COMMONWEALTH OF MASSACHUSETTS
EXECUTIVE OFFICE OF ENVIRONMENTAL AFFAIRS
DEPARTMENT OF ENVIRONMENTAL PROTECTION
ONE WINTER STREET, BOSTON, MA 02108 617-292-5500

JANE SWIFT
Governor

BOB DURAND
Secretary

LAUREN A. LISS
Commissioner

MASSACHUSETTS INLAND WETLAND REPLICATION GUIDELINES

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Program Applicability: DEP Wetlands Program and Office of Administrative Appeals, local Conservation Commissions, environmental permitting consultants, and the general public

Approved by: [SIGNED
Cynthia Giles, Assistant Commissioner
Bureau or Resource Protection

Copies of the Inland Wetland Replication Guidelines may be obtained from DEP's WE B site (**http://www.mass.gov/dep**) or by mail beginning in April, 2002. For further information contact DEP Wetlands Program, One Winter St., 6th Floor, Boston, MA 02108.

Massachusetts Department of Environmental Protection

Bureau of Resource Protection
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Massachusetts Inland Wetland Replication Guidelines

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1.0 Introduction and Background

1.1 The need for guidance

A study conducted by the University of Massachusetts[1] found that the majority of wetland replication projects undertaken in the Commonwealth do not meet the minimum performance standards in the regulations. In many projects, proposed mitigation failed to meet performance standards because no replication project was ever built, or because of inadequate wetland hydrology, poor vegetation replanting plans, or replication areas built smaller than required in the plans.

This guidance responds to the evidence of replication failure by confirming the importance of avoiding and minimizing impacts to wetlands in the first instance to reduce reliance on replication. Secondly, this guidance attempts to increase the effectiveness of replication mitigation by providing applicants with an outline of the steps necessary to design an appropriate wetland replication project. The guidance also assists Conservation Commissioners and Department of Environmental Protection staff in determining if a replication project is designed appropriately, constructed as designed, and adequately monitored to ensure the success of the project. Although this document represents current knowledge of wetland replication science, the Department contemplates that the science of wetland replication will continue to improve. As such, the application of this guidance manual should allow for future advances that improve the long-term success of wetland replication projects.

1.2 Regulatory Requirements

This guidance document provides information about freshwater wetland replication in Massachusetts. Wetland replication, provided as compensation for permitted wetland impacts, is the term used to describe the creation of a wetland site where none exists. Replication typically involves excavation of upland soils to a depth where the naturally occurring water table can support wetland vegetation. This document has been written to help applicants prepare freshwater replication plans to meet the requirements of the Wetlands Protection Act (WPA) for bordering vegetated wetlands (310 CMR 10.55 (4)) and Section 401 of the Clean Water Act pertaining to Water Quality Certification (314 CMR 9.06(2)). This document has also been written to help Conservation Commissions and the Department ensure that the interests of the WPA are protected.

Projects that impact bordering vegetated wetlands (BVW) require replication under 310 CMR 10.55(4)(b). The performance standards for BVW impacts include the requirement of wetland replication in the event that a BVW is destroyed or otherwise impaired. In addition to these specific requirements, the regulations give broad authority to the Conservation Commissions to determine how to ensure that a replication site replaces the lost functions of an impacted wetland. Section 310 CMR 10.55 (4)(b) of the WPA regulations states, in part, that the Order of

[1] Brown, S., and P. Veneman. 1998. Compensatory Wetland Mitigation in Massachusetts. Massachusetts Agricultural Experiment Station, University of Massachusetts, Amherst. Research Bulletin 746.

Conditions may include "any additional, specific conditions the issuing authority deems necessary to ensure that the replacement area will function in a manner similar to the area that will be lost." Examples of additional requirements that Conservation Commissions have imposed include vegetation goals, specific approaches to planting or soil translocation, and completion of the replication site before any project work begins.

The general conditions governing the replication of up to 5000 square feet of BVW set forth in 310 CMR 10.55(4)(b) can be summarized as follows:

- ✓ Surface area must be equal to the lost area;
- ✓ The replication area must have similar ground water and surface elevation as the lost area;
- ✓ The replication area must have a similar location relative to the bank as the lost area;
- ✓ The replication area must have an unrestricted hydraulic connection to the same water body or waterway as the lost area;
- ✓ The location of the replication area must be in the same general area as the lost wetland;
- ✓ The replication area must have at least 75% cover of native wetland plants within two growing seasons, and there must be temporary stabilization of exposed soil to avoid erosion.

In cases of wetland restoration, proposed sites should only include former wetlands sites that have been so completely altered that they would now represent non-wetland areas. Enhancement of existing but degraded wetlands, while valuable, would not meet the performance standards for replication. Stormwater management facilities do not qualify as replicated wetlands and should not be considered as a form of wetland mitigation.
The complete text of the performance standards in the regulations should be reviewed when assessing the adequacy of a replication plan.

1.3 Sequencing (Avoidance, Minimization, Mitigation)

The UMASS report documented a high failure rate for replication projects in Massachusetts. This Guidance is intended to improve that record by outlining standards for design, construction and oversight of replication projects. Although more careful design and management of replication projects can improve replication success, the UMASS report and other studies completed since the UMASS report[2] establish that replication is at best an uncertain science. Based on this compelling evidence, the Commonwealth is wary of placing too much reliance on replication, even under improved standards, to achieve the goals of the Wetlands Protection Act or the no net loss of wetlands policy of the Water Resources Commission (April 9, 1990). These

[2] See, National Academy of Sciences: Committee on Mitigating Wetland Losses. 2001 Compensating for Wetland Losses Under the Clean Water Act. National Academy Press, Washington, D.C.

goals can best be achieved by avoiding and minimizing impacts to wetlands, thereby reducing the need for replication projects of uncertain success.

The importance of avoiding and minimizing wetland impacts is expressly recognized in the regulations at 310 CMR 10.53 governing limited projects. These regulations mandate that the issuing authority consider the availability of reasonable alternatives to the proposed activity, the extent to which adverse impacts are minimized, and the extent to which mitigation measures, including replication or restoration, are provided to contribute to the protection of the interests identified in the WPA.

In exercising its discretionary authority to approve or disapprove limited projects pursuant to 310 CMR 10.53, an issuing authority should evaluate the project design prior to deciding whether to approve replication. Replication is the final step in the process of wetland mitigation. Wetland mitigation involves reducing the impacts to wetland resources through a three-step process often referred to as "sequencing":

1) Avoidance of wetland impacts;
2) Minimizing necessary impacts as much as possible; and
3) Replicating losses that cannot be avoided.

The issuing authority should consider alterations in the project design by the applicant in an attempt to avoid and minimize wetland impacts before evaluating a replication plan. Replacement of lost wetland functions through replication should only be considered for unavoidable losses that cannot be further reduced by redesign of the project. It is often more cost effective to design a project to avoid wetland impacts than to propose replication, since the requirements to ensure a successful replication area can often be costly and take many years to complete.

The first step, avoidance, involves evaluation of reasonable project designs that attempt to locate projects away from wetlands in order to avoid impacts. Project design considerations can include moving the construction to a different part of the site or changing the design in order to reduce the size of project impacts. Next, applicants should consider all possible minimization measures including steepening slopes, and, depending on the scale/nature of the project, construction of retaining walls or bridge spans to reduce wetland impacts. Once unavoidable impacts have been identified and impacts have been minimized to the maximum extent possible, wetland mitigation locations, preferably on site, should be thoroughly considered to determine the replication location with the best likelihood of success.

In comparison, while the regulations *require* the issuing authority to consider "sequencing" in the review of wetland impacts associated with Limited Projects, the regulations *allow* the issuing authority to consider, on a case by case basis, the relevance and propriety of "sequencing" for projects that propose to alter less than 5000 square feet of BVW under 310 CMR 10.55 (4) (b). While this regulation does not specify the factors to be considered in determining whether discretion should be exercised to allow replication, an issuing authority should take into account the particular facts and circumstances of each case and relate such factors to the objective of protecting the interests identified in the WPA. Factors that may be relevant in a given case

include the existence of reasonable revisions to design that would avoid or minimize wetland impacts, thus reducing or eliminating the need for replication projects. Even if the proposed wetlands replication area would meet all of the general conditions in 310 CMR 10.55(4)(b), an issuing authority may exercise its discretion under 310 CMR 10.55(4)(b) to deny the proposed BVW alteration if reasonable avoidance and minimization measures have not been taken. Issuing authorities are encouraged to convene a pre-application meeting with the project proponent to discuss these considerations.

2.0 Wetland Replication Plan Guidelines

2.1 Evaluation of Existing Conditions and Functions

The wetland regulations presume that BVW's serve the following public interests identified in the WPA: *public or private water supply, ground water supply, flood control, storm damage prevention, prevention of pollution, fisheries, and wildlife habitat (land containing shellfish pertains to coastal wetlands only).* These public interests describe the range of wetland functions that must be considered when designing replication for the loss of impacted wetlands. Although it is desirable that applicants design projects that replace the lost functions, good replication sites may be difficult to find and may have quite dissimilar characteristics to the impacted site. Therefore, replication efforts should focus on design characteristics that strive to maximize capacity for the functions impacted, as well as the functions the new wetland site will support. In all cases, replication plans should describe structural features and functions that will be replicated. Plans should clearly indicate the goal of replication in a measurable way so that the success or failure can be determined objectively and enforced

Wetlands form as a result of the dynamic interactions of a large number of ecological conditions, and understanding these conditions at the replication site is necessary to develop a plan for maximizing ecological functions. Characterization of the wetland to be impacted should include classification (Cowardin type [i.e. palustrine, riverine etc.] and local descriptor [i.e. shrub swamp, bog]), dominant plants in each layer, a description of the hydrology, and an evaluation of the public interests (flood control, storm damage prevention, prevention of pollution, wildlife habitat etc.) that the wetland provides.

Appendix 1 describes sources of information that may be useful in evaluating wetland functions. The following table describes the major ecological functions performed by wetlands within the Commonwealth and design features to consider in designing replacement

Public Interests:	**General Description of Wetland Function:**	**Design Features Replicate Function**
Public and private water supply, groundwater supply	Movement of surface water (usually downward and lateral) from the wetland into the ground water. Movement of ground water (laterally or upward) through the wetland into surface water (*e.g.*, springs, ponds, streams etc.).	Adequate surface water source, porous or organic soils and subsurface, long water retention-time within the wetland basin, wetland elevation permits groundwater/surface water exchange (sand and gravel deposits, also known as stratified drift, provides for better exchange than till).
Flood Control and Storm Damage Prevention	The ability of wetlands to store flood waters and gradually release them from upstream to downstream points. Also, any wetland-caused decrease of erosive energy or increase of shoreline anchoring whether or not erosion is significantly reduced	Flood control: greater if outflow is restricted, soils similar to impacted floodplain soils, vegetation is dense, and wetland is large. Storm damage protection: greater if wetland has dense persistent vegetation (i.e. Increased stem density), meanders in streams and riffles/pools.
Prevention of pollution	Process by which suspended particles, dissolved constituents and chemical contaminants (such as pesticides and heavy metals that may be attached to organics) are retained and deposited within a wetland. The storage of nutrients within the sediment or plant substrate; the transformation of inorganic nutrients to their organic forms; and the transformation to and subsequent removal of nitrogen as a gas.	Nutrients in receiving waters are effectively reduced if water moves slowly through the wetland allowing for uptake by plants. Sediment removal is increased by lagging the flow of water and by dense rapidly growing vegetation. Soils high in organic matter contribute to contaminant adsorption.
Fisheries	Providing support for the aquatic food chain through the flushing of large amounts of organic material from the wetland to downstream or adjacent deeper waters. Also, the support of on-site diversity and/or abundance of fish and other aquatic life using the water and saturated soils.	Different species of fish have different habitat requirements. To replace lost ecological functions, the hydrology and the diversity of aquatic vegetation should be similar to impacted site. Over story species and shrubs should be incorporated to provide shading and cover which reduces temperatures. Water temperatures that are too high may increase mortality and decrease suitable fisheries.
Wildlife habitat	Providing food, shelter, or other life history requirements for the on-site diversity and/or abundance of wetland-dependent wildlife.	Vegetation structure (herbs, shrubs, over story), species diversity and surface hydrology should be similar to the impacted wetland. Location relative to other BVW and upland habitat/land uses is important. Also, non-living features such as snags, woody debris, rock piles, boulders, etc.

2.2 Replication Site Selection

The success of a replication area is dependent on the existence of an appropriate site as determined by the evaluation of site characteristics and other pertinent data. Replication areas can be sited on upland areas or previously filled wetland areas. Good replication sites may include degraded landscapes, such as mined out gravel pits, where creating a wetland will greatly increase resource value beyond what exists now. Types of information that should be collected include land ownership, land use (current and historical), topography, geology, hydrology, soils, proximity to other wetlands and water bodies or waterways, ability to take advantage of existing over story trees (for shading), and regulatory requirements. Design goals should be based on existing wetland functions as well as opportunities/limitations at the mitigation site. Once a preferred site is selected, detailed investigation as discussed below must be done to improve the likelihood of a successful replication area.

2.3 Hydrology, Soils, and Vegetation

2.3.1. Hydrology

General

The hydrology at the replication site is critical in controlling the plant community that develops, and many of the ecological functions of the site**.** Inadequate hydrology is often a result of inadequate evaluation of the replication site before construction, particularly when sites depending on ground water are not excavated deeply enough to provide water in adequate quantity and at appropriate seasons. Conversely, problems can also result when the replacement site is over-excavated to a depth below the water table. The application should include information demonstrating that the applicant understands the hydrology of the replication site, since it is critical to predicting the surface and ground water elevations that will result following completion of the project. For the existing wetland, pre-construction area proposed for replication and post-construction replication area, plans should also show the water budget inputs/outputs, with the goal of replicating the existing wetland functions. There should be unrestricted hydraulic connections between the replicated wetland and water source (other than limits imposed by the soil matrix).

Desirable Information

The expected annual seasonal depth, duration, and timing of both inundation and saturation must be established for the existing wetland and for each of the proposed vegetation class in the mitigation area. Data sources should be gathered from the surrounding area and may include hydrological records that provide evidence of periods of continuous flooding from 7 to 21 days during the growing season (such as those from USGS stream gauging stations, US Army Corps of Engineers data from major water bodies, state and local flood data, or NRCS flood information); direct observation of inundation, ponding or saturation; mean annual high water or bank full indicators on streams/rivers, or their equivalent in isolated wetlands. Evidence of soil

saturation is also an indicator of hydrology including free water in a soil test hole, saturated soil or oxidized rhizospheres[3]. At a minimum for all wetlands, a soil pit dug by soil hand auger should be used to determine seasonal groundwater levels. Applicants should begin data collection activities as far in advance of the project as possible.

In more complex replication sites, monitoring wells or piezometers may be necessary to collect groundwater data.[4] Typically, groundwater-monitoring wells may be required in replication areas greater than 5000 square feet or at proposed replication sites lacking adjacent wetlands that can be used to observe hydrology (the assumption is that surface water elevations of wetlands approximate groundwater elevations). Groundwater monitoring wells or piezometers should not be required at other sites (unless the proposed replication site is complex). A Request for Determination of Applicability or Notice of Intent must be filed prior to the installation of monitoring wells or piezometers unless they are located in a buffer zone or riverfront area. Care should be taken while conducting borings to minimize wetland disturbance. Monitoring wells should be removed when they are no longer needed and the site stabilized to prevent erosion or sedimentation. Consult with the Conservation Commission regarding individual cases.

Anticipated Hydroperiod

Based on the data collected, a discussion of the anticipated hydroperiod of the resource area should be included that describes the anticipated seasonal depth, duration and timing or frequency of both inundation and saturation for each proposed vegetation class (forested, shrub, emergent, etc.). Information should be compared to water regime characteristics for the proposed plantings. In addition, the water budget should be described to ensure that inputs equal or exceed outputs or the site will not support a wetland system[5]Wetlands that depend on groundwater, precipitation, or overland surface flow to supply water have different hydroperiods, soils, vegetation, and wildlife use. Ideally, replication areas should not depend on precipitation and sheet runoff flow only, but should have a seasonal source of groundwater and should have a surface water source as well. Perched wetlands may be established without these latter inputs, but monitoring wells or piezometers should demonstrate that runoff and precipitation inputs would exceed infiltration rates into the summer.

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[3] For Further information, see *Delineating Bordering Vegetated Wetlands* Handbook, published in March 1995 by the Massachusetts Department of Environmental Protection Division of Wetlands and Waterways. Also see the DEP approved method for determining high ground-water elevation as defined in 310 CMR 15.103 (3). Included in the methodology is the report entitled Frimpter, M.H. 1980. "Estimating maximum ground-water levels in Massachusetts", in Farquhar, O.C. Ed. March 1980, *Proceedings of Conf. Geotechnology in Massachusetts*, p. 73.

[4] Monitoring wells and piezometers are open pipes set in the ground. The difference between them is where along the pipe the water is allowed to enter. Typically, a monitoring well is sufficient to investigate a smaller replication area when a free water surface is within the top foot or two of the soil. Piezometers are appropriate when investigating larger replication areas to characterize water flows into and out of a wetland or differences in water pressure of soil horizons. Piezometers are also recommended in groundwater driven replication areas to allow long-term monitoring of groundwater. In the event that groundwater monitoring is required, it should be conducted twice monthly (March-November), and/or modeled based on monthly precipitation data for a 25-year period or USGS groundwater gaging station data. It is advisable to then do a surface hydrologic budget based on watershed characteristics and precipitation data so you know total potential water budget and design accordingly.

[5] See *Creating Freshwater Wetlands*, Donald A. Hammer, 1997 by CRC Press Inc., 2nd edition, page 51.

Land Subject to Flooding

Only the flood storage that the existing BVW provides should be designed in the replication areas. Additional, compensatory flood storage should not be allowed in replication areas, unless it can be demonstrated that spring floods will not impact the replication area. Impacts from flooding can include inundation for extended periods, scour and deposition. Compensatory flood storage must, however, be designed at the site of the impact.

2.3.2. Soils

General

An important factor in the success of a replication area is the proper use of soils either translocated (i.e. the relocation and reuse of hydric soils from the impacted resource area to the proposed replication area) from the impacted wetland or soil amendments brought from off-site. The development of hydric soils provides substrate for wetland plants, which in turn supports wildlife habitat. Hydric soil acts as a matrix to treat groundwater, adsorbs and absorbs pollutants, and supports vegetation that slows floodwaters. Commissions should ensure that the factors described below are considered in the replication design. Appropriate hydrology must be provided to maintain the soils in a hydric condition.

Soil Translocation

Soil translocation is the preferred methodology for obtaining replication soils. If possible, construction sequencing should provide for construction of the replication area first, using materials from the impacted wetland. If additional soils are needed then soils amendments from off-site may be used. The mitigation plan should include descriptive soil profile information from test pits at the existing wetland. Information should include horizons, and characteristics such as texture, organic matter, Munsell hue, value, and chroma, and evidence of hydrologic influence, e.g. redoximorphic features such as mottles (frequency and color), gleying, and root depth. A detailed schedule for the collection, stockpiling, and placement of the soils should also be included. Replication sites containing subsoil's that have developed in upland conditions will have difficulty in supporting hydric soils. Prior to placement of hydric soils in the replication area, all excavation of the replication area to appropriate sub grade elevations should be completed. Soil taken from areas where the invasive species listed in Section 2.3.3 are present should always be avoided.

Soil Amendments

If soils are brought from off-site, the specifications should include detailed descriptions of the composition of the additional material, and the techniques to be used in its preparation and placement. Specifications should also require that the contractor be responsible for obtaining a suitable source of this material in the event that it is proposed during design. Plans using translocation as the primary method should include a contingency for

obtaining soil amendments in the event that the existing wetland site soils are insufficient to provide the soil depths specified in the replication plan.

Specifications

The method (such as rototilling) to ensure appropriate compaction levels (e.g. not too loose, not too dense) should be addressed in the soils description. After the soil is managed for proper consistency (e.g. loose to friable), the soil consistency should be tested. If the proper consistency has not been achieved, further efforts should be undertaken to achieve proper consistency. Surveying of sub grades and finished elevations should be conducted frequently during construction.

One reason for the failure of some replication sites is that when the upland soils have been excavated, all of the B-horizon (subsoil) has been excavated, and a few inches of A or O horizon material have been placed over the C-horizon. Although some C-horizons are sandy and may work well as subsoil, C-horizons generally have not undergone soil-forming processes (pedogenesis), and may not provide a suitable rooting medium for plants to thrive. Mitigation sites that are constructed on dense compacted C-horizons with a thin layer of A or O placed on top are at risk of failing. Therefore, Commissions should request evidence that a C-horizon will provide suitable rooting medium in lieu of a B-horizon if proposed.

The goal for soils at the replication site should be to create soil profiles that approximate as closely as possible the soil profiles at the nearest undisturbed existing wetland. This means that a surface horizon is created that approximates the A or O horizon at the undisturbed wetland site and that at a minimum, contains 6-12 inches of A or O material. Beneath the A or O there should be a B-horizon (subsoil) that approximates the depth and texture of the B-horizon at the undisturbed wetland (or a suitable composition of the C horizon). The consistency of the replication B-horizon should be loose to friable, and the texture should be loamy sand to silt loam. Within these ranges, the consistency and texture should be chosen to approximate the conditions at the existing site. To supplement organic material, it is recommended that course woody debris (e.g. logs) be scattered on the replication area in between plantings to add structure and a long-term source of decaying organic material.

The ability of a soil to oxidize and reduce substances (or “redox”) contributes to the development of hydric features/indicators, slowed decomposition and accumulation of organic matter, and the ability of a wetland to adsorb and absorb certain pollutants. The ability to measure whether the soils show potential to develop into functional hydric soil, prior to its actual development as such, aids in monitoring wetland success. The soil pH also plays a role in redox reactions. Although not required, use of redox and pH meters in the replication area and adjacent wetlands will aid in replication success by allowing the applicant to make assumptions as to long term hydric soil development and function. It is

recommended that applicants seek guidance of a professional experienced in this testing since the range of results may vary depending on site conditions.[6]

Soils to be used at the mitigation site should be used immediately if possible or stockpiled for as little time as possible. While stockpiled, the soils should be kept wet and not be allowed to dry out. The method for maintaining the appropriate moisture level should be documented. Contamination of these soils should be prevented. They should be transported in vehicles that have been washed so that no exotic/invasive seeds from other sites get mixed in with them.

If soil amendments are used for the replication area A- horizon they should consist of a mixture of equal volumes of organic and mineral materials. These materials should be uncontaminated and should not include any woodchips. The organic material used should be well or partially decomposed. Clean leaf compost is the preferred soil amendment to achieve these standards. Mineral materials should be predominantly in the loam, loamy sand to silt loam texture range, with minimal quantities of gravel or rock. For further information on soil characteristics, Appendix 1 lists sources of information that applicants can pursue.

2.3.3. Vegetation

General

In accordance with 310 CMR 10.55, at least 75% of the surface of the replacement area must be reestablished with indigenous wetland plant species within two growing seasons. In order to accomplish this, the hydrology and soils conditions must be appropriate for each type of wetland vegetation (i.e. emergent, shrub, forested etc.) that is proposed in the replication area.

Commissions should ensure that the plan clearly describes the dominant plants in each layer of the existing wetland and, proposed replicated wetland vegetation. Plans should show existing vegetation that will remain in the replacement areas along with proposed vegetation both in plan view and narration, including relative cover and wetland indicator status for each vegetative layer proposed (herbaceous, shrub, sapling, climbing woody vine, and forested canopy). The wetland canopy layer and buffer zone vegetation should be evaluated for shade factor. Any proposed micro topography should be shown using typical cross-sections that include the approximate spacing of mounds and pools.

Planting Requirements

[6] Wetland soils generally have negative redox potential but can range from –300 to +300 millivolts (mV). The pH of wetland soils nationwide appears to be circumneutral (7) but it is not clear whether this is true in the northeastern U.S. where many wetland soils are poorly buffered. See *Creating Freshwater Wetlands*, Donald A. Hammer, 1997 by CRC Press Inc., 2nd edition, page 53; and *Mitigating Freshwater Wetland Alterations in the Glaciated Northeastern United States: An Assessment of the Science Base*, Joseph S. Larson and Christopher Neill, Editors, Publication 87-1, The Environmental Institute, Umass at Amherst, 9/86 pages 31 and 32.

The plan should provide detailed descriptions of the techniques proposed to establish wetland vegetation, including transplantation of appropriate plant materials. Planting procedures should be overseen by a qualified professional with training in wetland science. If the created wetland will be planted using vegetation transplanted from the impacted wetland, include a detailed plan for this procedure including species to be transplanted, and techniques for maintenance of the viability of seeds, rootstocks, and plants during the transplantation process. If wetland plants from the existing wetland are being used for planting, they should be removed in plugs or culms and protected against desiccation. Trees and shrubs should be root pruned prior to transplanting**.** Plants should be planted within one day of removal from existing wetland or as soon as possible and properly protected (e.g. burlap), watered and handled. Shrubs should be planted 8–10 feet on center, trees should be planted 10 –15 feet on center unless the or qualified wetland professional recommends otherwise**.** Shrub and tree densities should be used to determine the total number of specimens within a given however, the wetland professional should be responsible establishing the plantings in a naturalistic manner (i.e. clumping, mini-communities, leaving mud flats, etc.).

Consideration should be given to leaving existing mature upland trees on humocks within the replication site if they are facultative or wetter, as they may provide shading to the plantings installed around these humocks.

and nursery

area; for

The plan should provide details regarding any additional planting proposed to take place from other sources. If the proposed wetland will be planted with stock from off-site, include a detailed description of the methods to be used, sources of plant material, and a list of species to be included.

Invasive Species

Plans should also discuss potential sources of invasive species and potential control measures for undesirable invasive species. If the following invasive species are found growing in replication areas, measures should be taken to eliminate them as soon as possible. Soils from existing wetlands containing these species should never be used in replication areas.

- ✓ Purple Loosestrife (*Lythrum salicaria*);
- ✓ Phragmites (*Phragmites australis);*
- ✓ Buckthorn, *(Rhamnus Frangula alnus);*
- ✓ Honeysuckles *(Lonicera spp.);*
- ✓ Garlic Mustard *(Alliaria petiolata);*
- ✓ Japanese Knotweed (*Polygonum cuspidatum or Fallopia Japonica);*
- ✓ Japanese Stilt Grass (Microstegium vimineum);
- ✓ Reed Canary Grass (*Phalaris arundinacea*);
- ✓ Bittersweet nightshade (*Celastrus Orbiculatus);*
- ✓ Black Swallow-wort (*Cynanchum nigrum);*
- ✓ Pale Swallow-wort (*Cynanchum rossicum).*

Trucks that have previously been on other sites should be washed prior to introduction to the replication site so that mud/dirt with exotic/invasive seeds is not inadvertently brought to the replication site.

Timing of Plantings

All planting should occur at the beginning or end of the growing season. Fall plantings should be done before the first frost. Shrubs and trees, however, may be planted up to November 15, weather permitting. It should be noted, however, that some plant species are ill-suited to fall planting (including red maple) and therefore, careful investigation regarding individual plant tolerances should be investigated during design, and checked once the construction schedule is known. Information on specific growing season can be found in Appendix 2.

Predicted Vegetation Community and Contingency

The plan should contain a general discussion about the wetland vegetation anticipated after two growing seasons and the predicted vegetation community that will develop following natural succession. A contingency plan should be included in case of vegetation mortality, invasive species, inadequate size or hydrology etc.

2.3.4.Wildlife Habitat

Wetland resource areas provide important food, shelter, migratory and over-wintering areas, and breeding areas for many birds, mammals, amphibians, and reptiles. Wetland characteristics that provide wildlife habitat include hydrologic regime, plant and soil composition and structure, topography and water chemistry. To the greatest extent possible, plans and narratives should describe the wildlife habitat characteristics of the wetlands to be lost to determine its wildlife habitat value. The most recent *Estimated Habitat Map of State-Listed Rare Wetlands Wildlife* published by the Natural Heritage and Endangered Species Program of the Department of Fish, Wildlife, and Environmental Law Enforcement must be reviewed to determine if state-listed rare species habitat is present on the site. If so, special review procedures (310 CMR 10.59) must be followed.

For projects impacting the wildlife habitat function of bordering vegetated wetlands, Conservation Commissions have the authority to require replication of that function regardless of the size of the impact. The designer must consider the inclusion of structural characteristics and composition of vegetation to successfully replicate the desired wildlife habitat. Woody vegetation of varying heights adds structural diversity that is important for wildlife. While it is not immediately feasible to replicate a mature forested swamp complete with large trees and standing snags, replication projects should incorporate shrubs and saplings so that woody components will develop over time, as well as emergent areas and hummocks. It is also beneficial to provide water at varying depths, times and duration. Wetlands with diverse conditions are preferred, instead of simple wetlands such as ponds rimmed by emergent aquatic plants.

Although not a specific requirement in the wetland regulations, it is recommended that wildlife habitat mitigation be designed by an individual with at least a master's degree in wildlife biology or ecological science from an accredited college or university, or other competent professional with at least two years experience in wildlife habitat evaluation. This would be consistent with the required credentials for a person conducting a wildlife habitat analysis under 310 CMR 10.60.

Changes to wildlife habitat may not be directly related only to the size of a project, but can also result from secondary impacts such as fragmentation of habitat caused by roadways and the loss of surrounding upland buffer areas. Many wetland-dependent wildlife species are already listed as rare or endangered or are experiencing population declines. In particular, small, slow-moving species, which depend on both wetlands and adjoining uplands, are threatened severely by roadway crossings and buffer zone clearing. Continued loss and fragmentation of wetlands, combined with inadequate protection of adjoining upland buffer zone habitat, will exacerbate this situation. To address this problem, Conservation Commissions should require applicants to address not just the size of the impacted wetland, but its specific ecological functions. See Table on page 8.

2.4 Replication Area Design & Application Requirements

The replication area must be designed to ensure that the interests of the Wetlands Protection Act will be protected. This requires different amounts of detail depending on the size and complexity of the replication area. Applicants should provide the following information as part of their permit application describing both the existing wetland to be altered, and the replication site. Appendix 3 includes an example replication checklist.

2.4.1. Narrative Description

A narrative description of the existing wetland (in general terms) and proposed wetland (more detailed) should include descriptions of water flow in and out (surface water and groundwater hydrology), wetland vegetation (especially species and their relative cover, and interspersion and diversity of various cover types), soils, proximity to other wetlands, and underlying geological conditions. The specific type of wetland the applicant proposes to create (e.g. wet meadow, marsh, shrub-scrub, or forested) should be included. The description should document how the replication plan adheres to the performance standards and how the functions of the existing wetland will be replicated.

A narrative and plans as appropriate should be included that describes replication area either on or off site. Conservation Commissions may request that the applicant consider alternative sites if they find that the proposed site is unlikely to be successful. The information should include but not be limited to the following considerations:

1. Description of how the site(s) are likely to meet the criteria defined in 310 CMR 10.55 (4);
2. An assessment of the functions and values of the existing and proposed wetland areas with respect to the public interests;

3. Compatibility with undesirable neighboring land uses. For example, replicated wetlands adjacent to hazardous waste sites or downstream of parking lots, snow disposal areas or roadways may receive large inputs of pollutants (including salt) that may affect their ecological functions. Replication sites adjacent to high intensity land uses are less likely to provide the full range of wildlife habitat and other ecological functions of the impacted wetland**.** Applicants should address whether replication areas near undesirable land uses will meet the performance standards.
4. Topographic and geologic considerations may affect construction feasibility in the event large amounts of fill or bedrock require removal to achieve appropriate grades.
5. Soils must be examined for composition, distribution and depth; soil chemistry (i.e. redoximorphic features and ph) should be considered.
6. Hydrological considerations include 1) area of contributing watershed; 2) water budget inputs and outputs; 3) elevation of seasonal high and average groundwater table; 4) boundaries of wetlands; and 5) seasonal changes.
7. Applicants should consider avoiding valuable upland wildlife habitats such as mature forests so that inadvertent impacts to upland animal or plant species do not result. Replication is required, however, even if the only feasible site is forested. If this is the case, applicants may choose to consider potential areas off-site prior to using forested uplands. Upland rare species habitat and vernal pools should also be avoided. It is important to note that Conservation Commissions have no jurisdiction over upland areas adjacent to inland wetlands under the Wetland Protection Act unless they are buffer zones, riverfront area or bordering land subject to flooding. Any measures taken to avoid valuable upland habitats that are non-jurisdictional are strictly voluntary by the applicant.

2.4.2 Plan

A site location map such as a 1" = 2000' USGS locus depicting the geographic relationship between the impacted and proposed wetlands should be included. A plan showing the size and location of the existing and replicated wetland, at a scale in the range of 1"=10' to 1" = 40' should also be submitted, including easily identifiable landmarks such as surveyed flag locations, benchmarks, or structures. Plans should be developed with contour lines at 1-foot intervals in and around existing wetland and replication areas. Grading should demonstrate elevation differences required for different vegetation classes (forested, shrub, herbaceous, open water). In addition, the locations of hydrology test pits or other data collected, soil test pits and vegetation plots should be specified. Conservation Commissions should require that a Professional Land Surveyor (PLS) and/or a Registered Professional Engineer (PE) stamp plans.

Plans should also include details on any proposed planting or seeding plans and detail on the soil profile to be created. Location and extent of general wetland cover types and detail on the plant composition and spacing proposed within each cover type is recommended, especially for more complicated sites with one or more vegetation types.

It is important to note all details proposed in the Notice of Intent and required in the Order of Conditions on the plan, since it is often the most used tool by the contractor to construct the replication area. Make sure to include equipment access and storage areas as well.

2.4.3 Surface Area Calculations.

The regulations require that replication areas be designed at a 1:1 replacement to impact ratio after avoidance and minimization efforts are complete. Applicants may wish to consider a replication area greater than 1:1 in order to ensure the success of at least 1:1. A higher replacement to impact ratio may decrease the chances that a replication site will fail because it provides a contingency in the event of unforeseen circumstances such as mortality of vegetation, layout errors during construction, accidental encroachment and erosion and sedimentation. It is important to make sure that the side slopes of the replication area are not counted as part of the replication area or the final wetland will be smaller than required. This information should be included on the plans and in narrative form.

2.4.4 Cross-Sections

Cross-sections of the proposed wetland subsurface, showing soil types, depths, and locations, and if applicable, the 100-year floodplain elevation should be depicted using both horizontal and vertical scales. Also include predicted high and low ground water elevations, perched ground water conditions, and other indicators of surface or ground water hydrology including direct observations and soil characteristics. Locations of cross-sections should be indicated on the plan view.

2.4.5 Stormwater Management

One of the intents of the Massachusetts Stormwater Management Policy (MSWMP) is to protect wetlands from becoming degraded from untreated stormwater discharges. Best Management Practices (BMP's) are built to treat the stormwater prior to discharge to natural wetlands. Some of these BMP's are man-made "constructed wetlands". In the event that a "constructed wetland" is used for required stormwater compliance purposes, the area shall not be included as replication credit for an impacted wetland resource area. If any stormwater is to be directed to bona-fide replicated wetland, the stormwater shall be treated prior to discharge in accordance with the MSWMP. This means that stormwater must meet all 9 stormwater policy standards before it can be discharged to a replicated wetland (e.g. replicated wetlands cannot be used for removal of total suspended solids, nor can they be used for on-site detention of stormwater volume for peak rate attenuation, even if 80% TSS removal is accomplished beforehand). If stormwater is to be recharged, care must be taken to ensure the groundwater flow path will supply the replicated area. Fully treated stormwater may be useful in supporting the hydrology of replicated wetlands. Replication areas for freshwater wetlands should be located away from snow disposal areas. If a replication area may be impacted by road salting operations, care should be taken in the design to avoid or minimize such effects.

2.4.6 Erosion Control Plan

An erosion control plan showing how the applicant will stabilize all ground surfaces to prevent erosion should also be included within the application. Upon completion of the replication area, consideration should be given to the installation of siltation fencing between the replication area and the adjacent upland (if the adjacent upland will be disturbed during construction) to prevent sediments from entering the replication area. Prior to permanent establishment of vegetation in the replication area, soils should be temporarily stabilized to prevent impacts from erosion by mulching and seeding with a wetland seed mixture until re-establishment of wetland vegetation occurs. Hydro seeding is a valuable erosion control measure and may discourage colonization by invasive species. Caution is suggested in use of hay bales due to the possible inclusion of invasive seeds within the bales. If hay bales are to be used, the source site should be documented to be free of invasive wetland plants such as Purple Loosestrife and Phragmites. If invasive wetland plants are found at the source site then silt fence only or other erosion control measures should be considered. A commitment to remove erosion control measures following site stabilization and approval by the issuing authority should be included.

All embankment slopes adjacent to wetland replication areas should have slopes no greater than 2H: 1V unless stabilized by structural means. Bioengineering stabilization methods are recommended for slope stabilization.

3.0 Considerations During Construction

3.1 Schedule & Sequencing

The wetland replication plan should include a schedule showing the sequence of major construction steps and compliance monitoring. The schedule should include the proposed dates for the start of construction, and for each procedure included in the replication plan. Provisions should be included for surveying of finished elevations throughout the construction period in order to make appropriate adjustments due to compaction. In addition, contact information for the contractors and wetland consultants should be included.

If the flags placed during permitting are not clearly visible, flags should be replaced before construction begins. Flagging should include both the wetland to be altered and the location of the replication site. The flagging should clearly identify the limits of work in the existing wetland to avoid unintended impacts.

When possible, the replication area should be excavated and graded to the specifications in the plan before work in the existing wetland begins. The Conservation Commission should be given adequate notice prior to commencement of excavation for the wetland replication area so that inspection may be completed during the excavation procedure. Depending on the conditions encountered, the Conservation Commission may request modifications to the replication area design or location. Organic soils and wetland vegetation should not be placed in the replication

area until the wetland scientist has verified that the final excavated grade for the replication area will allow the finished grade of the replication site to meet the design specifications in the replication plan. The replication project should be substantially complete before existing wetlands are impacted (however, if use of soils or vegetation from the impacted wetland is proposed, the disturbance necessary to remove the wetland soils or vegetation may precede completion of the replication site). In any case, the proposed replication area should be excavated prior to filling the wetlands to be altered.

Following excavation work, final grading and landscaping should be completed as soon as possible to minimize erosion. The overall construction schedule should be planned so that soils or vegetation are not stockpiled for an extended period of time. All exposed soil should be stabilized using seed-free mulch or other appropriate erosion control measures in the event that seasonal conditions result in a delay in planting. If the site is excavated to the sub grade in the fall and a delay is inevitable, consideration should be given to stabilizing the site for winter, and conducting final grading in the spring. Use of hydro seeding has been found to stabilize a site quickly and may possibly hinder growth of invasive species. Erosion control measures such as hay bales and silt fences shall be removed as soon as the site is stable to allow for proper hydrologic conditions.

4.0 Monitoring Requirements

Monitoring is critical in wetland replication efforts due to the complex issues that can arise when trying to replace the specific ecological conditions of wetlands. Monitoring to ensure that the project is built according to the design specifications will ensure that the most common cause of failure is avoided. A project monitor (preferably a qualified professional with training in wetland science) with a minimum 5 years of experience in the construction of wetland replication areas and general construction practices should be on-site to monitor the excavation, grading, and planting of the replication area (at the end of the first growing season, a professional with less than 5 years experience in wetland replication construction may conduct the monitoring if supervised by a professional with at least 5 years experience). The application should include specific monitoring plans and schedules for reporting to the issuing authority. An example checklist is included as Appendix 4. The project supervisor or monitor should be present during the most important tasks in replication construction including:

1. Before excavation or erosion control installation work begins to inspect site flagging;
2. During excavation of the altered area if vegetation is to be translocated to the replication area to ensure survival of the plantings;

3. Before soil translocation or addition into the replication area to inspect excavated elevations and likely post-construction ground water elevations for the replication area;

4. After each stage of grading work is completed to inspect finished elevations;

5. During planting and seeding and after the first month of the growing season to inspect propagation techniques;

6. After one growing season to observe vegetation development and regulatory compliance;

7. After two growing seasons to determine vegetation development and regulatory compliance

8. After subsequent growing seasons, if a greater than 2-year monitoring program is required.

A project should have a monitoring report submitted in the late spring and at the end of each of the first two growing seasons at a minimum. Monitoring should be required until regulatory compliance goals are met. Reports should include recommendations for additional plantings should the replication area appear to be unlikely to meet the 75% reestablishment standard (note that the 75% revegetation may include volunteer hydrophytic species as well as replacement plantings and seeding). Monitoring for invasive species should also be conducted and any invasive handpicked before becoming widespread and established. Each monitoring report should project potential successional patterns based on observed establishment of vegetation. The final monitoring report should be accompanied by an as-built plan. The final monitoring report should indicate the conditions at the replication site (including stabilization of embankments), and describe in detail how the functions of the impacted wetland have been replaced by the development of the replication site. See the example-monitoring sheet in Appendix 4. Should the replication area fail to achieve the standard of 75% wetlands vegetation within two growing seasons, the Conservation Commission should require additional contingency measures and a Certificate of Compliance should not be issued until regulatory compliance is achieved.

Commissions should require that all replication plans include a narrative specifying target rates of survivorship, and alternative plans for plants or vegetative communities that do not become established successfully. Applicants should be prepared to mobilize after the completion of construction in the event that the replication area is not successful as determined by the Conservation Commission. A description of who will be responsible for post-construction remedial actions should be included in the Notice of Intent and Order of Conditions.

It is suggested that each Conservation Commission maintain records of replication projects in their town. The records are a valuable tool for the Commission to help learn from experience what approaches work well in the area, and to document reasons for project failure.

5.0 Issuing a Certificate of Compliance

The issuance of a Certificate of Compliance is an important step in ensuring a successful replication area. Commissions should review the following list prior to issuing a Certificate of

Compliance. Commissions can deny a request for Certification if replication areas do not meet the 75% wetland plant criteria or are not constructed as designed or conditioned.

1. An as-built plan stamped by a R.L.S. or P.E. should be submitted that documents the construction of the replication area. The size of the replication area should be documented as consistent with the size proposed.

2. A site visit should be conducted prior to issuing a Certificate of Compliance. The replication area should be compared with the design plans and the Order of Conditions to ensure that it has been constructed as proposed and wetland interests have been replicated.

3. At least 75% of the surface area of the replication site should be reestablished with indigenous wetland species within two growing seasons. A qualified wetland professional should certify to the plant species composition of the area and compliance with this condition. The qualified wetland professional should also certify that the plants proposed in the planting plan are those that were planted, in the correct number, and the spacing of the plantings. The Order of Conditions may be extended if it is about to expire but the replication area has not fully established itself through two growing seasons. Each different layer of wetland vegetation (forested, shrub, herbaceous etc.) should be checked to ensure that it is surviving as designed and that the hydrology is appropriate.

4. Vegetation should be checked to ensure that no invasive species are colonized in the replication area. If so, measures should be taken to eliminate the invasive species.

5. All surrounding buffer zone areas should be stabilized. Inspections should be conducted of erosion control devices such as hay bales and silt fences and those devices should be removed once the site is stabilized. A Certificate of Compliance should not be issued until all erosion controls are removed and any soils disturbed by their removal stabilized.

6. Any drainage feature that supplies water to the replication areas should be checked to ensure a free-flow without clogging from sediments, trash or other impediments.

Conservation Commissions should deny requests for Certificate of Compliance if replication areas are not adequate and/or not substantially in compliance with the Order of Conditions. Procedurally, Commissioners can allow additional time for plantings or remedial work to reach compliance by extending an Order of Conditions, requiring submission of a new Notice of Intent if the Order has expired, or issuing an enforcement order if they cannot get compliance voluntarily. The Certificate of Compliance should be recorded in the Registry of Deeds.

6.0 Conclusions

Protection of the wetland resources in the Commonwealth cannot be successful unless permitted wetland losses are adequately mitigated by successful replication projects. Improvement in the success of replication projects can be accomplished if all of the critical steps outlined above are followed when handling projects with wetland replication. Replication plans should be carefully analyzed using the checklists provided to ensure that appropriate requirements are included. The

project should be monitored at appropriate points before, during and after construction, so that mid-course corrections can be made if necessary. Appendix 5 describes *Common Mistakes and Problems* and should be referenced during project design and implementation. Finally, Certificates of Compliance should only be issued when the project has met all of the appropriate requirements. Following these critical steps in accordance with the guidance provided here will ensure that the public interests in the wetlands of the Commonwealth will be protected.

Appendix 1. Sources of Planning Information

Product	Source
Aerial Photography	Massachusetts DEP Wetlands Conservancy 617-292-5907
Floodplain Elevations	Federal Emergency Management Agency (1-877-336-2627), Corps of Engineers (1-978-318-8214), Massachusetts DEP (1-617-292-5500) www.fema.gov/maps/
GIS maps and information	Mass GIS (1-617-626-1000) www.state.ma/mgis/
National Wetlands Inventory (NWI) maps	Local contact information at: http://mac.usgs.gov/mac/isb/pubs/forms/wetlands2.html (1-413-545-0359)
Soil Survey Information/Growing Season information	USDA Natural Resource Conservation Service field offices. A directory of state and field offices is located at: http://www.nrcs.usda.gov/NRCSorg.html (1-413-253-4350 for soil survey; 1-978-692-1904 for growing seasons)
Topographic maps	See U.S. Geological Survey Map Finder at: http://mcmcweb.er.usgs.gov or call 1-800-USA-MAPS.
U.S. Army Corps of Engineers wetland replication checklist	http://www.nae.usace.army.mil/reg/index.htm, click on plan review checklist)(978-318-8335 or 800-362-4367).
University of Massachusetts Soil Testing Laboratory	http://www.umass.edu/plsoils/soiltest/broch1c.htm (413) 545-2311 Also, for interpretive information: www.umass.edu/plsoils/soiltest/interp1.htm

Appendix 2. USDA Growing Seasons

Soil Survey Area	Growing Season Dates	Weather Station
Barnstable County	April 26 – October 23	Hyannis
Berkshire County	May 6 – October 8	Stockbridge
Bristol County (Northern)	April 24 – October 11	Taunton
Bristol County (Southern)	April 2 – November 11	Fall River
Dukes County	April 10 – November 6	Edgartown
Essex County (Northern)	April 12 – October 26	Middleton
Essex County (Southern)	April 15-October 26	Peabody
Franklin County	April 14 – October 25	Sherborn Falls
Hampden County (Central)	April 6 – October 27	Springfield
Hampshire County (Central)	April 29 – October 12	Amherst
Hampshire/Hampden (east)	April 29 – October 12	Amherst
Middlesex County	April 16 – October 18	Bedford
Nantucket County	April 5 – November 16	Nantucket
Norfolk County	April 30 – October 7	W. Medway
Plymouth County	April 17 – October 26	Rochester
Worcester – Northeast	April 14 – October 23	Worcester
Worcester – Northwest	April 10 – November 1	Birch Hill
Worcester - South	April 14 – October 23	Worcester

Appendix 3. Replication Checklist

A. Sequencing (See Section 1.3 for further guidance)

1. The Notice of Intent should include the following information:

   ☐ Narrative on avoidance of wetland Impacts.

   ☐ Narrative and plans showing minimization of wetland impacts.

   ☐ Narrative/drawings of alternative replication designs to ensure success.

   ☐ Carefully designed replication plans with identified goals for unavoidable impacts.

B. Elements of a Complete Replication Plan (See Section 2.3 for further guidance)

1. The application should include the following general information:

   ☐ Narrative description of the existing and proposed wetland;

   ☐ A site location map (such as a USGS locus) of existing and proposed wetlands;

   ☐ A 1"=10' to 1" = 40' plan including easily identifiable landmarks (e.g.surveyed flag locations, benchmarks, or structures), contour lines at 1-foot intervals, and locations of soil test pits and vegetation plots. A Professional Land Surveyor (PLS) and/or a Registered Professional Engineer (PE) should stamp plans.

   ☐ Grading should demonstrate elevation differences for different vegetation classes (forested, shrub, herbaceous, open water);

   ☐ Surface area calculations demonstrating a minimum 1:1 replacement to impact ratio (consider greater than 1:1 to ensure the success of at least 1:1). Do not count side slopes as part of the replication area;

   ☐ Cross-sections of subsurface soil types, depths and locations, 100-year floodplain using both horizontal and vertical scale, existing and predicted high and low groundwater elevation, perched water conditions and other indicators of hydrology. Indicate cross-section locations on plan view;

2. Hydrology – The narrative and plans should include the following:

   ☐ The expected seasonal depth, duration, and timing of both inundation and saturation must be established for the existing wetland and for each of the proposed vegetation class in the mitigation area.

   ☐ Evidence of soil including free water in a soil test hole, soil color, saturated soil or oxidized rhizospheres.

☐ In addition, the inputs and outputs in the water budget should be described. Ideally, replication areas should not depend on precipitation and sheet runoff flow only, but must have a seasonal source of groundwater and should have a surface water source as well. Perched wetlands may be established without these latter inputs, but monitoring wells or piezometers should demonstrate that runoff and precipitation inputs would exceed infiltration rates into the summer.

☐ Demonstration that groundwater and surface water will have unrestricted hydraulic connections to the replication area;

☐ Only the flood storage that the existing BVW provides should be designed in the replication areas;

3. Soils- the narratives and plans should include the following information:

☐ Test pits of translocated soils including horizons, characteristics such as texture, organic matter, Munsell hue, value and chroma, consistence and evidence of hydrologic influence, e.g. mottles (frequency and color), gleying, and root depth;

☐ Replication areas should have a minimum of 6-12" of A- Horizon soil. If used, soil amendments for the A-Horizon consist of equal volumes of organic and mineral materials. No woodchips should be used, and organic material should be well or partially decomposed.

☐ Enough A and B-Horizon material (or A over a suitable composition of the C horizon) should be provided to create a suitable rooting medium, and to approximate the conditions at the nearest undisturbed existing wetland. Consistency should be loose to friable and texture should be loamy sand to silt loam.

☐ Although not required, use of Redox and pH Meters in the replication area and adjacent wetlands may aid in replication success. Seek guidance of a professional experienced in this testing.

☐ A detailed schedule for collection, stockpiling and placement of soils, including a discussion of techniques used to prevent the drying out and contamination of hydric soils.

☐ Confirmation that invasive species listed in Section 2.3.3 are not present in the vicinity of the soil to be translocated.

☐ If soil amendments will be brought from off-site, a description of the source, preparation and placement should be included.

☐ Discussion of a method to ensure appropriate compaction levels and the final consistency and texture of mitigation soils, by horizon.

☐ Survey of finished elevations during construction should be conducted frequently and a proposed schedule included.

☐ Discussion of post-construction soil characteristics such as horizons, depths, texture, organic matter, Munsell hue, value and chroma, consistence and evidence of hydrologic influence, e.g. mottles (frequency and color), gleying, percent gravel and rock, and root depth;

4. Vegetation- narratives and plans should include the following information:

☐ The dominant plants in each layer of the existing and proposed wetland and the relative cover and wetland indicator status for each vegetative layer proposed (herbaceous, shrub, sapling, tree and climbing woody vine);

☐ Transplantation techniques including maintenance of viability of seeds, rootstock and plants during transplantation. Shrubs should be planted 8-10" on center and trees should be planted 10-15' on center unless otherwise recommended by a nursery or wetland professional.

☐ Consideration should be given to leaving mature trees on hummocks for shading if they are facultative or wetter.

☐ A detailed description of sources of off-site plant material, species list, and methods to be used for planting.

☐ Schedule for planting (at the beginning or end of the growing season - before the first frost). Check each species for ideal planting times. See Appendix 2 for growing seasons.

☐ Wetland vegetation expected after two growing seasons as well as predicted community after natural succession.

☐ Contingency plan in case of mortality of vegetation, invasive species, complete failure, inadequate size, etc.

☐ For larger projects micro topography should be shown in cross-sections including number of mounds and pools if proposed to replicate existing conditions.

5. Wildlife Habitat

☐ Documentation of the *Estimated Habitat Map of State-Listed Rare Wetlands Wildlife* findings for the site should be included.

☐ For projects impacting the wildlife habitat functions of BVW's, wildlife habitat characteristics of the site, including vernal pools, should be described and replicated. Design should include diversity of vegetation structure and composition, and of hydrological conditions. Credentials of wildlife habitat specialist should be included.

6. Stormwater Management

☐ Created wetlands for stormwater "best management practices" shall not be given credit as replication areas;

7. Erosion Control- narratives and plans should include the following:

☐ An erosion control plan that details stabilization techniques during construction and a contingency plan for construction and post- construction periods.

☐ A commitment to remove erosion control measures once the site is stabilized and following approval by the issuing authority.

☐ Embankment slopes should be no greater than 2H: 1V unless structural stabilization.

C. Considerations During Construction (See Section 3.0 for further guidance)

☐ The erosion and sedimentation control plan must be implemented.

☐ The wetlands and replication area should be reflagged prior to construction start date if the flags placed during permitting are not clearly visible.

☐ A construction schedule listing the sequence of events for replication construction (preferably before work in the existing wetland);

☐ A project monitor with a minimum 5 years experience should be identified;

D. Monitoring Plan (See Section 6.0 for further guidance)

☐ A plan to monitor the construction and subsequent growth for at least two years or until the 75% criteria is met following construction should be included (See Appendix 3 for example checklist). Include contingency plan in the event that the replication area does not meet the 75% reestablishment standard.

☐ Colored photographs from established reference points should be included with each monitoring report.

☐ Plan must include inspection of embankments to ensure that they are stable, properly vegetated and constructed as designed.

Appendix 4. Example Monitoring Data Sheet

(Note: this sheet should be accompanied by a plan or sketch showing the locations of the monitoring points. Representative photos should be taken at each visit)

DEP FILE NUMBER: _____

Landowner Name:_____Address:_____

Person completing form:_____

Inspection at project stage (circle one):

- ✓ Before excavation work or erosion control installation begins to inspect site flagging;
- ✓ During excavation of the altered area if vegetation is to be translocated to the replication area to ensure survival of the plantings;
- ✓ Before soil translocation or addition, to inspect excavated elevations;
- ✓ After each stage of grading work is completed to inspect finished elevations;
- ✓ During planting and seeding and after first month of growing season to inspect propagation techniques;
- ✓ After one growing season to observe vegetation development;
- ✓ After two growing seasons to determine regulatory compliance;
- ✓ After subsequent growing seasons if greater than a 2-year monitoring program is required;

Note: when possible, monitoring should be conducted in late spring and at the end of the growing season.

Site Visit Date: _____

Designed Size: _____

Note: In the post-construction monitoring phase % below should be given for each separate area or class of that particular vegetation type (example: if replication area is designed to include two shrub dominant areas, then a percentage should be given for each of the two areas). Percentages should include hydrophytic non-invasive species and non-hydrophytic non-invasive species.

VEGETATION & COVER

	Hydrophytic/Non-Hydrophytic
% Cover herbaceous vegetation	_____/_____
% Cover shrubs	_____/_____
%Cover trees	_____/_____

%Cover woody vines _____/_____

%Cover aquatic vegetation _____/_____

% Total Cover non-invasive vegetation: _____

% Cover invasive species _____/_____

Location and type of invasive species: _____

Distance to nearest potential source of invasive species:

_____

Efforts taken to control invasive species: _____

%Cover exposed soil _____

%Cover standing water: _____

HYDROLOGY

Unrestricted connection to neighboring water body or waterway:
(Contiguous, isolated, channel connection): _____

Elevation of seasonal high and average groundwater table and surface water depth:
_____

Other indicators of hydrology_____

SOILS

Profile, Munsell hue, value, chroma_____

Evidence of mottling, gleying etc. _____

Ph and Eh (Redox Potential) recommended but not
required_____

OTHER

Anticipated Succession_____

Are erosion control measures in place and well maintained, embankments stable, vegetated and constructed as designed? _____

Wildlife Observed_____

Appendix 5. Common Mistakes and Problems

1. Stormwater detention basins are not wetland replication areas. Such basins are drainage structures and need to be maintained (cut, dredged etc). RECOMMENDATION: Include maintenance provisions in Order of Conditions for detention basins and require that replication areas not be used as stormwater structures.

2. Side slopes of the proposed replication area are not accounted for, and the final replicated wetland is smaller than required. RECOMMENDATION: During the permitting process review plans to be sure that side slopes do not extend into replication area. The issuing authority should require an inspection immediately after excavation of replication area.

3. Monitoring is rarely carried out and the vegetation dies and is not replaced. RECOMMENDATION: It is critical to check plant viability and replant if necessary before issuing a Certificate of Compliance. Include a condition in the Order requiring written monitoring reports at regular intervals and make sure the plan includes adding vegetation if it is anticipated that the site will not meet 75% after the first year.

4. Replication site too dry. RECOMMENDATION: Bottom elevations should be surveyed and if necessary, additional grading should be conducted to try and achieve the proper hydrology. The wetland monitor should determine the groundwater elevations before allowing organic soils to be added to ensure that elevations are low enough to ensure adequate hydrology. Monitor seasonal groundwater elevations in the replication area.

5. Replication site too wet. RECOMMENDATION: Wetland soils should be added to the site to ensure proper grades. Grades in the replication area should be surveyed to determine exactly how much fill is needed to achieve design elevations. Groundwater data collected during design should be reevaluated and the design adjusted to establish proper elevations for the proposed vegetation.

6. The applicant constructs the project first and fails to complete the replication area as required. RECOMMENDATION: Require wetland replication to be an initial phase of the project. Commissions should follow up with the landowner, applicant and the wetland specialist identified in the application immediately during construction to obtain voluntary compliance and a milestone schedule for completion. If the replication area is not completed, a Certificate of Compliance should not be issued. Enforcement action should be taken if voluntary compliance cannot be achieved.

7. The replication area is deeper than the adjacent wetland, resulting in a change in hydrology and drying out of adjacent wetland. RECOMMENDATION: Review the cross-sectional information for groundwater depths and depth of replication area and make appropriate changes.

8. The plants proposed for the replication area are not common in nearby wetlands. RECOMMENDATION: Plants should reflect the species density and composition in the altered area. Require native species that are common in your town.

9.The topography is at insufficient detail to accurately assess groundwater elevations, compensatory storage requirements, and resulting hydrology. RECOMMENDATION: Require surface elevation data be shown at 1-foot contours.

10.Invasive species are beginning to colonize in the replication area. RECOMMENDATION: Avoid using soils or plants from areas containing invasive species. Require monitoring and if found, removal during the first growing season and in subsequent years after (if necessary).

11.Wildlife habitat functions not replicated. RECOMMENDATION: Require plans to reproduce existing wildlife habitat features of the plant community and structure.