Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

Constructed Wetland

Code 656

(Ac)

DEFINITION

An artificial wetland ecosystem with hydrophytic vegetation for biological treatment of water.

PURPOSE

- To treat wastewater or contaminated runoff from agricultural processing, livestock, or aquaculture facilities
- To improve water quality of storm water runoff or other water flows.

CONDITIONS WHERE PRACTICE APPLIES

This standard applies where at least one of the following conditions occurs:

- Wastewater treatment is necessary for organic wastes generated by agricultural production or processing.
- Water quality improvement is desired of agricultural storm water runoff.

A constructed wetland is typically applied where wetland function can be created or enhanced to provide treatment of wastewater or other agricultural runoff.

Do not use this standard in lieu of NRCS Conservation Practice Standards (CPS), Wetland Restoration (Code 657), Wetland Creation (Code 658), or Wetland Enhancement (Code 659), where the main purpose is to restore, create, or enhance wetland functions other than wastewater treatment or water quality improvement.

Do not use this standard in lieu of CPS Denitrifying Bioreactor (Code 605) where the main purpose is to reduce nitrate nitrogen concentration in subsurface drainage flow or CPS Saturated Buffers (Code 604) where the main purpose is to reduce nitrate nitrogen concentration from subsurface drain outlets or to enhance or restore saturated soil conditions.

CRITERIA

General Criteria Applicable to All Purposes

Plan, design, and construct constructed wetlands to comply with federal, state and local laws and regulations.

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

NRCS reviews and periodically updates conservation practice standards. To obtain the current version of this standard, contact your Natural Resources Conservation Service State office or visit the Field Office Technical Guide.

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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. Refer to CPS Structure for Water Control (Code 587), for design criteria.

Design the minimum height of interior embankments to 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, design the minimum depth for accretion of 1 inch per year for the design life of the practice or between scheduled debris and sediment removal maintenance operations.

Provide the impoundment with sufficient capacity to handle the peak flow and runoff volume from the, 25-year frequency, 24-hour duration storm without overtopping the embankment and provide erosion protection for the perimeter embankment. Capacity may be achieved through the outlet control structure, temporary storage, and/or an auxiliary spillway.

Unless otherwise specified, refer to the design criteria contained in CPS Pond (Code 378) for the spillway requirements, embankment configurations, excavated side slopes, embankment soils, protective cover on disturbed soils and disposal of excavated material.

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

For a constructed wetland where specific wetland vegetation is to be planted, select wetland species 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 other species that could spread and become a nuisance to surrounding wetlands. Refer to the appropriate state technical information for recommended species and seeding methods.

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

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

Provide an adequate access for cleanout and maintenance.

Plant Materials. Many species that are suitable for uptake and filtration of bio solids may exhibit invasive characteristics. Utilize native plant materials when feasible. Plant materials shall be approved prior to establishment by the State Biologist. Known noxious or invasive species such as *Phragmites* or narrow-leaf cattails shall not be utilized.

Additional Criteria Applicable to Constructed Wetlands for Wastewater Treatment

Locate the constructed wetland outside the boundary area of natural wetlands of any classification.

Locate a constructed wetland for wastewater treatment above the 25-year floodplain elevation unless site restrictions require location within the floodplain. When located in a floodplain, provide protection from inundation or damage from a 25-year frequency, 24-hour flood event.

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

Divert runoff from above or provide sufficient storage upstream of the wetland to contain the wastewater to be treated and the precipitation/runoff from a 25-year frequency, 24-hour duration storm. Design the outlet of this storage to deliver water to the wetland at a rate consistent with the treatment objectives of the wetland.

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

Determine the surface area using design procedures in NRCS National Engineering Handbook (NEH), Part 637, Chapter 3, "Constructed Wetlands," or alternative design procedures recognized by the regulatory and academic conservation partners in the state.

Design and construct wetland cells with a sufficient length-to-width ratio to assure uniform and predictable hydraulic retention times.

Seepage control. Where appropriate, design seepage control measures according to the procedures in NRCS NEH, Part 651, Agricultural Waste Management Field Handbook, Appendix 10D.

Exclude livestock from the constructed wetland to prevent damage to the plants, embankments, and water control structures.

Additional Criteria Applicable to Constructed Wetlands for Water Quality Improvement

When located in a floodplain or watercourse, provide protection from damage from a minimum 10-year frequency, 24-hour flood event.

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

Use design procedures recognized by the regulatory and academic conservation partners in the State. Select a design hydraulic retention time that will achieve the intended water quality results.

CONSIDERATIONS

Considerations Applicable to All Purposes

Landscape impact. Consider the impact a constructed wetland could have on existing wetlands, including watershed or other significant features in the landscape ecosystem. Constructed wetlands may require a large footprint to treat relatively small amounts of effluent depending upon many variables.

When constructed in or near populated areas, consider the potential of odor in regards to prevailing winds.

Vector and nuisance insect control. Consider installing 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.

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

Recycling effluent. Consider storing constructed wetland effluent for land application, recycling through the wastewater management system, or using elsewhere in the agricultural operation.

Wetland performance. Consider providing a structure that captures the first flush of storm water runoff and allows excess flow to bypass the wetland in situations where wetland performance may be compromised by large, infrequent storm events.

Consider a sediment basin, and reaches of shallow and deep water within the wetland to enhance wetland function.

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 that may cause environmental problems due to accumulation, biological uptake, or release during maintenance operations.

Consider vegetative buffers around the perimeter of the constructed wetland for additional filtering of pollutants entering and leaving wetland areas during precipitation events and to prevent excessive buildup of sediment.

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 NRCS Conservation Practice Standards, Fish Passage (396), Access Control (472), Wetland Restoration (657), Wetland Enhancement (659), Wetland Creation (658) and Wetland Wildlife Habitat Management (644).

Plant materials. 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.

Select plant materials that provide habitat requirements for desirable wildlife and pollinators. The addition of native forbs and legumes to grass mixes will increase the value of plantings for both wildlife and pollinators. Refer to the Kentucky Pollinator Handbook for information regarding species suitable for pollinators in wetlands.**Access.** Use fences or other measures as needed to exclude or minimize access of humans or animals that could adversely affect the constructed wetland or inhibit its function.

Embankment protection. Consider providing embankment protection against burrowing animals.

PLANS AND SPECIFICATIONS

Prepare plans and specifications for constructed wetlands that describe the requirements for applying the practice according to this standard. As a minimum the plans and specifications must include, but are not limited to—

- A site-specific plan view of the practice showing the main features of the constructed wetland in relation to each other and the waste management system, if applicable. Show the seasonal high water table for the site.
- Specifications or information carried as construction notes on the construction drawings that include materials, methods and sequence. Construct core and compact hig clay content material below the top of the seasonal high water table under berms and sideslopes.
- Location, size, type of material, and elevations of all structures.
- Typical cross sections of the constructed wetland, including berm dimensions and side slopes if applicable
- Plant species selection.
- Rates for seeding, sprigging, or planting density for containerized plants.
- Planting dates, care and handling of the seed or plant materials 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 pH adjustment sufficient to establish and grow selected plant species.

OPERATION AND MAINTENANCE

Develop an operation and maintenance plan and review the plan with the operator responsible for the success of this practice.

Include the requirements for safety, water management, cleanout of sediment and accumulated organic matter, maintenance of structures, embankments, and vegetation, control measures for vectors and pests, and containment of potential pollutants during maintenance operations.

Operational requirements include, as appropriate, but not limited to—

- 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.
- Inspection of inlet and outlet structures for damage after large storm events and at least annually.

Maintenance requirements include, as appropriate, but not limited to—

- Repair of embankments.
- Control density of desirable vegetation.
- Removal of invasive and/or nonnative species that could be a problem in native habitats.
- Debris and sediment removal.
- Repair of fences or other ancillary features.
- Replacement of wetland plants.
- Repair of pipelines and spillways.
- Control of unwanted rodents or vectors (mosquitoes).

REFERENCES

USDA, NRCS. National Engineering Handbook, Part 637, Chapter 3, Constructed Wetlands. Washington, D.C.