

**NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD**

**CONSTRUCTED WETLAND
(Ac.)**

CODE 656

DEFINITION

An artificial ecosystem with hydrophytic vegetation for water treatment.

PURPOSE

For treatment of wastewater and contaminated runoff from agricultural processing, livestock, and aquaculture facilities, or

For improving the quality improvement of storm water runoff or other water flows lacking specific water quality discharge criteria.

CONDITIONS WHERE PRACTICE APPLIES

- Constructed wetlands for the purpose of wastewater treatment apply where a constructed wetland is a component of an agricultural wastewater management system.
- Constructed wetlands for the purpose of water quality improvement apply where wetland effluent is not required to meet specific water quality discharge criteria.

GENERAL CRITERIA APPLICABLE TO ALL PURPOSES

Comply with all applicable laws, rules, regulations, and permit requirements including those applicable to the discharges to waters of the state.

Constructed wetlands shall not cause surface or subsurface flow to encroach upon an upstream neighboring property unless a flowage easement is signed and recorded.

Locate outside the boundary area of jurisdictional wetlands of any classification

Locate the wetland to minimize the potential for contamination of ground water resources and to protect aesthetic values.

Provide appropriate inlet control structures to prevent debris from entering the wetland, to control the rate of inflow during normal operations, and to control inflow as necessary for operation and maintenance.

Provide an outlet control structure capable of maintaining appropriate water depths to achieve the desired water treatment, and to meet the requirements of the hydrophytic vegetation. The treatment wetland is to be designed with provisions to allow complete drainage of the wetland cells for future maintenance. In general, a gravity drain will be provided; otherwise provisions for pumping will be provided, and wetland drainage procedures explained in the operation & maintenance plan.

The minimum height of interior embankments shall contain the design water depth and a sufficient depth for the accretion of settleable solids, decayed plant litter, and microbial biomass. In the absence of an accretion rate analysis the minimum depth for accretion shall be 1 inch per year for either the design life of the practice or between scheduled debris and sediment removal maintenance operations.

Unless otherwise specified in this standard, the spillway requirements, embankment configurations, excavated side slopes, protective cover on disturbed soils and disposal of excavated material shall comply with the general criteria, criteria for embankment ponds, and criteria for excavated ponds as appropriate as contained in conservation practice standard 378, Pond.

Embankments require a cut-off trench a minimum of 3 ft deep.

Use a planting medium that has a cation exchange capacity, pH, electrical conductivity, organic matter, and textural class that is conducive to wetland plant growth and retention of contaminants.

Select wetland plants that are suitable for local climatic conditions and tolerant of the concentrations of nutrients, pesticides, salts and other contaminants flowing into the wetland. Do not use invasive or non-native species that could be a problem in native habitats.

Provide supplemental water as necessary to establish and maintain plants in a condition suitable for the water treatment purpose.

CRITERIA APPLICABLE TO WASTEWATER TREATMENT

When located in a floodplain, provide protection from inundation or damage from a 25-year flood event.

Pretreat water flowing to the wetland to reduce the concentrations of solids, organics, and nutrients to levels that will be tolerated by the wetland system and to prevent excessive accumulation of solids within the wetland.

Provide sufficient storage upstream of the wetland to contain the wastewater and runoff from a 25-year 24 hour storm. The outlet of this storage shall deliver the water to the wetland at a rate consistent with the treatment objectives of the wetland; or the wetland can be designed to store the runoff from a 25-year 24 hour storm. When the runoff from a 25-year 24 hour storm is stored in the wetland, design the wetland so that it will return to design operating levels within 96 hours after the 25 year, 24 hour storm event.

Design the wetland system with a minimum of two rows of functionally parallel cells, or three cells in series. Flow through the cells shall be designed to prevent hydraulic short circuiting between cells.

Determine the surface area using design procedures in Part 637 of the NRCS National Engineering Handbook, Chapter Three, Constructed Wetlands or alternative design procedures that are recognized by the regulatory and academic conservation partners in the state. Wetlands designed using the presumptive method shall be designed for maximum daily loading not to exceed 65 lb BOD₅ per acre of surface area.

Construct wetland cells with a sufficient length-to-width ratio to assure uniform and predictable hydraulic retention times. The minimum hydraulic retention time for average daily design flow is 12 days.

Soil exploration to a minimum depth 3 ft below the planned bottom of the constructed wetland is required. Control seepage as necessary for similar wastewater management facilities.

Exclude livestock from the wetland.

Unless the wetland is designed for discharge under a NPDES permit, effluent from the wetland is to be irrigated onto cropland, or discharged into a vegetative treatment area through a level spreader or other means necessary to distribute the flow evenly across the width of the vegetative treatment area.

The wetland shall be designed so that each cell can be fully drained to provide maintenance access

CRITERIA APPLICABLE TO WATER QUALITY IMPROVEMENT

When located in a floodplain or watercourse provide protection from damage from a 10-year flood event.

Provide an auxiliary spillway or inlet bypass with sufficient capacity to pass the peak flow of the 25 year 24 hour storm and provide erosion protection for the perimeter embankment

When used to improve the water quality of surface water runoff, design the wetland so that it will return to design operating levels within 72 hours after a 10 year, 24 hour storm event.

When used in populated areas install safety fences and warning signs forbidding access to unauthorized persons.

Provide an adequate access for cleanout and maintenance.

When used to treat runoff from crop production areas; the drainage area will be managed to an RMS level to minimize sediment production and transport into the treatment wetland, or a sediment basin meeting practice standard 350, Sediment Basin will be constructed in conjunction with the constructed wetland

When used to treat subsurface drainage discharge, the system can work by gravity flow or the tile effluent can be pumped into the treatment wetland. Pumping systems are to meet practice standard 533, Pumping Plant for Water Control. Discharge from the treatment wetland into the natural watercourse shall be by gravity flow.

The minimum surface area of wetlands for treatment of surface or subsurface crop production runoff is 0.5% and can go up to 2% of the contributing drainage area. Consider design procedures that are recognized by the regulatory and academic conservation partners

A minimum of 75% of the surface area of the treatment wetland is to have a design treatment depth not to exceed 2 ft.

Stormwater flow through the treatment wetland shall meet design criteria found in practice standard 587, Structure for Water Control.

CONSIDERATIONS

Consider bat boxes, mosquito fish, and other measures to control vectors and nuisance insects when locating the wetland near residences, commercial buildings, and public use areas.

Consider seasonal storage of contaminated water upstream of the wetland during cold, dry, or excessively wet climatic conditions when the function of the wetland may be compromised.

Effluent from the wetlands may be stored for land application, recycled through the wastewater management system, or otherwise used in the agricultural operation.

Measures for controlling seepage may be designed according to the procedures of NEH Part 651, Agricultural Waste Management Field Handbook, Appendix 10d, "Geotechnical Design and Construction Guidelines."

Where wetland performance may be compromised by large, infrequent storm events, consider providing an inlet that captures the first flush of storm water runoff and allows excess flow to bypass the wetland.

Consider a sedimentation basin, and reaches of shallow and deep water within the wetland.

Provide inflow and outflow structures and cell geometries that promote cross-sectional mixing of water flowing through the wetland cell.

Consider the potential of pollutants entering the wetland to cause environmental problems due to accumulation, biological uptake, or release during maintenance operations.

When selecting vegetative species, give priority to native wetland plants collected or grown from material within the Major Land Resource Area (MLRA) of the Constructed Wetland location, and consider potential nutrient and pesticide contamination.

Fences or other measures may be needed to exclude or minimize access of humans or animals that could be adversely affected by the constructed wetland or that would inhibit its function.

Consider egress for animals that might be entrained into and trapped in the wetland. Flatter side slopes generally provide better habitat for wildlife. If there is a desire to use the constructed wetland for wildlife habitat, consult Wetland Restoration (657), Wetland Enhancement (659) and Wetland Creation (658), Wetland Wildlife Habitat Management (644) and Shallow Water Development and Management (646).

Consider providing embankment protection against burrowing animals.

Consider vegetative buffers (herbaceous and woody) around the perimeter of constructed wetland for additional filtering of pollutants entering and leaving wetland areas during precipitation events.

PLANS AND SPECIFICATIONS

Prepare plans and specifications for each specific field site where a constructed wetland will be installed. Define the purpose, goals and objectives of the practice and the soils, hydrology and vegetation criteria. Include information about the location, construction sequence, and vegetation establishment.

Specifications shall include:

- Dimensions of the constructed wetland
- Details for hydraulic control structures necessary for maintaining the desired water depth and stormwater management
- Species selection and seeding or sprigging rates for vegetation
- Planting dates, care and handling of the seed to ensure that planted materials have an acceptable rate of survival.
- Site preparation such as stabilizing crop, mulching, or mechanical means of stabilizing, fertilizer, and lime requirements sufficient to establish and grow selected species.

OPERATION AND MAINTENANCE

Develop an operation and maintenance plan that is consistent with the purposes and intended life of the practice. Include the requirements for safety, water management, cleanout of sediment, maintenance of structures, embankments, and vegetation, control measures for vectors and pests, and containment of potential pollutants during maintenance operations.

Operational requirements should include:

- Maintenance of water level in wetland cells appropriate for vegetation including initial establishment of hydrophytic vegetation
- Control flow to wetland according to water budget
- Monitoring of wetland performance
- Sampling effluent for nutrients prior to utilization
- Surveillance of inlet and outlet

Maintenance requirements should include:

- Repair of embankments
- Control of vegetation
- Repair of fences or other ancillary features
- Replacement of wetland plants
- Repair of pipelines and spillways
- Control of unwanted animals (varmints) or vectors (mosquitoes)

REFERENCES

Part 637, Environmental Engineering National Engineering Handbook, Chapter 3, Constructed Wetlands. USDA, NRCS, September, 2002

<http://www.info.usda.gov/CED/ftp/CED/neh637-ch03.pdf>