structure is needed as an integral part of an irrigation, drainage, or other water-control system to serve one or more of the following functions:

1. To conduct water from one elevation to a lower elevation within, to, or from, a ditch, channel, or canal. Typical structures: drops, chutes, turnouts, surface water inlets, head gates, pump boxes, and stilling basins.

2. To control the elevation of water in drainage or irrigation ditches. Typical structure: checks.

3. To control the division or measurement of irrigation water. Typical structures: division boxes and water measurement devices.

4. To keep trash, debris, or weed seeds from entering pipelines. Typical structure: debris screens.

5. To control the direction of channel flow resulting from tides and high water or backflow from flooding. Typical structure: tide and drainage gates.

6. To control the level of a water table or to remove surface or subsurface water from adjoining land, to flood land for harvesting, frost protection or to manage water levels for wildlife recreation. Typical structures: water level control structures, pipe drop inlets, and box inlets.

7. To provide water control for recreation or similar purposes.

8. To convey water over, under, or along a ditch, canal, road, railroad, or other barriers. Typical structures: bridges, culverts, flumes, inverted siphons.

9. To modify water flow to provide habitat for fish, wildlife, and other aquatic animals. Typical structures: deflectors, chutes, cold water release, or structures to make pools and riffles.

Planning Considerations for Water Resources

WATER QUANTITY

This practice may have only a minor effect on the quantity of surface and ground water. For the specific application, the storage of runoff water or soil water retention may be significant.

WATER QUALITY

Use of this practice to control the level of the watertable or to remove surface or subsurface water from adjoining land, to flood land for frost protection, or to manage water levels for wildlife or recreation may increase infiltration and percolation of water by supplying a surplus of water to the surface when used for flooding.

When used to control the division of chemigation water, this practice may have a significant effect on the quality of surface and ground water. This will reduce the amount of suspended chemicals which are attached to organic material and soil particles from entering surface waters. Also, this practice will allow for the biological treatment of dissolved chemicals when detained in the system for the required holding period. Chemicals that remain in the system may be bound up in the soil organic matter; however soils that are low in organic matter may have a tendency to allow for the leaching of dissolved chemicals into the ground water.

Use of this practice to conduct water from one elevation to a lower elevation within, to or from a ditch, channel, or canal may not have any effect on the quality of surface or ground water.

Use of this practice to control the elevation of water in drainage or irrigation ditches may reduce bank erosion and scouring in the channel, which results in the reduction of sediment and related pollutants delivered to the surface water.

Use of this practice to control the direction of channel flow resulting from tides and high water or backflow from flooding has little effect on the quality of surface and ground water.

When used to remove drainage water from the surface or subsurface, substances may be "straight-lined" into the surface waters. When the function is to impound water, the pH of the surface may be lowered with a consecutive increase in tannic acid and iron content. Water temperature may be increased in the summer months.

Use of this practice to convey water over, under or along a ditch, canal, road, railroad or other barriers will have little effect on the quality of surface and ground water.

Use of this practice to modify water flow to provide habitat for fish, wildlife and other aquatic animals may increase the dissolved oxygen content of the stream, and may lower the water temperature.

Design Criteria - Water Control Structures
Outlets on Cranberry Bogs and Irrigation Pits

Water control structures as outlets on cranberry bogs and irrigation pits to manage the level of water for harvesting, winter flooding, trash removal, pest control or other management purposes shall be designed as follows:

1. The structure shall be designed to pass the required volume of water within the flood or deflood time to meet the grower's management plan for the bog system. However, the structure shall pass, at a minimum, the discharge from a 10-year, 24-hour precipitation without overtopping the dike. An earthen emergency spillway may be used to reduce the structure size from the 10-year storm, provided the spillway is located in natural ground and sized according to procedures outlined in the Engineering Field Manual, chapter 11.

2. If trash or debris is a potential problem, then a 12-inch minimum pipe or a trash rack shall be installed.

3. The materials used for the structure shall be in accordance with the pipe requirements in the Pond standard (378).

4. Adequate measures shall be made to prevent uplift of the structure. A minimum factor of safety of 1.25 shall be used. A base plate made of metal or wood may be used. Metal base plates shall be of the same metal

as the structure unless measures are taken to prevent contact between the structure and the base plate for the life of the structure. Wood base plates shall be of pressure treated lumber to resist decay.

5. Consideration should be given to installing a grating or platform at the top of the riser to provide the grower safer access and operation of the structure.

6. The dike associated with the structure shall be designed in accordance with the Dike standard (356).

7. Design procedures are outlined in Massachusetts Technical Note Engineering No. 213, Cranberry Bog Engineering.

Design Criteria
Water Control Structures on By-Pass Channels

Water control structures as inlets to by-pass channels for the purpose of temporarily diverting water around the bog system during chemigation applications shall be designed according to the same requirements as described for outlets to cranberry bogs, except that structures for by-pass channels shall be designed to pass, at a minimum, the peak discharge from the 2-year, 24-hour precipitation without overtopping the dike.

Structures for by-pass channels shall be managed so that after the required holding period for chemigation on the bog has passed, stream flow is returned to the bog and flow into the by-pass channel is stopped.

Design Criteria - Turnout Structures

Turnout structures used to temporarily retain water on the bog during chemigation holding periods shall be designed according to the following:

1. The structure and associated low-flow dikes shall be designed to hold, at a minimum, the depth of water from the chemigation application and the rainfall from a 2-year, 24-hour storm. The structure shall be designed to pass this volume of water within the deflood time to meet the grower's management plan for the bog system.

2. The pipe used for the turnout structure may be plastic or metal. A gate or similar structure shall be installed on the pipe to control the water. The gate shall be of compatible material with the pipe, and shall be installed according to the manufacturer's recommendations.

3. The dike associated with the turnout structure shall be designed in accordance with the Dike standard (356).

4. Design procedures are outlined in Massachusetts Technical Note Engineering No. 213, Cranberry Bog Engineering.

Design Criteria - Other Structures

Structures shall be designed on an individual job basis, or applicable SCS standard drawings shall be adapted, to meet site conditions and functional requirements. They shall be part of an approved and overall engineering plan for irrigation, drainage, wildlife, recreation, channel improvement or similar purposes.

Care must be used to ensure that the area's visual resources are not damaged. If watercourse fisheries are important, special precautions or design features may be needed to ensure continuation of fish migrations.

Plans and Specifications

Plans and specifications for installing structures for water control shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose.

Operation and Maintenance

An operation and maintenance plan shall be developed and provided to the landowner. This plan should consider the following general recommendations, as applicable:

1. Remove any debris that may accumulate on or in the immediate area of the structure.

2. Repair spalls, cracks and weathered areas in concrete surfaces.

3. Repair or replace rusted or damaged metal and paint.

4. Check all valves, gates, stop logs and other appurtenances for proper functioning. If worn or damaged, repair or replace following the manufacturer's recommendations.

5. Check all timber or lumber sections for decay and other damage, especially sections in contact with earth or other materials. Repair damaged sections and apply protective coatings as needed.

6. Immediately repair any vandalism, vehicular or livestock damage to any earthfills, spillways, outlets or other appurtenances.

7. Structures for by-pass channels shall be managed so that after the required holding period for chemigation on the bog has passed, stream flow is returned to the bog and flow into the by-pass channel is stopped.

Supporting Data for Documentation

DESIGN DATA. The following information shall be recorded in the design and/or on the drawings, as applicable:

1. Sketch of the bogs or other area applicable to the design of the water control structure.

2. Intended purpose of the water control structure, that is, whether the structure is for management of water on a bog, as an outlet for an irrigation pit, to control water to a by-pass channel, as a turnout structure for chemigation applications, or as a control structure for wildlife, drainage, etc.

3. Criteria used to design the structure, such as, required flooding or deflooding time, storm runoff, or other applicable criteria.

4. Survey shots taken to establish elevations needed for the design.

5. All required computations to properly design the structure in accordance with the guidelines in Massachusetts Technical Note Engineering No. 213, Cranberry Bog Engineering.

6. Any special considerations involved in the design.

7. Dimensions of the structure to be installed, including the base plate, if needed.

8. Refer to the Dike standard (356) for the required design data for the dikes associated with water control structures.

CHECK DATA. The following information shall be recorded on the drawings to certify installation of this practice:

1. Check notes to show that the structure was installed to the elevations as required in the design.

2. Dimensions of the structure installed, including the base plate.

3. Refer to the Dike standard (356) for the required documentation for certifying the dikes associated with water control structures.

References

1. Engineering Field Manual, Chapter 6, Structures.

2. Massachusetts Technical Note Engineering No. 213, Cranberry Bog Engineering.

Specifications

1. Construction shall be in accordance with an approved plan, as staked in the field, and conforming to Soil Conservation Service Standards.

2. Trees and stumps, brush and other vegetation shall be cut at approximate ground level. They shall be removed from the site, except when the dike is being constructed over deep (more than 10 feet) organic material. The surface layer of organic material shall be removed for dikes constructed in mineral soil.

3. Excavation for the pipe shall extend at least two (2) feet from the sides of the conduit and its appurtenances. Foundation surfaces shall be sloped no steeper than 1:1. The foundation area shall be thoroughly scarified before placement of the fill material. The surface shall have moisture added or it shall be compacted if necessary so that the first layer of fill material can be compacted and bonded to the foundation.

4. The conduit through the dike shall be placed on a firm foundation to the lines and grades shown on the plans. Care should be taken not to excavate below the depth specified. Overexcavation shall be corrected by placing firmly compacted layers of earth to provide a firm foundation. If rocks or boulders are exposed in the bottom of the excavation, they shall be removed to a minimum depth of eight (8) inches below the invert of the pipe and the excess excavation replaced with firmly compacted earth to the specified grade.

5. Selected backfill material shall be placed in layers not to exceed six (6) inches around the conduit and their component parts and each layer shall be thoroughly compacted. Care should be taken that compaction around the pipe spillway does not cause uplift on the pipe with a resulting void beneath the pipe. Hand tamping, only, should be used to compact the fill under the bottom half of the pipe.

6. Power driven equipment shall not pass over the pipe conduit until the compacted fill has reached a minimum height of two (2) feet over the conduit.

7. Earthfill material shall be free of organic matter and other objectionable material. Placing and spreading of fill shall begin on the lowest part of the working area and continue in horizontal layers of approximate uniform thickness, preferably six (6) inches, but not more than twelve (12) inches, depending on the equipment used. The construction equipment shall be operated over the entire area of each layer in a manner to break up large clods and obtain compaction.

8. Fill material shall be moist, but not too wet for equipment operations and shaping. Water shall be added to the fill material where it is too dry to properly compact.

9. When earthfill is to be added to an existing dike, the top of the dike shall be excavated to remove all vegetative and organic material. After removal of the top layer, the foundation shall be scarified and if too dry, moistened, before fill is added.

10. When a dike is to be constructed over organic material of depths greater than two (2) feet, and initial fill layer of two (2) feet minimum depth shall be placed.

11. All areas disturbed during construction will be treated to minimize erosion of the site during the construction period. Upon the completion of construction, all disturbed areas will be seeded or sodded in accordance with Critical Area Planting (342), unless protected with mechanical means, such as riprap.