NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

WETLAND RESTORATION

(Ac.)

CODE 657

DEFINITION

The rehabilitation of a degraded wetland or the reestablishment of a wetland so that soils, hydrology, vegetative community, and habitat are a close approximation of the original natural condition that existed prior to modification to the extent practicable.

PURPOSE

To restore wetland function, value, habitat, diversity, and capacity to a close approximation of the pre-disturbance by:

- Restoring hydric soil
- Restoring hydrology (depth, duration, and season of inundation, and/or duration and season of soil saturation)
- Restoring native vegetation (including the removal of undesired species, and/or seeding or planting of desired species)

CONDITIONS WHERE PRACTICE APPLIES

This practice applies only to sites with hydric soil which were natural wetlands that have been previously degraded hydrologically and/or vegetatively, or to sites where hydric soils are covered by fill, sediment, or other deposits.

This practice is applicable only where the natural hydrologic conditions, including the hydroperiods, can be approximated by modifying drainage and/or artificial flooding of a duration and frequency similar to natural conditions.

This practice does not apply to:

- Constructed Wetland (656), intended to treat point and non-point sources of water pollution
- Wetland Creation (658), for creating a wetland on a site which historically was not a wetland
- Wetland Enhancement (659), intended to modify an existing wetland where specific attributes are heightened by management objectives, and/or returning a degraded wetland back to a wetland but to a different type than previously existed on the site

CRITERIA

General Criteria Applicable to all Purposes

The soil, hydrology, and vegetative characteristics existing on the site and the contributing watershed shall be documented before restoration of the site begins.

The purpose, goals, and objectives of the restoration shall be clearly outlined, including soils, hydrology, and vegetation criteria that are to be met and are appropriate for the site and the project purposes.

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

The impact of this practice on existing non-degraded wetland functions and/or values will be evaluated.

The water quality of the drainage area shall be suitable for the intended use of the wetland.

Where offsite drainage or the presence of invasive species impact the site, the design shall compensate for these landscape changes (e.g.: increased water depth, berms, or microtopography).

Sites suspected of containing hazardous waste shall be tested to identify appropriate remedial measures. Sites containing hazardous material shall be cleaned prior to the installation of this practice.

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. This includes, but is not limited to, the manipulation of water levels or topography to control unwanted vegetation. The establishment and/or use of non-native plant species shall be discouraged.

Establish vegetative buffers around the wetlands to reduce the movement of sediment and soluble and sediment-attached substances carried by runoff. Use Filter Strip (393) to determine the minimum width of the vegetative buffer.

Dikes and excavated areas shall be shaped in a manner that is compatible with the existing landscape. For excavated areas leave ground surface as irregular as possible.

Criteria for Hydric Soil Restoration

Restoration sites will be located on hydric soils.

If the hydric soil is covered by fill, sediment, spoil, or other depositional material, the material covering the hydric soil shall, to the extent practicable, be removed.

Criteria for Hydrology Restoration

The hydrology (including the timing of inflow and outflow, duration, and frequency) and hydroperiod of the restored site shall approximate the conditions that existed before alteration. This includes effects to hydrology restoration caused by roads, ditches, drains, terraces, etc., within the watershed.

Any existing surface or subsurface drainage systems that would affect or be affected by the wetland shall be located and measures taken to determine the extent of those systems.

Existing drainage systems will be utilized, removed, or modified as needed to achieve the intended purpose.

The work associated with the wetland shall not adversely affect adjacent properties or other water users, the capacity of drainage systems on other properties, and shall not back surface water onto an adjoining property or restrict the capacity of adjacent subsurface drainage systems unless authorized through a written easement, permit, or equivalent legal document.

A natural water supply shall be used to reestablish the site's hydrology that approximates the needs of the wetland type. If this is not possible, an artificial water supply can be used to approximate natural hydrology; however, these sources shall not be diverted from other wetland resources (e.g.: prairie pothole wetland complexes or springs).

To the extent practicable, re-establish topographic relief and/or microtopography. Use reference sites within the area to determine desired topographic relief.

Excavations from within the wetland shall remove post-settlement deposition to approximate the original topography and/or microtopography or a water level will be established that will compensate for the sediment that remains.

Criteria for Vegetative Restoration

Hydrophytic vegetation established shall be of species typical for the wetland type(s) being restored. Preference shall be given to native wetland plants with localized genetic material.

Vegetative establishment shall address species, functional, and structural diversity.

Where known nutrient and pesticide contamination exists, the species selected will be tolerant of these conditions.

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

Where planting and/or seeding is necessary, the minimum number of native species to be established shall be based upon the type of vegetative communities present in reference wetlands and the vegetation type planned:

- 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 and evenness shall be addressed in the planning of herbaceous communities.

- Where the dominant vegetation will be forest or woodland community types, vegetation establishment will include a minimum of six species.

Seeding rates shall be based upon percentage of pure live seed that shall be tested within 6 months of planting.

Ensure that the approved seeding mixture does not include weed species and invasive species (e.g.: reed canarygrass).

Applicable guidelines for hydrophytic vegetation establishment can be found in Iowa Biology Technical Note 9, Iowa Biology Job Sheet 3, Conservation Cover (327), Tree/Shrub Establishment (612), Restoration and Management of Declining Habitats (643), Wetland Wildlife Habitat Management (644), and NEH, Part 650, Chapter 13.

If uplands are planned as part of a wetland creation, then native seedings shall be used for these areas as well. Refer to Conservation Cover (327) for herbaceous restorations, or Tree/Shrub Establishment (612) and Upland Wildlife Habitat Management (645) if trees and/or shrubs are desired.

Where topsoil will be used as a seedbank, topsoil shall not be stockpiled prior to redistribution during the summer. For other periods, topsoil shall only be stockpiled in a manner that limits deterioration of viable plant parts and seeds. Refer to NEH, Part 650, Chapter 13, for guidance.

To decide if natural revegetation is appropriate, refer to NEH, Part 650, Chapter 13, for natural regeneration decision keys. Where natural revegetation is chosen and pre-identified selected species should dominate within 5 years, sites may be left to revegetate naturally.

Deep tillage or other methods shall be used to expose the buried seedbank or bring the buried seedbank to the surface. If a site has not become dominated by the targeted species within 5 years, active forms of revegetation may be required.

DESIGN CRITERIA

Subsurface Drain Plugging or Removal.

The effects of the subsurface drainage system may be eliminated by one or a combination of the following:

- Removing or rendering inoperable a portion of the drain at the downstream edge of the site
- Modifying the drain with a water control device
- Replacing the drain with non-perforated pipe throughout the wetland site
- Outletting the drain above the wetland area
- Routing the drain around the wetland area

Subsurface drains shall be removed or rendered inoperable throughout the wetland. The maximum spacing between tile breaks can be determined by the following formula:

Tile Break Spacing = Drain Depth ÷ (2 x Grade)

Where:

Tile Break Spacing - Distance between subsurface interval breaks (feet)

Drain Depth - Depth of subsurface drain flow line below the ground surface (feet)

Grade - Grade of subsurface drain (feet/foot)

In no case shall the tile break spacing exceed 1500 feet. The minimum length of drain to be removed or rendered inoperable at each tile break is shown in Table 1.

Table 1. Length of Drain Removed, Rendered Inoperable, or Conduit Installed

Permeability** (inches per hour)	Minimum Length (feet)
Greater than 2.0	150
0.6 – 2.0	100
Less than 0.6	50

****** Permeability is for the profile above the drain flow line. When the permeability varies throughout the profile, determine the type of drainage system and which layer(s) are critical. Standard values for permeability for each soil map unit can be found in the county soil survey or the Field Office Technical Guide.

Where dikes will be constructed over existing drains, all subsurface drains shall be removed starting at the minimum distance downstream of the dike centerline shown in Table 1, and extending an additional 15 feet upstream from the upstream toe of the dike.

All envelope, filter, or flow enhancing material shall be removed within the length specified for drain removal. If the downstream removal distance is not possible the subsurface drain shall be removed as far downstream as possible and extend upstream the minimum distance as shown in Table 1.

The trench constructed to remove the subsurface drains shall be backfilled in 12-inch lifts and compacted with similar soil so as to obtain a density of not less than the adjacent natural soils.

Disconnected subsurface drains leaving the wetland shall be removed for the distance shown in Table 1 and the ends blocked or connected to a water control structure as provided in the section "Water Control Structures." The ends of remaining disconnected subsurface drains shall be capped.

If the drain is routed around the wetland and perforated tubing or drain tile is used, the drain shall be located so that it has no lateral effect on the wetland area. This minimum offset distance from the wetland shall be determined by scope and effect equations. Refer to NEH, Part 650, Chapter 19.

Shallow Water Excavation. Shallow water excavations may be used to restore irregular ground features and varying inundation periods. Refer to NEH, Part 650, Chapter 13, and Biology Technical Note 24.

To accomplish this, shallow water excavations shall have a variety of depths which range from ground level to a maximum depth of four feet. For shallow water excavations in areas with buried hydric soils the overburden can be removed to the surface of the original hydric soil.

A minimum of 2/3 of the shallow water excavation shall have water depths of 0 to 18 inches. The remainder of the excavation may be deeper if needed to meet the objectives of the restoration.

At least 50 percent of the excavated area shall have side slopes of 6:1 or flatter. The remaining side slope area shall not be steeper than 3:1. Side slope grades may be as gentle as 10:1 or flatter if site conditions allow, based on desired species management goals and objectives. Leave ground surface as irregular as possible.

Shallow water excavations shall be irregularly shaped to increase the edge and provide additional cover for wildlife utilizing the site. Design shallow water excavations with a variety of shapes and depths. Wetland complexes may be created by linking shallow water excavations with level swales, if their use meets the goals of the restoration. Swales shall have irregular cross sections similar to natural stream channels. Space shallow water excavations from 200 to 800 feet apart. Meander the connecting level swales.

Spoil material shall be placed adjacent to the excavation in low, irregular mounds not more than three feet high. Mounds shall be discontinuous, placed on either side of the swale or shallow water excavation, and shall be done so as to blend with surrounding ground and accentuate irregular ground features. When applicable, either nesting islands or loafing areas may be constructed in shallow water excavation areas. Refer to Iowa Biology Technical Note 19.

Wetland Dikes. Provisions shall be made to store, pass, or divert the flow from the minimum design storm as shown in Table 2 so that it does not cause erosion or flooding impacts on non-wetland areas.

Dikes shall meet the requirements of Dike (356) and shall only be used to restore original drainage patterns or overcome the effects of sedimentation.

Dikes with an effective height greater than 10 feet shall be designed using the criteria for Pond (378) or Grade Stabilization Structure (410).

Where man-made or man-enhanced drainage features were constructed to drain or to prevent water from entering a wetland, the drainageway will be filled with earth, rendered inoperable, or controlled with a water control structure to restore the wetland hydrologic conditions. Ditch plugs shall be designed and constructed according to criteria established for Dikes (356).

Flow over the top of the ditch plug may be used in limited cases. All of the following conditions must be met for flow over the ditch plug to be allowed:

- Drainage area < 50 acres
- No trickle flow
- Fill height < 5 feet, and

- Stable grade downstream

In these cases, use a minimum top width of 30 feet, 3:1 upstream slopes, and 10:1 or flatter downstream slopes.

Principal Spillway. A principal spillway shall be provided to control the storm as indicated in Table 2 and shall meet the requirements of Structure for Water Control (587). The minimum pipe conduit size is listed in Table 2. The inlet elevation of the principal spillway shall be such that the principal spillway flows at full pipe flow before the vegetated spillway operates. In no case shall the difference in elevation between the principal and vegetated spillway be less than 0.5 foot.

Vegetated Spillway. The vegetated spillway shall be designed to safely control the flow from the storm as shown in Table 2. Use of vegetated spillways in natural low areas without shaping is desirable since established vegetation is not disturbed. A natural or excavated spillway shall have a minimum 10 foot bottom width. Refer to NEH, Part 650, Chapter 11 for design procedures.

Floodplain Wetland Dikes. In addition to the Dike (356) criteria, dikes located on a floodplain where overtopping of the dike by flow from the floodway into the wetland is likely may have the vegetated spillway area on level natural ground, in excavation, or on compacted fill. Vegetated spillways shall be at least 100 feet wide and have a crest length of at least 25 feet.

Compacted fill spillways shall meet the following criteria:

- Height of spillway crest to downstream toe is 2 feet or less
- Design flow depth of 0.5 feet or less
- Inlet and outlet slopes shall be 5:1 or flatter
- Mulching of spillway is required

The dike for a distance of 50 feet on each side of the principal spillway or water control structure shall have an additional 1 foot of overfill added to the constructed height to protect the control structure from damage by the overflow water.

The vegetated spillway shall be located in a position that minimizes the likelihood for flood flows from the stream system to damage the dike, water control structure, and vegetated spillway.

Water Control Structures. Water control structures shall only be used to recreate natural hydrologic patterns or to allow management and maintenance of the desired community. Wetland control structures shall meet the requirements of Structure for Water Control (587).

Mechanical outlets serve the purpose of maintaining a desired water level and reducing damage caused by storm runoff and trickle flow. A water control structure may also include devices for manipulating the water level in the wetland such as stop-logs or valves.

Natural drawdown through evapotranspiration is a natural and often desirable process rather than regulating water levels with water control structures. Drawdown of permanent storage is often necessary or desirable to manage wetlands.

A drawdown pipe shall be designed to accomplish management objectives in a timely manner. Any drawdown device shall be situated so that the entire pool area is not drained down even if the drawdown structure is completely open. For additional information on drawdown timing see Iowa Biology Technical Note 20.

If base flow - which may include seepage, subsurface drainage or spring flow - exists, a trickle tube or water control structure shall be provided. Base flow is designed as the greater of 1) the quick return flow [see NEH, Part 650, Chapter 2] or 2) the capacity of the intercepted subsurface drainage system. A trickle tube shall have a minimum diameter of 4 inches.

Non-perforated conduits shall be used downstream of a water control structure for distances as shown in Table 1 and under any dike. The connections of the water control structure and non-perforated conduit will be watertight for the pressure developed at the maximum pool level.

CONSIDERATIONS

Consider the effect of this practice on pollutant fate and transport in surface and ground water.

It is expected that for wildlife purposes planting density and stocking rates will generally be lower than for production purposes, and that the selection of species will generally be different than those used for production purposes.

Consider adding 1 to 2 dead snags, tree stumps, or logs per acre to provide structure and cover for wildlife. As an additional carbon source for food chain support, detrital material can be spread throughout the basin.

Deep tillage or other methods can be used to expose the buried seedbank or bring the buried seedbank to the surface.

Consider manipulation of water levels to control unwanted vegetation or to enhance desirable vegetation.

Consider impact that water surface draw-downs will have on concentrating aquatic species such as turtles into diminished pool area resulting in increased mortality.

Consider linking wetlands by corridors of vegetation or habitat wherever appropriate to enhance the wetland's use and colonization by the native flora and fauna.

Consider the effect restoration will have on disease vectors such as mosquitoes.

Consider effect of volumes and rates of runoff, infiltration, evaporation, and transpiration on the water budget.

Consider effects on downstream flows or aquifers that would affect other water uses or users.

Consider the effect of water control structures on the ability of aquatic species to move in and out of the wetland.

Consider establishing herbaceous vegetation by a variety of methods over the entire site or a portion of the site and at appropriate densities and depths.

Consider effects on wetlands and water-related resources, including fish and wildlife habitats, which would be associated with the practice.

Consider effects on temperature of water resources to prevent undesired effects on aquatic and wildlife communities.

Soil disturbance associated with the installation of this practice may increase the potential for invasion by unwanted species.

For discharge wetlands, consider underground upslope water and/or groundwater source availability.

Consider microtopography and hydroperiod when determining which species to plant.

Consider controlling water levels to prevent oxidation of organic soils and inundated organic matter and materials.

PLANS AND SPECIFICATIONS

Plans and specifications for this practice shall be prepared for each site. 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.

Specifications shall be recorded using approved specifications sheets, job sheets, narrative statements in the conservation plan, or other documentation.

The following list of Construction Specifications is intended as a guide to selecting the appropriate specifications for each specific project. The list includes most, but may not contain all, of the specifications that are needed for a specific project:

IA-1 Site Preparation
IA-3 Structure Removal
IA-5 Pollution Control
IA-6 Seeding and Mulching for Protective Cover
IA-9 Drainage Tile Investigation and Removal
IA-11 Removal of Water
IA-13 Sheet Piling
IA-21 Excavation
IA-23 Earthfill
IA-26 Topsoiling
IA-27 Diversions
IA-45 Plastic (PVC, PE) Pipe
IA-46 Tile Drains for Land Drainage
IA-51 Corrugated Metal Pipe
IA-52 Steel Pipe Conduits
IA-61 Loose Rock Riprap
IA-81 Metal Fabrication and Installation
IA-83 Timber Fabrication and Installation
IA-95 Geotextile

OPERATION AND MAINTENANCE

An operation and maintenance (O&M) plan will be prepared for each wetland site.

Specified actions include normal repetitive activities in the application and use of the practice (operation), and repair and upkeep of the practice (maintenance). If applicable, the

following activities shall be addressed in the plan:

- Timing and level setting of water control structures required for establishment of desired hydrologic conditions or for management of vegetation. Refer to Iowa Biology Technical Note 20
- Inspection schedule of dikes and structures for damage assessment
- Depth of sediment accumulation allowed before removal is required
- Management needed to maintain vegetation, including control of unwanted vegetation in and around the wetland area
- Acceptable uses and timing (e.g.: grazing and haying)

Any use of fertilizers, mechanical treatments, prescribed burning, pesticides, and other chemicals shall assure that the intended purpose of the wetland restoration shall not be compromised.

Biological control of undesirable plant species and pests (e.g.: using predator or parasitic species) shall be implemented where available and feasible.

REFERENCES

Invasive Species, Executive order 13112, February 3, 1999, Federal Register: Vol.64, No. 25

Restoring Prairie Wetlands: An Ecological Approach, Iowa State University Press

Impact of a Controlled Wetland Drawdown on Blanding's Turtles in Minnesota, Chelonian Conservation Biology, Vol. 3, No. 4

Delineating Hydric Soils, in Wetland Soils – Genesis, Hydrology, Landscapes and Classification, Hurt, G.W. and V.W. Carlisle, CRC Press

Habitat Management Guidelines for Amphibians and Reptiles of the Midwest, Partners in Amphibian & Reptile Conservation

Aquic Conditions and Hydric Soils: The Problem Soils, Soil Science Society of America, Special Publication Number 50

Functional Requirements and Design Parameters for Restocking Coarse Woody Features in Restored Wetlands, ASAE Meeting Presentation, Paper No: 012059

USDA-NRCS, Creation of Waterfowl Nesting Islands, Iowa Biology Technical Note 19

USDA-NRCS, Wetland Vegetation and Water Management Considerations, Iowa Biology Technical Note 20

USDA-NRCS, Shallow Water Excavation for Wildlife, Iowa Biology Technical Note 24

USDA-NRCS, Field Indicators of Hydric Soils in the U.S., Version 5.0, in cooperation with the National Technical Committee for Hydric Soils

USDA-NRCS, Wetland Restoration, Enhancement, and Management, Wetland Science Institute

USDA-NRCS, National Engineering Handbook (NEH), Part 650, Engineering Field Handbook (EFH), Chapters 2, 11, 13, 14, and 19

Table 2. Wetland Dike Spillway Requirements[1/]

	Drainage Area (Acres)	Minimum Conduit Diameter (Inches)	Maximum Storage Capacity (Acre-Feet)	Effective Fill Height (Feet)	Minimum Design Frequency (24-hr. Duration Storm)		Minimum Vegetated Spillway Depth (Feet)
					Principal Spillway (Year)	Vegetated Spillway (Year)	
Iowa NRCS Design Criteria	0 – 20	4	≤ 50	0 – 5	----[2/]	10	1
				5 – 10	----[2/]	10	1
	20 – 80	6	≤ 50	0 – 5	----[2/]	10	1
				5 – 10	2[3/]	10	1
	80 – 250	10	≤ 50	0 – 5	---[2/]	25	1
				5 – 10	2[3/]	25	1
	0 – 250	12	> 50	0 – 5	2[3/]	50	1
				5 – 10	5	50	1
	250 – 1000	15	≤ 50	0 – 5	2[3/]	50	1
				5 – 10	10	50	1
	250 – 1000	15	> 50	0 – 5	5	50	1
				5 – 10	10	50	1
	≥ 1000	15	--------	0 – 5	5	50	1
				5 – 10	10	50	1
IDNR Dams	< 250	12[4]	--------	--------	10	50	1
	≥ 250	18[4]	--------	--------	25	50	1

[1/] If a DNR permit is required, more restrictive criteria may apply.

[2/] Mechanical Spillway not required unless continuous base flow exists.

[3/] The principal spillway capacity need not exceed the capacity of the D drainage curve, see NEH, Part 650, Chapter 14.

[4/] These are guidelines set by IDNR. The NRCS requirement for pipe size is normally acceptable.