

NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

CONSTRUCTED WETLAND

Code 656



agricultural lands including livestock, poultry, aquaculture, or nursery facilities.

This standard should not be used in lieu of Florida NRCS Conservation Practice Standards, Wetland Restoration, Code 657, Wetland Creation, Code 658, or Wetland Enhancement Code 659, when the main purpose is to restore, create, or enhance, wetland functions other than wastewater treatment or water quality improvement.

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 water quality of storm water runoff or other flows lacking specific water quality discharge criteria.

This practice is not to be applied as compensation for wetland losses (i.e., constructed wetlands cannot be used as mitigation for impacts to natural wetlands).

CONDITIONS WHERE PRACTICE APPLIES

- Constructed wetlands for the purpose of wastewater treatment apply where a constructed wetland is a component of a planned conservation system or 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.
- Constructed wetlands are for the treatment of wastewater or runoff that originates from

CRITERIA

General Criteria Applicable To All Purposes

Laws and Regulations. Comply with all Federal, state, and local laws, rules, regulations and permit requirements governing the use of constructed wetlands. Constructed wetlands for wastewater treatment shall not be designed to discharge to waters of the state unless permitted by state laws and regulations, and appropriate permits have been obtained. In addition, if discharge is permitted, the receiving surface water must have the capacity to assimilate the constructed wetland's treated effluent during low flow periods.

Impact to cultural resources, wetlands and Federal and state protected species shall be evaluated and avoided or minimized to the extent practicable during planning, design and implementation of this conservation practice in accordance with established National and Florida policy, General Manual (GM) Title 420-Part 401; Title 450-Part 401, Title 190-Parts 410.22 and 410.26, National Planning Procedures Handbook (NPPH) Florida Supplements to Parts 600.1 and 600.6, National Cultural Resources Procedures Handbook (NCRPH), National Food Security Act Manual (NFSAM), and the National Environmental Compliance Handbook (NECH).

Conservation practice standards are reviewed periodically, and updated if needed. To obtain the current version of this standard, contact the Natural Resources Conservation Service.

Location. Locate the constructed wetlands outside the limits of natural wetlands of any classification.

Locate the constructed wetlands to provide sufficient separation distance and utilization of prevailing winds and landscape elements (e.g., building arrangement, landforms, and vegetation) to minimize odors and protect aesthetic values.

Locate the constructed wetland with a horizontal and vertical separation distance that will minimize the potential for contamination of ground water resources.

Type. Design the constructed wetland as surface flow systems consisting of adequate seepage control, a suitable plant medium, rooted emergent hydrophytic vegetation (in some cases floating or submerged vegetation may be appropriate as well), and the structural components needed to contain and control the flow.

Influent. Pretreat the influent flowing to the wetland to reduce the concentrations of solids, organics, and nutrients to levels that will be tolerated by wetland plants and not cause excessive accretion within the wetland.

Where significant sediment and organic debris are expected in the wastewater or runoff to be treated, provide provisions for its entrapment before entry into the wetland. The entrapment area will be cleaned and the accreted material disposed of according to Florida NRCS conservation practice standards Waste Utilization, Code 633 and Nutrient Management, Code 590.

Water budget. Base the required wetland size and storage requirements on a water budget that evaluates runoff or wastewater volumes, precipitation, evaporation, and water use. In addition, the wetland size shall include the required hydraulic retention time when pretreatment and post treatment facilities are included.

Embankments. The perimeter embankment shall have a minimum top width of 10 feet. Interior embankments shall have a minimum top width of 8 feet. If site conditions will not permit the required top width, narrower widths may be used if suitable provisions are included in the Operation and Maintenance plan for vegetation maintenance and embankment repair. All embankment side slopes shall be a minimum ratio of 2 horizontal to 1 vertical (2:1).

Use soils suitable for the purpose of constructing the embankment according to the Unified Soil Classification System.

Unless otherwise specified, the spillway requirements, embankment configurations, excavated side slopes, protective cover on disturbed soils and disposal of excavated material shall comply with the general criteria for embankment ponds, and criteria for excavated ponds as appropriate as contained in Florida NRCS Conservation Practice Standard, Pond Code 378.

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

Outlet. 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.

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

Vegetation. Vegetation selected for the constructed wetland shall be hydrophytic plants suitable for local climatic conditions and tolerant of the concentrations of nutrients, pesticides, and other constituents in the runoff or wastewater stream. Select species based on their treatment potential. Do not use invasive or non-native species that could be a problem in native habitats.

Give preference to native wetland plants with localized genetic material. Wherever possible, avoid harvesting native plants from existing wetlands, as this practice may be prohibited for certain species or geographic areas and may be detrimental to natural wetlands.

Exclude livestock from the constructed wetland to avoid damage to vegetation.

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

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

Seepage control. Locate the constructed wetland in soils with an acceptable permeability that meets all applicable regulations, or it shall be lined. Measures for controlling seepage may be designed according to the procedures in NRCS National Engineering Handbook (NEH) Part 651, Agricultural Waste Management Field Handbook, Appendix 10D, "Geotechnical Design and Construction Guidelines."

Criteria Applicable to Wastewater Treatment

Location. Protect constructed wetlands located within a floodplain from inundation or damage from a 25-year flood event, or larger if required by laws, rules, and regulations.

Topography. Site topography shall accommodate the requirements for sufficient length to width ratios of the wetland and the wetland cells, and the requirement that the wetland cells be level side to side and grades of less than 0.1 ft/ft lengthwise to assure uniform and predictable hydraulic retention times.

Inlet. Provide an inlet structure that will allow control of flow discharged to the wetland and screening of influent to prevent debris from entering wetland. Design of the inlet structure shall assure its function throughout the life of the wetland considering accretion. Criteria in Florida NRCS Conservation Practice Standard Waste Storage Facility, Code 313, for fabricated structures shall apply as appropriate.

Provide sufficient storage upstream of the wetland to contain the wastewater and runoff from a 25-year frequency, 24 hour duration storm. The outlet of this storage shall deliver the water to the wetland at a rate consistent with the treatment objectives of the wetland.

Influent. Constructed wetlands for wastewater treatment shall not allow for direct inclusion of contaminated and/or uncontaminated runoff.

Keep the constructed wetland moist at all times and provide supplemental water as necessary to establish and maintain plants in a condition suitable for the water treatment purpose.

Surface Area. Determine the surface area using design procedures in NRCS National Engineering Handbook, Part 637, Chapter 3, Constructed Wetlands, or alternative design procedures that are recognized by the regulatory and academic conservation partners in the state.

Configuration. The constructed wetland shall have an overall length to width ratio of 1:1 (minimum) to 4:1 (maximum). Individual cells

within the constructed wetland shall have a length-to-width ratio of 10:1 (minimum) to 15:1 (maximum).

Design the wetland system with a minimum of two rows of functionally parallel cells.

Flow depth. The design depth shall be based on the most severe season of operation, the desired level of treatment, and the required littoral zone of the plant species being used. The design depth shall be a minimum of 0.33 foot and a maximum of 1.5 feet.

Embankments. Height of the constructed wetland perimeter embankment shall be the sum of the following:

- Design depth
- Wetland accretion -- a minimum of 1 inch per year for the cleanout interval
- 25-year, 24-hour precipitation
- 12 inches of freeboard
- Hydraulic head on overflow device

The height of wetland's interior embankments shall be the minimum of the sum of the following:

- Normal design flow depth
- Wetland accretion -- minimum of 1 inch per year for the cleanout interval

Overflow Device. An ungated overflow device shall be provided to operate when the 25-year, 24-hour precipitation is exceeded. The overflow device shall operate without infringing on the wetland perimeter embankment's freeboard.

Outlet. Constructed wetlands shall discharge to storage facilities to allow for land application in accordance with NRCS conservation practice standards Waste Utilization, Code 633 and Nutrient Management, Code 590 or recycled through the waste management system.

Seepage. Control seepage as necessary for similar wastewater management facilities.

An outlet structure shall be provided that allows maintenance of proper water level in the wetland and controls the flow from the wetland.

Cleanout. The waste treatment cells shall be designed so that each of the parallel cells can be completely drained in order to accomplish periodic maintenance and removal of accreted material.

Exclusion. Exclude livestock from wetland.

Criteria Applicable to Water Quality Improvement

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

Design Storm. The constructed wetland system shall be designed to contain a 2-year, 24-hour storm runoff. Limited area sites handling only the “first flush” volume shall have a minimum capacity to store 0.5 inch of runoff volume from the entire drainage area. When less than full runoff is stored, bypass of the excess storm flow shall be provided.

Detention Time and Surface Area. The detention time and surface area shall be calculated on the time required to achieve the required level of treatment based on the limiting contaminant present.

Wetland Cells. Length to width ratios are to be 4:1 to 10:1. Other dimensions and shapes that provide a more natural landscape appearance that meet treatment requirements can be used.

Florida NRCS conservation standards for Dike, Code 356 and Structure for Water Control, Code 587 shall be used as appropriate. Refer to the NRCS Engineering Handbook, Part 637, Chapter 3, Constructed Wetland, and Chapter 6, “Structures,” for additional design information. Existing drainage systems shall be utilized, removed, or modified as needed to achieve the intended purpose.

Depth. Maximum water depth shall be 24 inches except in those instances where deep water areas are included as a special design. The maximum depth can be deeper than 24 inches if provisions are made to drain the constructed wetland down to the 24-inch level within 72 hours. This will allow for additional settlement of solids without damaging the wetland vegetation.

Overflow Device. An ungated overflow device shall be provided to operate when the 25-year, 24-hour precipitation is exceeded. The overflow device shall operate without infringing on the wetland perimeter embankment’s freeboard.

Outlet. A water control structure to automatically regulate storage release in accordance with the design detention time shall be installed.

CONSIDERATIONS

Locate constructed wetlands downgrade and as near the source of wastewater as practical.

Consider the impact a constructed wetland could have on existing wetlands or other significant features in the landscape ecosystem.

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 the potential to transport chemical contamination from the wetland plant site to the constructed wetland.

In addition to selecting vegetation based on treatment potential, consider the species suitability as a physical substrate for attached organisms (e.g., algae, bacteria).

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

Install measures to exclude or minimize attractiveness of the constructed wetland to wildlife that could be adversely affected by the constructed wetland. Consider providing embankment protection against burrowing animals.

Consider the use of fences to exclude livestock and wildlife to maintain embankment integrity. Fences or other measures may be needed to exclude or minimize access of humans or animals that could adversely be affected by the constructed wetland or that would inhibit its function.

Consider access for animals that might be attracted to the wetland, and egress for fish that could be entrained and trapped. Flatter side slopes generally provide better habitat for wildlife. If there is a desire to use the constructed wetland for wildlife habitat, consult Florida NRCS Conservation Practice Standards, Wetland Restoration, Code 657, Wetland Enhancement, Code 659, Wetland Creation, Code 658, Wetland Wildlife Habitat Management, Code 644, and Shallow Water Development and Management, Code 646.

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

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

Recycle constructed wetland effluent back through the agricultural waste management system when practical.

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

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

Consideration may be given to the ancillary use of the constructed wetland area for the commercial production of wetland plants. Selective harvesting and sale of wetland plants may be a potential source of income.

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

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.

PLANS AND SPECIFICATIONS

Prepare plans and specifications for each specific field site where a constructed wetland will be installed. Include information about the location, construction sequence, and vegetation establishment.

As a minimum, plans and specifications shall include:

- Location of constructed wetland
- Dimensions of the constructed wetland
- Typical cross sections of structures such as dikes, water control, etc
- Details of all structures
- Species selection
- Seeding rates, sprigging rates or planting density or containerized plants.
- 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, mulch, or mechanical means of stabilizing, fertilizer, and pH adjustment sufficient to establish and grow selected species.

OPERATION AND MAINTENANCE

Develop an operation and maintenance plan and review with the landowner 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
- 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 density of desirable vegetation
- Removal of invasive and/or non-native species that could be a problem in native habitats.
- Repair of fences or other ancillary features
- Replacement of wetland plants
- Repair of pipelines and spillways
- Control of unwanted animals (varmints) or vectors (mosquitoes)
- Removal of accreted sediments from waste treatment cells

REFERENCES

General Manual
Title 420-Part 401
Title 450-Part 401
Title 190-Parts 410.22 and 410.26
National Cultural Resources Procedures Handbook
National Environmental Compliance Handbook
National Food Security Act Manual
National Planning Procedures Handbook Florida Supplements to Parts 600.1 and 600.6
Engineering Field Handbook, Chapter 6
Florida NRCS Conservation Practice Standards:

Critical Area Planting, Code 342
Dike, Code 356
Pond, Code 378
Nutrient Management, Code 590
Shallow Water Development and
Management, Code 646
Structure for Water Control, Code 587
Wetland Creation, Code 658
Wetland Enhancement, Code 659
Wetland Restoration, Code 657
Waste Storage Facility, Code 313
Waste Treatment Lagoon, Code 359
Waste Utilization, Code 633
Wetland and Wildlife Habitat Management,
Code 644

NEH Part 637, Chapter 3, Constructed Wetlands
NEH Part, 637, Structures
NEH Part 651, Agricultural Waste Management
Field Handbook, Appendix 10D,
“Geotechnical Design and Construction
Guidelines”
National Environmental Compliance Handbook
National Food Security Act Manual
National Planning Procedures Handbook Florida
Supplements to Parts 6001.1 and 600.6