



Natural Resources Conservation Service
CONSERVATION PRACTICE STANDARD
WETLAND RESTORATION
CODE 657
(Ac.)

DEFINITION

The return of a wetland and its functions to a close approximation of its original condition as it existed prior to disturbance on a former or degraded wetland site.

PURPOSE

This practice may be applied to restore wetland function, value, habitat, diversity, and capacity to a close approximation of the pre-disturbance conditions by restoring one or more of the following:

- Conditions conducive to hydric soil maintenance.
- Wetland hydrology (dominant water source, hydroperiod, and hydrodynamics).
- Native hydrophytic vegetation (including the removal of undesired species, and/or seeding or planting of desired species).
- Original fish and wildlife habitats.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies only to sites that were historically wetlands that have been subject to the degradation of hydrology, vegetation, and/or soils. These sites may have been completely converted to non-wetland conditions by filling, draining, or other hydrologic changes, or they may still meet wetland criteria but have impaired functions due to hydrologic and/or vegetative modifications.

On sites where hydrology has been altered, this practice is applicable where the natural hydrologic conditions can be approximately restored by actions such as modifying drainage; restoring stream/floodplain connectivity; removing diversions, dikes, and levees; and/or by using low embankments and other structural measures to restore wetland hydrology to an approximation of the historic condition.

This practice does not apply to:

- Development of a wetland specifically for the treatment of point and non-point sources of water pollution. Refer to the Maryland conservation practice standard for Constructed Wetland (656).
- The augmentation of wetland functions beyond the original natural conditions on a degraded or naturally functioning wetland site, possibly at the expense of other functions. Refer to the Maryland conservation practice standard for Wetland Enhancement (659).

- The creation of a wetland on a site that was historically not a wetland. Refer to the Maryland conservation practice standard for Wetland Creation (658).
- The management of fish and wildlife habitat on wetlands restored under this standard. Refer to the Maryland conservation practice standard for Wetland Wildlife Habitat Management (644).

CRITERIA

General Criteria Applicable to All Purposes

In addition to the criteria included in this standard, follow the criteria and specifications provided in the *Maryland Wetland Design Guide* for design requirements. Follow the specifications in the *Maryland Wildlife Habitat Planning Guide* for habitat design and management requirements, as applicable. For additional requirements concerning plant species selection, planting dates, rates, methods, and care in handling and planting of seed or planting stock, refer to the applicable sections of the *Maryland Conservation Planting Guide*.

The purpose, goals, and objectives of the restoration shall be clearly defined in the restoration plan, including soils, hydrology, vegetation, and fish and wildlife habitat criteria that are to be met and are appropriate for the site and the project objectives.

These planning steps shall be done with the use of a functional assessment-type procedure or a state approved equivalent. The objectives will be determined by an analysis of current and historic site functions. They will be based on those functions that can reasonably be supported by current site constraints. Data from historic and recent aerial photography and/or other remotely sensed data, soil maps, topographic maps, stream gage data, intact reference wetlands, and historical records shall be utilized to the extent feasible.

The soils, hydrology, and vegetative conditions existing on the site, the adjacent landscape, and the contributing watershed (if applicable) shall be documented during the planning process.

Where known nutrient and pesticide contamination exists, the nutrient and pesticide tolerance of the plant and animal species likely to occur shall be evaluated. If hazardous wastes are suspected on the site, test for the presence of hazardous waste in accordance with local, state, and federal requirements to identify appropriate remedial measures. If remedial measures are not possible or practicable, the practice shall not be planned.

Upon completion, the site shall meet soil, hydrology, vegetation, and habitat conditions of the wetland that previously existed on the site to the extent practicable.

Where offsite hydrologic alterations or the presence of invasive species impact the site, the design shall compensate for these impacts to the extent practicable.

Invasive species, federal/state listed noxious plant species, and nuisance species (e.g., those whose presence or overpopulation jeopardize the practice) shall be controlled on the site as necessary to restore wetland functions. The establishment and/or use of non-native plant species shall be discouraged.

Additional Criteria to Restore Hydric Soil

Wetland restoration sites shall be located on hydric soil. If the hydric soil is covered by fill, sediment, spoil, or other depositional material, the material covering the hydric soil shall be removed to the extent needed to restore the original soil functions.

Soil hydrodynamic and bio-geochemical properties, such as permeability, porosity, pH, or soil organic carbon levels, shall be restored to the extent needed to restore hydric soil functions.

Additional Criteria to Restore Hydrology

The hydroperiod, hydrodynamics, and dominant water source of the restored wetland shall approximate the conditions that existed before alteration. The restoration plan shall document the adequacy of available water sources based on groundwater investigation, stream gage data, water budgeting, or other appropriate means.

The work associated with restoring the wetland shall not adversely affect adjacent properties unless agreed to by signed written agreement or easement.

Timing and level setting of water control structures, if needed, will be based on the actions needed to maintain a close approximation of the original, natural hydrologic conditions.

A natural water supply shall be used to reestablish the site's hydrology to approximate the hydrologic conditions of the wetland type, to the extent feasible.

On sites that have been in long-term agricultural use, grading, shaping, and tillage shall be used as needed and feasible to restore the diverse macro- and microtopography that occurs naturally in wetlands. The location, size, and geometry of earthen structures, if needed, shall match that of the original macrotopographic features to the extent practicable.

Structural measures such as embankments, ditch plugs, and water control structures, shall meet the requirements as specified in the *Maryland Wetland Design Guide*. If the feature exceeds the limits or is not specified in the *Maryland Wetland Design Guide*, the feature shall meet the requirements of other practice standards to which they may apply due to purpose, size, water storage capacity, hazard class, or other parameters (e.g., Dike (356)).

Excavations from within the wetland shall remove sediment to approximate the original topography or establish a water level that will compensate for the sediment that remains.

Water control structures installed in natural or channelized streams that may impede the movement of target aquatic species or species of concern shall meet the criteria in the Maryland conservation practice standard for Aquatic Organism Passage (396).

Wetland restoration sites that exhibit soil oxidation and/or subsidence, resulting in a lower surface elevation compared to pre-disturbance, shall take into account the appropriate hydrologic regime needed to support the original wetland functions.

Additional Criteria to Restore Vegetation

Hydrophytic vegetation restoration shall be of species typical for the wetland type(s) being established and the varying hydrologic regimes and soil types within the wetland. Preference shall be given to native wetland plants with localized genetic material.

Where natural colonization of acceptable species can realistically be expected to occur within 2 years, sites may be left to revegetate naturally. If not, the appropriate species will be established by seeding or planting.

Adequate substrate material and site preparation necessary for proper establishment of the selected plant species shall be included in the plan.

Where planting and/or seeding is necessary, the minimum number of native species to be established shall be based on a reference wetland with the type of vegetative communities and species planned on the restoration site:

- Where the dominant vegetation will be herbaceous community types, a subset of the original vegetative community shall be established within 5 years, or a suitable precursor to the original community will be established within 5 years that creates conditions suitable for the establishment of the native community. Species richness shall be addressed in the planning of herbaceous communities. Seeding rates shall be based upon the percentage of pure live seed and labeled with a current seed tag from a registered seed laboratory identifying the germination rate, purity analysis, and other seed statistics.
- Where the dominant vegetation will be forest or woodland community types, vegetation establishment will include a mix of woody species (trees and/or shrubs) adequate to establish the reference wetland community.

After the site is restored, the vegetation shall generally remain undisturbed so that the wetland will perform its natural functions, including (but not limited to) accumulation of organic matter, nutrient and contaminant sequestration, and retention of surface and subsurface water. Limited moist soil management may be implemented on sites restored on cropland, following the specifications in the *Maryland Wildlife Habitat Planning Guide*.

Note: Specific programs may dictate criteria in addition to, or more restrictive than, those specified in this standard.

CONSIDERATIONS

General Considerations

Consider long-term maintenance requirements of the restored wetland.

Take note of constraints such as economic feasibility, access, regulatory or program requirements, social effects, and visual aspects, such as compatibility with the natural landscape.

Refer to the *Maryland Wildlife Habitat Planning Guide* and the *Maryland Wetland Design Guide* for further discussion of planning considerations.

Soil

Consider the effects of the natural topography and soils of the site on the water regime and vegetation prior to design.

Consider making changes to physical soil properties, including increasing or decreasing saturated hydraulic conductivity by mechanical compaction or tillage, as appropriate.

Consider the effect of construction equipment on soil density, infiltration, and structure.

Consider changes in soil bio-geochemical properties, including increasing soil organic carbon by incorporating compost, and increasing or decreasing soil pH with lime, gypsum, or other compounds.

Hydrology

Consider potential adverse impacts to adjacent properties, roads, septic systems, and other features resulting from raising the water table.

Consider the general hydrologic effects of the restoration, including impacts on downstream stream hydrographs, volumes of surface runoff, and groundwater resources due to changes of water use and movement created by the restoration.

Consider the impacts of water level management, including:

- Increased predation due to concentrating aquatic organisms in small pool areas during draw downs.
- Increased predation of amphibians due to high water levels that can sustain predators.
- Decreased ability of aquatic organisms to move within the wetland and from the wetland area to adjacent habitats as water levels are decreased.
- Increases in water temperature on-site, and in off-site receiving waters.
- Changes in the quantity and direction of movement of subsurface flows due to increases or decreases in water depth.
- The effect changes in the hydrologic regime have on soil bio-geochemical properties, including oxidation/reduction, maintenance of organic soils, and salinity increase or decrease on site and on adjacent areas.

Vegetation

Consider:

- The natural availability of plant species in the soil seed bank vs. the need for planting in the restored wetland.
- The need for temporary water level management to promote seedling survival when vegetation is planted in the wetland.
- The need for additional conservation practices, such as Riparian Herbaceous Cover (390) and/or Riparian Forest Buffer (391), to establish a vegetative buffer around the wetland. Buffers can help to reduce movement of sediment and other pollutants into the wetland and can also provide wildlife habitat.
- The selection of vegetation for the protection of structural measures that is appropriate for wetland function.
- The potential for invasive or noxious plant species to establish on bare soils after construction and before the planned plant community is established.
- The use of prescribed burning to restore wetland and adjacent upland plant communities.

Fish and Wildlife Habitat

Consider:

- The long-term land use objectives of the client. If the client is interested in providing wildlife habitat, consider the wildlife species or groups of species to be supported and the habitat needs that can be met on the managed area.
- The addition of coarse woody debris on sites to be restored to woody plant communities for an initial carbon source and fish and wildlife cover.
- The potential to restore habitat capable of supporting fish and wildlife with the ability to control disease vectors such as mosquitoes.
- The potential to establish fish and wildlife corridors to link the site to adjacent landscapes, streams, and water bodies and to increase the site's colonization by native flora.

- The adverse impacts of nearby populations of nuisance wildlife, such as muskrats, beavers, or resident geese, on the establishment and maintenance of the site. Also consider the potential for attracting nuisance wildlife into an area.

PLANS AND SPECIFICATIONS

Plans and specifications for this practice shall be prepared in accordance with the previously listed criteria. Plans and specifications shall contain sufficient detail to ensure successful implementation of this practice, and shall be recorded using approved engineering specifications sheets or other documentation. The plans and specifications for structural features will include, at a minimum, a plan view, quantities, and sufficient profiles and cross-sections to define the location, line, and grade for stakeout and checkout.

Supporting Data and Documentation

The following is a list of the minimum data and documentation to be recorded in the case file:

- Location of the practice on the conservation plan map.
- Assistance notes. The notes shall include dates of site visits, name or initials of the person who made the visit, specifics as to alternatives discussed, decisions made, and by whom.

Planning Information, Field Data, and Survey Notes. The following is a list of the minimum data and documentation to be recorded in the case file:

- Description of the objectives of the project, including the desired functions that the wetland is expected to provide.
- Soil investigation logs and notes.
- Inventory of existing vegetation on the site. If applicable and available, note the agrichemicals that have been used on the site during the past 5 years.
- Topographic survey or lidar-based DEM for the site, as appropriate for site conditions and the proposed design.
- Identification on a map of structural features causing hydrology degradation, such as ditches, tile drains, or existing levees, and extent of existing blockage (if any).

Design Data. For guidance on the preparation of engineering plans see Chapter 5 of the Engineering Field Handbook, Part 650. The following is a list of the minimum required design data:

- Hydrologic and hydraulic design computations.
- Normal and design storm water surface elevations.
- Cross-section(s) of embankments.
- Profile of vegetated spillway, as appropriate.
- Detail of water control structure, as appropriate, including profile, elevations, and materials specifications with type and gauge/thickness of pipes.
- Planned blockage of drainage systems, including cross sections and lengths of drain plugs.
- Plan view(s) to scale with north arrow and stationing showing topographic contours, planting zones for vegetation, soil borings, and locations of other features, as appropriate.

- Seeding and/or planting requirements, including species selected for each planting zone, stocking/seeding rates, and the size and type of planting stock to be used (e.g., bare-root seedlings, containerized stock, etc.), shown on plans or referenced to Implementation Requirements sheets.
- Quantities estimate.
- Show job class on plans.
- Operation and maintenance plan, typically provided on a document separate from the engineering design.

Utilities Notification.

- Forms ENG-5 and ENG-6 can be used to assist in tracking utility notifications.
- Document on CPA-6 initial discussion about the landowner's responsibility to notify Miss Utility.
- Document on CPA-6 any information from the landowner about the existence and location of known utilities.
- Document on CPA-6 assurances from the landowner that Miss Utility has been notified, including staking by the utilities.

Construction Check Data/As-Built. Record on survey notepaper, SCS-ENG-28, other appropriate engineering paper, or on approved design. Survey data shall be plotted on plans in red. The following is a list of minimum data needed for as-builts:

- Documentation of site visits on CPA-6. Include the date, who performed the inspection, specifics as to what was inspected, all alternatives discussed, and decisions made and by whom.
- Check notes recorded during or after completion of construction, and plans showing as-built conditions of all structures.
- Note plant species as-installed, including species used, quantities, date(s) planted, and arrangement of plants within each planting zone. Vegetation not installed specifically for erosion control or critical area stabilization, and designed based on a different practice standard (e.g., 612, 327) may be installed and certified at a later date if the design is documented on an Implementation Requirements sheet or separate planting plan.
- Final quantities and documentation for quantity changes and materials certification.
- Sign and date checknotes and plans by a person with appropriate approval authority. Include statement that practice meets or exceeds plans and NRCS practice standards.

OPERATION AND MAINTENANCE

An Operation and Management (O&M) plan shall be prepared and is the responsibility of the client to implement. The O&M Plan shall provide specific instructions for proper operation and maintenance of each component of this practice, and shall detail the level of repairs needed to maintain the effectiveness and useful life of the practice. This plan shall be reviewed with and provided to the client.

A completed Wetland Wildlife Habitat Management (644) IR sheet can serve as the management plan, as well as supporting documentation, and shall be reviewed with and provided to the client.

At a minimum, the following components shall be addressed in the O&M plan, as applicable:

- Inspect all embankments and structures at least once per year and after every major storm. Promptly remove trash and obstructions, fix leaks, and make other repairs as needed.
- Inspect the site periodically (at least annually) to determine whether the desired vegetation is present in suitable quantity, quality, and distribution to meet the objectives of the project.
- On embankments to be maintained in herbaceous cover, spot mow or burn infrequently (not more than once every 2 to 3 years) if needed to reduce encroachment of trees and shrubs. To protect ground-nesting wildlife, do not mow or burn between April 15 and August 15.
- Control noxious weeds and other invasive plants by spot treatment, using mechanical methods or approved herbicides. Control of noxious weeds is required by state law. Noxious weed control can be conducted during the primary nesting season (April 15 to August 15), but may require prior approval if the site is enrolled in a financial assistance program. Contact your local weed control specialist concerning recommendations for spot-treating the weed problem.
- Deter colonization of undesirable plants (e.g., cocklebur, phragmites) by conducting regular site inspections and spot treating using mechanical methods or approved herbicides.
- Nuisance animals, such as beavers and muskrats, may be removed in accordance with state game regulations. Geese can be discouraged by minimizing areas of open water and promoting the growth of tall vegetation in the wetland and adjacent buffers.
- Avoid noisy activities, such as mowing or use of recreational vehicles, in or near the wetland when waterfowl are present. To the extent possible, do not allow livestock and other domestic animals to have uncontrolled access to the site.
- Limit use of motorized vehicles to designated trails and access roads to protect vegetation and minimize disturbance to wildlife. Avoid use of motorized vehicles on ponded or inundated areas at any time during the year to prevent damage to soil, vegetation, and aquatic wildlife (e.g., frogs, salamanders).
- Avoid the use of pesticides on the site to prevent harm to wildlife that use the wetland area.
- Describe the acceptable uses (e.g., flash grazing, cropping, timber production, hunting, nature preserve, etc.) and time of year or frequency of use restrictions, if any. *Pay particular attention to program requirements as they relate to acceptable vs. restricted uses and other management restrictions.*

REFERENCES

Martin, Alexander C., Herbert S. Zim, and Arnold L. Nelson. 1951. *American Wildlife and Plants: A Guide to Wildlife Food Habits*. Dover Publications, New York. 500 pages.

Maryland Department of Transportation, State Highway Administration. 2008. *Standard Specifications for Construction and Materials*. Baltimore, Maryland.

University of Maryland Extension. *Wildlife Management Fact Sheets*.
<https://extension.umd.edu/tags/wildlife-management>

USDA, Natural Resources Conservation Service. *Conservation Practice Standards*. Maryland Field Office Technical Guide, Section IV.

USDA, Natural Resources Conservation Service. *Engineering Field Handbook, Chapter 5, "Preparation of Engineering Plans"; Chapter 6 "Structures"; Chapter 11, "Ponds and Reservoirs"; Chapter 13, "Wetland Restoration, Enhancement or Creation"; and Chapter 14, "Drainage."*

USDA, Natural Resources Conservation Service. *Fish and Wildlife Habitat Leaflets and Technical Notes.*
<http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/plantsanimals/fishwildlife/pub/>

U.S. Fish and Wildlife Service, Chesapeake Bay Field Office, with the Natural Science Center and Adkins Arboretum. 1995. *Native Plants for Wildlife Habitat.* Annapolis, MD.