NJ650.14D Restoration of Drained Areas

a) Introduction

For centuries, drainage has been a common practice in New Jersey. Agricultural land has been created and enhanced, often at the expense of wetland ecosystems. Today there are opportunities to restore wetlands by modifying, interrupting, or removing the drainage systems installed to convert these areas to agricultural production.

This Appendix provides an overview of the evaluation process that can be used to help select what will be a successful restoration site and presents some general guidance on techniques for reestablishing wetland soil and hydrologic conditions. More detailed information on wetland restoration including biological, vegetation, and wildlife aspects can be found in Engineering Field Handbook Chapter 13, Wetland Restoration, Enhancement, or Creation.

b) Goals and objectives

The goal of restoration is to return an area as close as practical to the pre-drained ecological condition in terms of wetland function, value, habitat, diversity, and capacity. Frequently, it will not be possible to fully restore an area simply by removing or impairing the drainage system. Other local, regional, or physical changes may have occurred that will limit the recreation of pre-drained conditions such as the oxidation and subsidence of drained organic soils; downgrading of stream channels limiting overflow frequency into flood plains; upstream migration of saline conditions in tidal rivers; or land use changes in the contributing watershed.

Objectives may include the enhancement of certain functions beyond what existed historically. For example, there may be the desire to diversify habitat by the creation of shallow or open water pools within the restoration area.

Only with goals and objectives established can planners begin to evaluate a proposed restoration site and determine what can be accomplished through removal of the existing drainage features and what additional measures or management features may be necessary to achieve the desired conditions.

c) Site evaluation

Data collection is the first phase of site evaluation in planning a wetland restoration project. The information obtained is often used to determine feasibility. The level of data collection will depend on the complexity of the proposed project. For restoring drained areas, the following may be needed:

- Extent and type of existing drainage system
- Existing and converted wetland area boundaries
- Watershed information such as drainage area, land use, stream parameters, etc
- Soils investigation to determine texture, permeability, depth to water, presence of restrictive layers, etc
- Soil testing for nutrients, pH, organic matter content, etc for plant establishment
- Topographic data
- Environmental assessment including native vegetation, fish and wildlife habitat, cultural resources, etc
- Water inputs including quantity and quality

Site evaluation involves looking beyond the limits of the drained area considered for restoration. Impacts to adjacent land uses caused by a loss or reduction in drainage efficiency need to be determined. This can include impacts to roadways, structures, septic systems, cropland, woodland and other land uses from the alteration of both surface and ground water conditions. In tidal areas, changes in water quality due to an increase in salinity levels may occur. Impacts on irrigation water supplies, vegetation and shallow wells should be investigated.

Hydrologic systems

Wetlands form in three basic hydrologic systems: depressional, riparian, and tidal. All occur in New Jersey and areas of each have been drained for agricultural production. In considering a site for restoration, identify what drainage practices have been installed. Also take note of any physical changes that may have taken place since the area was drained that could complicate restoration.

(1) Depressional wetlands
Depressional wetlands include areas where water collects or pools due to lack of a positive surface outlet and poor infiltration caused by a restrictive soil layer, or high ground water level. Drainage measures for these areas have included surface ditches, subsurface drain conduits or a combination of both. Depressions, especially shallow areas, may have been removed through land grading. Also, diversions may have been installed to intercept and remove surface water from contributing upland areas. Subsidence has occurred in areas where highly organic soils have been drained.

(2)Riparian wetlands
Riparian wetlands occur along rivers and streams. They also include areas of seeps and springs that contribute to surface flow. Most of these wetland areas in New Jersey include a ground water component in addition to surface water from out of bank flooding. Drainage of riparian wetlands has typically been accomplished with surface ditches that are often supplemented with subsurface conduits. Land grading has been used to elevate low areas and reduce the frequency of flooding. Diking along the bank of a stream or non-tidal river has not been a common practice, although it has been used to create bogs or reservoirs in areas of cranberry production. Streams and rivers have been modified to reduce flooding and improve drainage both for agriculture and mosquito control. In some areas, streams have become incised which has reduced the frequency of out of bank flooding.

(3)Tidal wetlands
Historically, tidal wetlands have been drained for agricultural production, primarily salt hay. Beginning in the late 1700's, meadow companies were chartered for the purpose of constructing and maintaining dikes and channels. Dikes constructed along river banks and estuary edges prevent tidal inundation of adjacent uplands, while networks of channels and ditches convey drainage and runoff to water control structures that provide outlets through the dikes. These dikes and tidegate structures often separate brackish tidal water from upland freshwater. Where organic soils have been drained, subsidence has occurred.

Soils

An investigation to assess the soils at the site of a proposed restoration must be conducted. The soil survey provides an overview of expected conditions which need to be field verified. The intensity of the investigation will depend on the extent and complexity of the site. Test pits or borings should be used to fully describe the soil profile including texture, structure, moisture condition, evidence of perched, seasonal, or permanent ground water levels, etc. On-site testing or the taking of samples for laboratory testing may be necessary. Factors important to the establishment of vegetation such as soil pH, organic matter content, and nutrient levels should be determined.

Water Budget

In evaluating the suitability of a site for restoration, the source of water that will supply the wetland must be carefully evaluated. A water budget for a wetland is an account of inflow, storage, and outflow of water. Water inflow includes precipitation, storm water runoff from a contributing drainage area, base flow from streams and surface sources, seepage and springs from ground water sources, tidal inflow, and water artificially added to a wetland. Water storage includes the water on the surface and in the pore space of the substrate. The wetland substrate is the accumulated organic matter and the soils from the surface of the wetland to the bottom of the potential rooting zone. Water outflow includes evaporation from the surface, transpiration from the plants, deep percolation below the substrate, surface base flow, tidal outflow, storm water outflow, and water artificially removed from the wetland. Where existing drainage systems will be impaired or removed, evaluate the quantity and efficiency of water removal. Consider upstream, on-site, and downstream impacts of drainage system changes.

Vegetation

The selection of vegetation for a restoration site will be based primarily on objectives, site conditions, and availability. Consideration should be given to plant species value for wildlife food and cover, and erosion control. Preference should be given to native species typical of adjacent wetland areas. Planting to establish vegetation may not always be necessary. Natural colonization may be considered where adequate seed stock exists in the wetland substrate and there is a reasonable expectation of success.

d) Drainage alteration measures

Restoration of a previously drained wetland area can be accomplished, at least in part, by modifying, interrupting, or removing the drainage system. In some situation, additional measures may be required to mitigate for other physical changes that have occurred since the area was drained, or to enhance the wetland beyond what can be accomplished through alteration of the existing drainage system.

Subsurface drain plugs

Over the years, subsurface drainage has been accomplished with the installation of clay drainage tile and, more recently, perforated plastic drainage tubing. Drainage effects can be reversed by plugging or removing portions of the drainage tile or conduit.

The minimum length of the drain to be removed or plugged is based on the average hydraulic conductivity of the soil. For rates over 2.0 inches per hour (sands and organic soils), the length is 150 feet; where the rate is between 0.6 and 2.0 inches per hour (loams), remove or plug 100 feet; and use 50 feet where the rate is under 0.6 inches per hour (clayey soils). Both the drain line and any envelope material should be removed for the specified length. The trench opened for disruption of the drain line should be filled and the soil compacted.

When upland portions of the drainage system are to remain functional, the drain lines through the proposed wetland area can be replaced with non-perforated pipe or re-routed around the area. Consider ground water availability, soil conditions, and lateral drainage effects in evaluating if restoration will be successful.

When the ability to manage ground water levels is desired, water control structures may be added to subsurface drain lines as described for controlled drainage in Chapter 5, Water Table Management.

Surface drain plugs

Wetland areas drained with ditches can be restored by constructing plugs or water control structures in the open drain system.

For field ditches and laterals with little contributing drainage area, plugging can be accomplished by filling a 50 foot length of the open drain with compacted soil. The soil should be crowned a minimum of one foot above the lower bank.

When runoff from the contributing drainage area could result in overtopping of the plug, provisions must be made to store, pass through, or divert excess runoff. Options may include

- armoring the ditch plug for overtopping,
- extending the overfill for the ditch plug 50 feet laterally into the flood plain to disperse flow around the plug,
- grading broad, shallow auxiliary spillways around the plug to return flow to the ditch downstream of the plug, or
- installing a drop structure.

Old spoil piles from construction or maintenance activity may exist adjacent to the ditch. Openings may need to be created through the piles to avoid concentrating flow over the ditch plug and to allow flow into the flood plain.

Drop structures may be equipped with stop logs to allow management of water levels where desired as a part of the restoration plan.

Dikes

Restoration plans can include breaching existing dikes to restore tidal or storm flows into drained areas. Breach width may depend on soil conditions, depth and duration of flow, and the level of inundation to be achieved in the previously drained area. Where erosion or continued widening of the breach is a concern, consideration can be given to armoring or gently grading the ends of the dike fill. Channels may be constructed through a breach to improve flow into the restoration area.

Restoration plans may also include construction of low dikes designed to retain surface water in the restored area. Outlet structures and auxiliary spillways may be necessary depending on the contributing drainage area and depth of impoundment. Dikes should not be constructed in flood plain areas where they will restrict out of bank flow during storm events.

Land forming

Land forming includes altering the topography and can include:

- Removal of sediment or fill to recreate original grades,
- Creation of micro-topographic features such as small isolated shallow pools and hummocks,
- Excavation of shallow impoundments to intercept surface runoff or ground water.

Soil sealing

Where soils are too permeable to retain water to the degree desired in the restoration plan, sealing or lining may be necessary. Generally, sealing will be feasible only for small areas.

Sealing may be accomplished through compaction of on-site soils that have a sufficient content of clayey fines. (See National Engineering Handbook, Part 651, Agricultural Waste Management Field Handbook, Chapter 10.) Where on-site soils are not suitable, the addition of bentonite may be required. Synthetic liners may be used, but can be costly. The sealed soil layer or liner should be covered with at least a one foot thickness of soil or wetland substrate material.

<u>e) Maintenance</u>

Plans for the restoration of previously drained area should strive to return the area to as natural a condition as possible. Long term maintenance requirements should be minimized by limiting structural components. Likewise, limiting structural components that have a relatively short service life, will help to ensure the longevity and value of the restored ecosystem.

Frequent inspections and maintenance during an initial establishment period is expected. Where structures or devices for manipulation of ground or surface water levels are included in the project, an operation plan including management objectives is to be developed.