DRAFT INVASIVE SPECIES MANAGEMENT PLAN

Provincetown Municipal Airport
Capital Improvements Plan
May 2015

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1.0 BACKGROUND

Implementation of the Capital Improvements Plan (CIP) projects at Provincetown Municipal Airport (Airport) may provide opportunities for invasive plants to become established and may result in the accidental spread of existing populations of invasive plants. The CIP projects will result in the alteration of approximately 1,664 square feet (SF) of Bordering Vegetated Wetlands (BVW), 83,284 SF of Isolated Vegetated Wetlands (IVW)/adjacent wetlands/Isolated Land Subject to Flooding, and 44,871 SF of coastal dunes. In addition, nearly 12,924 SF of freshwater wetland (BVW and IVW/adjacent) as well as 24,028 SF of coastal dunes will be indirectly altered as a result of long-term maintenance along the eight-foot wide clear area along the safety/security fence. The Airport will mitigate for unavoidable resource area alterations by providing on-site wetland replication/restoration in three locations, resulting in a total of 79,000 SF IVW restoration, 5,000 SF of BVW replication, and 36,000 SF of coastal dune creation in two locations. In addition, the Airport proposes on-site wetland enhancement of 616,350 SF of IVW/adjacent wetlands through management of invasive species.

The following narrative documents the efforts to control invasive species observed at the Airport, and is largely focused upon the control of common reed (*Phragmites australis*), but also discusses the management of two additional species, purple loosestrife (*Lythrum salicaria*) and spotted knapweed (*Centaurea stoebe*). This Invasive Plant Species Control Plan was created following guidance provided by the U.S. Army Corps of Engineers (Corps), the Cape Cod Commission (CCC), and other guidance documents.

2.0 INTRODUCTION

Invasive plants are non-native species that have been introduced to areas outside of their native range, where they often thrive and out-compete and overtake endemic plant communities. Non-native plants are characteristically aggressive, have few natural enemies and/or limiting biological factors within their introduced range, and tend to have very effective reproductive abilities. The spread of such plants is a major concern in the United States, as they reduce the functions and values of habitat for native flora and fauna within both wetlands and uplands and are a nuisance to manage once they have become established within an area.

Adverse economic and environmental impacts are also often incurred by the establishment of invasive species.

This Invasive Species Management Plan (ISMP) is an element of the Airport's Compensatory Mitigation Plan, and includes measures to address the growth of existing invasive species as well as the potential growth of additional invasive plants within mitigation areas and stormwater facilities. It details the anticipated procedures for managing invasive plants in and enhancing the values of the wetlands and uplands (i.e., coastal dunes) at the Airport. This Plan will also supplement the Airport's existing vegetation management program. The presence of invasive species at the Airport also provides opportunities for wetland enhancement via invasive plant removal within undisturbed wetland areas, and will serve to offset indirect wetland impacts that will occur as a result of the CIP.

3.0 PLAN OBJECTIVES

The basic steps involved in managing invasive plant species are inventory, control, and monitoring. The overarching objective of this plan is to promote and restore native biodiversity to the greatest extent possible at the Airport. The goals of this Invasive Plant Species Control Plan are to:

- Identify the undesirable invasive plant species that are present and where they occur within the wetlands and upland areas at the Airport;
- Establish qualitative and quantitative monitoring mechanisms to track the status of the invasive plants;
- Establish a reporting protocol to provide the status of the Plan to regulatory agencies and stakeholders;
- Define preferred methods for managing, controlling, and eradicating invasive plants at the Airport; and
- Incorporate invasive plant control methods into the existing vegetation management plan at the Airport, for an integrated approach to management of wetland and upland plant communities within and near operational areas.

The primary objective of this ISMP will be to enhance the value of the wetlands within the CIP project area at the Airport, with a focus on the wetlands where invasive plants already occur (i.e., Wetlands H, I, and/or B). Furthermore, construction disturbance could promote additional colonization or spread of invasive plants from colonized wetlands to nearby wetlands. Particular care will be taken to address wetlands in which invasive species did not occur prior to construction, as certain invasive species are prevalent within the project locus and pose a

threat to such wetlands. Given the dominance of a variety of invasive plants in many areas, complete eradication of these species from the entire Airport site is unlikely.

4.0 INVASIVE SPECIES OF CONCERN

Invasive species that are most likely to pose problems at the Airport, particularly within the wetland mitigation areas and stormwater facility, include common reed, purple loosestrife, and spotted knapweed. Field investigations conducted between 2004 and 2010 have identified the occurrence of each of these species at the Airport. Below is a brief description of these three species, their growth habits, and general location at the Airport as observed by HW field biologists.

4.1 Common Reed

Common reed, or *Phragmites*, is the predominant and most conspicuous invasive species at the Airport. It is located in many of the freshwater wetlands, at the base of the dune ridge, and within the brackish areas of Hatches Harbor. This tall grass colonizes wetlands and the upper reaches of salt marshes, and is tolerant of a wide range of freshwater and brackish conditions. This species produces a copious seed bank, but spreads predominantly through its extensive root and rhizome (underground stem) system that forms dense mats. This species has flourished within the Hatches Harbor salt marsh system, and has been managed in the past within the tidal areas through the efforts of the Hatches Harbor Wetlands Restoration Program. However, this species has also spread within some of the isolated freshwater wetland areas at the Airport, most notably within Wetlands H, I, and B, although lesser amounts of this invasive plant species have been observed within Wetlands AE and AF among the dunes along the northern lease line, within Wetlands CM and CP in the western corner of the lease line, and within other wetlands to a lesser degree.

Although *Phragmites* provides some wildlife value for a limited number of species, once this non-native genotype has become established at a site, it causes the rapid decline of most other native species found in a given area, drastically reducing wildlife habitat value. This change has been most noticeable in the Hatches Harbor area, where native species were in severe decline due to the infestation of *Phragmites*. It is noted by Marks et al. (1993) that areas invaded by *Phragmites* have excellent potential for recovery, provided that long-term management and monitoring occur.

4.2 Purple Loosestrife

Purple loosestrife is a wetland perennial native to Eurasia that can form large, monotypic stands in part due to its vigorous rootstock, which enables this species to reproduce

vegetatively. Purple loosestrife blooms from July through September or October and produces copious seeds, with estimates of more than 2.5 million seeds annually per mature plant. Seeds can remain viable even after 20 months of submergence in water. Infestations of purple loosestrife appear to follow a pattern of establishment, maintenance at low numbers, and then dramatic population increases when conditions are optimal due to its high seed viability and prolific seed production. Thus management of this species when populations are low is important to maintain healthy native populations.

Purple loosestrife has been observed in small quantities within Wetland AL, Wetland C, Wetland I, and Wetland C/J/FK, with individuals noted in other more outlying isolated wetland areas at the Airport as well. As with many other invasive species, this plant out-competes local native vegetation, reduces native species diversity and wildlife habitat values, and can eliminate food sources, habitat, and cover for waterfowl and other wildlife throughout wetlands. A single mature plant alone has the ability to produce over one million long-lived seeds annually, and is capable of spreading vegetatively through rhizomes.

4.3 Spotted Knapweed

Spotted knapweed is a perennial herb with a strong taproot. This species grows aggressively in full sun and well-drained soils, conditions found within many coastal dunes. Known for its infestation of croplands and grazing areas, this species produces nearly 1,000 seeds throughout its lifetime, and these seeds may persist in the seedbank for a period of up to five years. The Massachusetts Invasive Plant Advisory Group identifies this plant as a “likely invasive” species in Massachusetts.

Spotted knapweed is found at the Airport along the dunes near the northern tip of the Airport lease line and within the dunes surrounding the entrance driveway and parking lot areas. Additional infestations of this species were observed along the bike path adjacent to the northeastern portion of the lease line. Established populations are especially troublesome in coastal dunes since the root system of this species, unlike native dune species such as American beachgrass (*Ammophila breviligulata*), has poor soil binding abilities.

5.0 INVASIVE PLANT CONTROL OPTIONS

Invasive plants may be managed using either manual (mechanical) methods, chemical methods, biological methods, or a combination of thereof. Often, integrating mechanical and chemical controls has demonstrated to be most effective in reducing invasive plant populations. However, the management approach and appropriate combination of techniques may vary among species. The primary control options under consideration for use in the ISMP for

common reed, purple loosestrife, and spotted knapweed are provided below based upon studies conducted by research scientists and land managers throughout the U.S. and worldwide.

5.1 Phragmites Control

Phragmites can be a difficult plant to eradicate, and reinvasion often occurs if a management strategy is not maintained. An initial chemical treatment followed by mechanical treatments has proven to be fairly effective by dramatically reducing populations, when site appropriate. A variety of mechanical and chemical treatments is available and presented below. The proposed control methods are discussed in Section 6.3.

5.1.1 Mechanical Techniques

Mowing. When small, isolated, low density stands exist and chemical methods are deemed inappropriate, harvesting or mowing can reduce plant biomass and increase the amount of sunlight available to other, native species. Mowing should be conducted once per season during the late summer to fall (i.e., September to first deep frost) when the species is using most of its energy for seed and flower production and when nesting birds are least likely to be disturbed. In addition, mowing a stand once per year after a chemical treatment for three consecutive years can eradicate the plant and reduce shading to encourage growth of native plants. *Phragmites* plants that remain living after herbicide treatment will re-colonize vegetatively within approximately three to five years, if the remaining dead stalks are not mechanically removed.

Hand pulling or digging may be effective on small (less than 18 inches) or very young plants. However, this method is very labor intensive, particularly if a plant becomes well established and is no longer a young shoot or seedling. Digging also becomes difficult when the root system is expansive and well established and may be potentially ineffective on increasingly mature stands.

Burning is another option for mechanical control, although land managers recommend that this method be used in combination with chemical treatments, as burning alone will actually encourage more vigorous growth of the plant. Burning is typically appropriate for large dense stands and should be conducted in late summer (mid-July through August) or winter (from January until just before the beginning of the growing season) during the year following herbicide application.

Smothering *Phragmites* with a layer of plastic for a minimum of three growing seasons is another method, and has been demonstrated to control growth and damages seed beds and

Phragmites seedlings. Implementation of this method involves first cutting the stand to a height of less than four inches prior to treatment. This is a difficult method to execute, as plants tend to puncture the plastic sheeting and it is not aesthetically appropriate in all landscapes. Additionally, the plastic will create an inhospitable habitat for re-growth of native plants and may destroy beneficial microbes within the soil.

Salt Water Inundation. Common reed is intolerant of salt water with a salinity of greater than 22 parts per thousand (ppt), such that reintroduction of salt water to coastal marsh areas results in the gradual transition (10 to 20 years) toward a native plant community. This method was employed during the Hatches Harbor Restoration Project and has reduced the extent of the *Phragmites* population at the Airport. This species is, however, tolerant of freshwater flooding. Thus, freshwater inundation is not a management method. Conversely, maintaining a water level of greater than one foot may suppress seedlings, particularly if the plants are hand cut at least one foot below the water surface to flood the shoot bases.

If mechanical techniques are being used in combination with chemical treatments, the mechanical controls should be used at least two weeks after the chemical method in order to allow the plants to absorb the herbicides, with the exception of the cut and drip method.

5.1.2 Chemical Techniques

Chemical control has proven to be very effective in the management of *Phragmites*. Glyphosate (Rodeo™), imazapyr (Habitat™), and triclopyr (Renovate 3™) are the most frequently used herbicides in the control of this species, using one or more of the following methods. While the cost of imazapyr may be much higher than glyphosate, studies suggest that imazapyr can control *Phragmites* for a longer period of time when used alone or in combination with glyphosate.

- Foliar spraying is most effective during the summer (typically late July or August, although this differs by type of herbicide), after the first seed head has formed, up to the first frost. The herbicide should be sprayed to wet the leaves and flower plumes (if present), but not to the point of dripping. An approved non-ionic surfactant must be mixed with the herbicide to ensure that the herbicide is taken up by the plants.
- The cut stem method (i.e., “cut and drip”) is also used to control this species, particularly in environmentally sensitive areas. This method involves cutting the stems right below a node in order to allow a long section of hollow tube before the next node. The stem is then treated by hand with herbicide, using a squeeze bottle to inject the stem or else with a sponge applicator. Enough herbicide should be applied to the hollow stem (e.g., filling it up to where it was cut) in order to maximize the applied

herbicide. This method works best on tall *Phragmites* stalks with thick stems which can "drink" a lot of herbicide solution.

- Wicking is another method employed to control *Phragmites*. This method involves applying herbicide by wiping the top of the plants with a canvas-covered applicator attached to a boom on each side of a boat or low ground pressure application equipment. However, this method may bend or break the stems of the plant, which reduces the efficacy of the herbicide and makes a second application necessary.

Herbicide application will cause gradual wilting along with yellowing, browning, and overall deterioration of the plant. However, if the herbicide concentration is too high, the top region of the plant may be killed, preventing translocation of the herbicide to the rhizome (underground stem) or root system. Repeat herbicide treatments are sometimes necessary to maintain control of a *Phragmites* stand, especially if it is a large population. Chemical techniques are most effective when coupled with mechanical controls. As noted above, cutting or mowing of stalks two to three weeks following herbicide application and subsequent removal of mowed materials stimulates growth of previously suppressed (native) plants.

5.2 Purple Loosestrife Control

Several control methods for purple loosestrife have been attempted with varying degrees of success, including mechanical, chemical, and biological methods. It is recommended that any control effort be followed up during the same growing season and for several years afterwards since some plants will be missed, new seedlings may sprout from the extensive seed bank, and a few plants will survive the low-dosage treatment. The various management techniques for the control of purple loosestrife are discussed below.

5.2.1 Mechanical Techniques

Managing purple loosestrife depends largely on early detection of this species. Wetland areas where a purple loosestrife population is detected within the first year or two of introduction can be managed mechanically through hand pulling or excavation of the entire plant (e.g., with a shovel), including the root crown and preferably before seed set. All parts of the plant must be removed and properly disposed of, since fragments of this species are able to re-sprout vegetatively. However, it has been shown that more mature populations of purple loosestrife cannot be manually removed, due to the extensive root and rhizome structure. Some land managers have found that larger, more mature populations can be controlled through extensive plowing, although this method would not be appropriate in undisturbed wetlands.

5.2.2 Chemical Techniques

It has been documented that smaller, well-developed populations of purple loosestrife have been successfully managed through the applications of glyphosate. Herbicide treatment is most effective when applied late in the season when the plants are preparing for dormancy. A mid-summer treatment combined with a late season treatment is ideal, to reduce the amount of seed produced. Large, dense populations (e.g., monocultures) of purple loosestrife can be sprayed by air or boat and must be combined with a high-intensity management plan which will monitor the treated area, and include provisions for re-application of herbicides as necessary.

5.2.3 Biological Techniques

Some success in managing purple loosestrife populations has been achieved through the introduction of leaf-eating beetles (*Galerucella calmariensis* and *G. pusilla*), whose sole food is purple loosestrife. However, this management technique is most appropriate with large dense areas of purple loosestrife, since smaller populations of purple loosestrife are unable to support a viable population of the leaf-eating beetles.

5.3 Spotted Knapweed Control

Management of spotted knapweed is recommended when there is evidence that this species has established and is expanding in population size. The most cost effective strategy is to prevent the spread of this plant to non-infested areas. As with other invasive species, potential management techniques for spotted knapweed include both mechanical and chemical measures. Research has shown that areas that have experienced infestations by spotted knapweed and have been treated by these measures eventually recovered and returned to the original native groundcover.

5.3.1 Mechanical Techniques

Small populations of spotted knapweed may be controlled through persistent hand-pulling prior to seed set. With hand pulling, the entire crown and taproot of the plant must also be removed. Digging is a control technique that has proven to be very effective in areas with densities of less than 10 plants per square meter. Proper disposal of the excavated plants is essential. Mowing of large, dense populations of spotted knapweed during the months of April and May, preceding germination, reduces the plant populations' ability to successfully produce a seed crop. Special care would need to be taken to ensure that plant fragments and seeds are not spread by the mower. However, due to the location of the knapweed populations within coastal dune areas at the Airport, mowing may not be appropriate. In addition, mowing often results in the plants merely reflowering at lower heights. Reseeding and/or planting with a

native grass species (i.e., American beachgrass) is recommended following removal of the knapweed to allow for native succession.

5.3.2 Chemical Techniques

Studies and previous control efforts reference two herbicides that have been used with varying degrees of success for managing spotted knapweed. These include the chemicals picloram and 2,4-D. Picloram, while successful in preventing germination of seeds within the soil, remains active in the soil for a period of up to four years. Its effects on other native species are unknown. Use of picloram near water or in porous substrata overlying groundwater that is less than ten feet from the surface is discouraged, as it leaches into groundwater and has been documented to adversely affect trees and shrubs. The herbicide known as 2,4-D is considered only a temporary method of control, since it does not prevent germination of the seeds already in the soil. Triclopyr application (3% solution, water soluble formulation) at a rate of three to four times per year for two years has been documented to control plants from growing in the seed bank. Triclopyr should be sprayed on the entire plant except the flower, sparing it for native fauna. In addition, triclopyr does not affect grasses.

5.3.3 Biological Techniques

Several biological controls exist, including two root mining moths, a flower moth, and a root mining beetle. Case studies document varying degrees of success with each biological control. Introduction of a biological control is typically warranted with large monocultures, which is not the case at the Airport.

6.0 INVASIVE SPECIES MANAGEMENT AT PROVINCETOWN AIRPORT

Invasive plant species management will be conducted as part of the resource enhancement component of the compensatory mitigation plan in the form of *Phragmites* management in Wetlands H and I (and B). Here the native populations of wetland shrubs and herbaceous species are slowing being overtaken by the tall, non-native grass. Discrete areas known to contain invasive species will also be targeted as a part of this ISMP and will be managed with manual and/or chemical measures. The target species for this plan are common reed, spotted knapweed, and purple loosestrife.

An enhancement plan will be included as an addition to the general invasive species management that is required within the proposed wetland replication areas. The plan will involve wetland enhancement activities including implementation of the preferred management method, replanting with native species, and long-term monitoring to track the successful regeneration of native plant communities within wetland areas currently supporting populations of *Phragmites*.

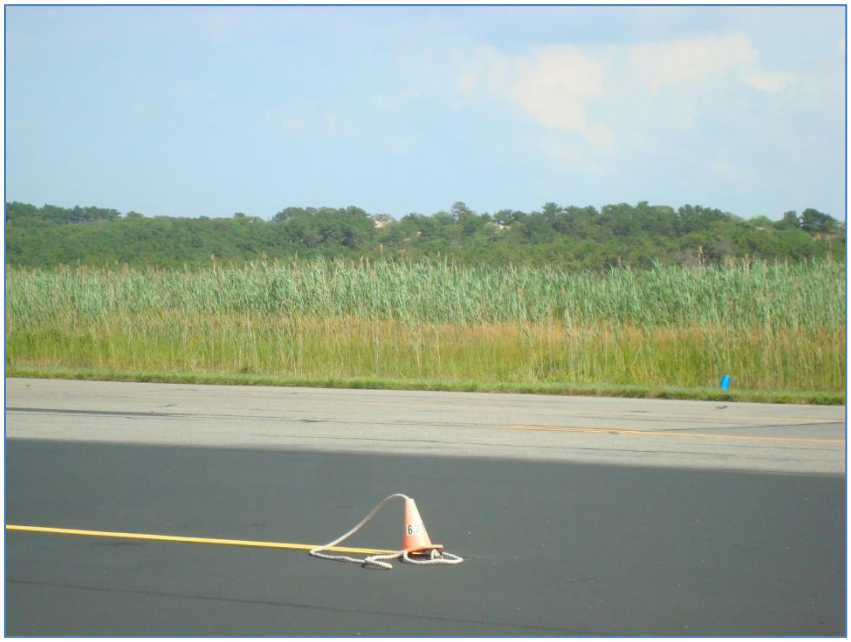

Photo 1. *Phragmites* within Wetland H

These areas have been targeted as priority areas for invasive species management and enhancement as they are discrete and therefore manageable. In addition, the growth of *Phragmites* in these locations, between the runway and the taxiways, has resulted in a safety issue, as the height of the species obscures necessary visibility for pilots and Airport personnel, which is particularly important as the Provincetown Municipal Airport does not have an airport control tower.

HW has documented that *Phragmites* exists in discrete patches, and survey located these areas in 2010. Figure 17 of the DRI depicts the surveyed locations of existing invasive plant populations at the Airport. At the time of the initial survey, approximately 616,350 SF (14.1 acres) between the runway and taxiways were occupied by *Phragmites.* It is anticipated that a supplemental survey will be necessary to further document the extent of this species within these wetland areas prior to implementation of the ISMP.

6.1 Preferred Control Options/Schedule of Management Activities

The most appropriate and preferred method of control for each species that ensures greatest success in management of these invasive plants has been identified below and will be conducted in compliance with NPS policies on land management and other regulatory agency requirements. Special care will be taken to avoid impacts to native species when using

chemical techniques, as imazapyr and glyphosate are non-selective herbicides and will adversely affect any plant species with which they come in contact.

6.2 Site Constraints

Given the sensitive nature of the wetlands and the sensitive setting of the Airport within the confines of the Cape Cod National Seashore (CCNS), precise methods of control, rather than broad-brush herbicide application or large scale mowing in wetlands, will be employed.

6.3 Proposed Management Techniques for *Phragmites*

The Airport proposes an integrated control program to address the populations of *Phragmites* present, particularly within Wetlands H and I. These areas will be managed using the "cut and drip" method, a combination of mechanical and chemical controls described above. This method is best conducted during the months of July and August following tasseling to control the spread of this species within the resource areas. The mechanical component of this strategy will involve cutting the plants to a height of approximately six inches (ensuring the cut is just below a node) on an annual basis following flower tassel when the plant is supplying most of its nutrients to the rhizomes (underground stems), with care taken to remove and dispose of the cuttings. Herbicide application will follow approximately two weeks after stems are cut.

6.4 Proposed Management Techniques for Purple Loosestrife

Mechanical removal of this species has been identified as the preferred management technique, as existing populations at the Airport are small and fairly low in density. Scattered individuals and small patches of purple loosestrife have been observed in 2005-2007 in Wetlands AL, C, I, and C/J/FK. Cutting and hand pulling will be employed to control existing and potentially emergent populations of this species.

Photo 2. Purple loosestrife in discrete clumps within Wetland I

6.5 Proposed Methods of Control for Spotted Knapweed

Given the location of spotted knapweed at the Airport within coastal dunes and other low-lying sandy areas along the parking area and the nearby bike path. At present, spotted knapweed occurs in an area approximately 10-15 feet outward from the parking area in a few discrete locations, and along the bikepath, approximately 2-3 on either side of the paved area for several hundred feet. As the extent of the existing population is minimal, the preferred method of control is mechanical. Chemical controls are not appropriate, as the extent of the knapweed populations is not large and the soils are highly permeable. Existing knapweed populations will be cut or pulled by hand, as described above. Caution will be exercised so as to not disturb the sensitive dune sediments and native flora. Revegetation with American beachgrass may be necessary, and will be recommended upon further survey and assessment of these discrete areas.

Photo 3. Clumps and patches of spotted knapweed north of the parking lot and along the bike path.

7.0 DISPOSAL METHODS

Invasive plant management efforts often generate a substantial amount of plant debris and sediments that often contain viable root fragments. If invasive plant debris is not properly disposed of, it may contribute to the introduction or spread of the species at the project site or even at the disposal location. If plants have been managed using chemical methods, it is best to leave them in place to biodegrade, in lieu of removing them off site. Likewise, if plants have flowers, movement of the plant will be minimized.

Any plant material resulting from management activities at the Airport will not be composted, in order to prevent regrowth or deposit of seeds into the compost sediment. All invasive plant

debris with will be bagged and allowed to rot within the bags in a sunny location for at least three weeks and then can be deposited in a landfill or incinerated. It is possible to air dry or incinerate herbaceous (non-grass) plants (i.e., purple loosestrife and spotted knapweed), but containing the plants within bags and allowing them to rot followed by removal off the site may have a higher success rate rather than on-site disposal at the Airport within the Cape Cod National Seashore.

8.0 REVEGETATION AND ACTIVE RESTORATION

Following implementation of the initial management plans for each invasive plant species, native vegetation will be allowed to re-colonize the areas via natural succession as part of an active restoration plan. The native communities will be supplemented with additional plantings of appropriate native species to facilitate their success and rapid re-colonization. For instance, exposed areas within the coastal dunes that are currently infested with spotted knapweed would be revegetated with American beachgrass, and overplanted with low-growing shrubs such as bayberry if appropriate. Likewise, supplemental plantings of native herbaceous or shrub species, compatible with the existing plant community composition, may be utilized to stabilize soils within wetland areas upon successful controlled management of non-native plants.

9.0 MONITORING

Monitoring for existing and new invasive species will be conducted as a regular component of construction oversight and will continue after the completion of all construction activities as part of the wetland mitigation plan. Monitoring will be conducted over subsequent growing seasons. If a new species is observed during monitoring that has not been previously documented at the Airport, a monitoring and control plan will be developed for that species as an adjunct element to this plan. Action will likely be taken immediately if new invasive plants are encountered, to prevent their spread, as delays may make the problem more difficult to address.

9.1 Environmental Monitor

As described within the draft wetland mitigation plan, an individual serving as an Environmental Monitor (EM) will be required to monitor construction activities and wetland mitigation efforts, as well as mechanical and chemical control efforts to manage existing populations of invasive species as identified. In addition, the EM will be responsible for follow up monitoring upon the completion of construction, mitigation, and invasive plant management efforts, and to provide recommendations for follow-up measures as appropriate.

A qualified wetland scientist or other landscape personnel with experience in wetland mitigation and invasive species control will be on site to ensure compliance with the mitigation plan and to make field adjustments when appropriate. This individual will oversee all aspects of the wetland mitigation and enhancement activities including installation of sedimentation control barriers, removal of impervious surfaces, excavation of salvaged plant materials, removal of invasive plant material, revegetation, and implementation of a monitoring plan.

9.2 Monitoring Schedule

During and immediately following the creation of the mitigation areas, monitoring will occur frequently to ensure the initial establishment of introduced plantings. Following the grow-in period and in accordance with the regulatory guidance, wetland mitigation areas and enhancement areas will be monitored twice annually for a minimum of five growing seasons to determine the relative success of the restored wetlands and to document the presence and extent of invasive species. Semi-annual site inspections conducted during late spring and late summer will include an assessment of the relative health and integrity of the salvaged vegetation and introduced nursery stock, percent cover of vegetation, and percent cover of wetland species. Monitoring will be in compliance with the performance standards under 310 CMR 10.55(4)(b)(1 through 7), the ACOE Compensatory Mitigation Guidance, and the Guidance for the New England District Mitigation Plan Checklist.

In addition to the overall assessment of the monitoring areas, additional data regarding the vegetation will be collected within study plots distributed randomly throughout the mitigation areas to provide data to determine the relative success of the wetland plant communities using scientifically recognized statistical methods. The intent of vegetation sampling is to quantify results in a statistically relevant fashion. Data collected from the study plots will be compared to test plots within nearby undisturbed reference wetlands or else collected within the impacted areas prior to restoration activities as baseline data. Specific measures will be taken during construction and monitoring of wetland restoration areas to discourage establishment of invasive species within the newly disturbed soils. The monitoring plan will be reviewed by various regulatory agencies and approved during the permitting phase of the CIP projects.

10.0 REPORTING

Results of the invasive species and mitigation area monitoring will be documented in annual monitoring reports. Written reports detailing the findings of each monitoring event will be submitted annually for five years to the Provincetown Conservation Commission, Massachusetts DEP, ACOE, the CCC, and NPS. Monitoring reports will provide details on the assessment of the wetland restoration areas, including remedial actions recommended or

taken during a given year. The five year monitoring period and annual reports will also allow for an evaluation of the effectiveness of the initial and follow up invasive plant treatments.

For the purpose of monitoring and reporting, permanent plots will be established and recorded for each targeted population to monitor the relative and overall success of the management techniques, along with the long-term stability of the rehabilitated areas in accordance with mitigation plan and permitting requirements. Photographic documentation from these permanent plots will be incorporated within the monitoring reports. DEP, ACOE, and CCC have established criteria for compliance, and adaptive management measures will be implemented as necessary to ensure the long-term success of mitigation and enhancement areas.

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