APPENDIX G: STATEMENT OF FINDINGS FOR WETLANDS AND FLOOD PLAINS

STATEMENT OF FINDINGS FOR WETLANDS AND FLOOD PLAINS

HERRING RIVER RESTORATION PROJECT

STATEMENT OF FINDINGS
WETLANDS and FLOOD PLAINS

For the Herring River Restoration Project
Cape Cod National Seashore, Massachusetts

June 2012

Recommended:	____________________________	______________
	Superintendent	Date
	Cape Cod National Seashore	
Certification of Technical Adequacy and Servicewide Consistency:	____________________________	______________
	Chief	Date
	NPS Water Resources Division	
Approved:	____________________________	______________
	Regional Director	Date
	Northeast Region	

TABLE OF CONTENTS

TABLE OF FIGURES

INTRODUCTION

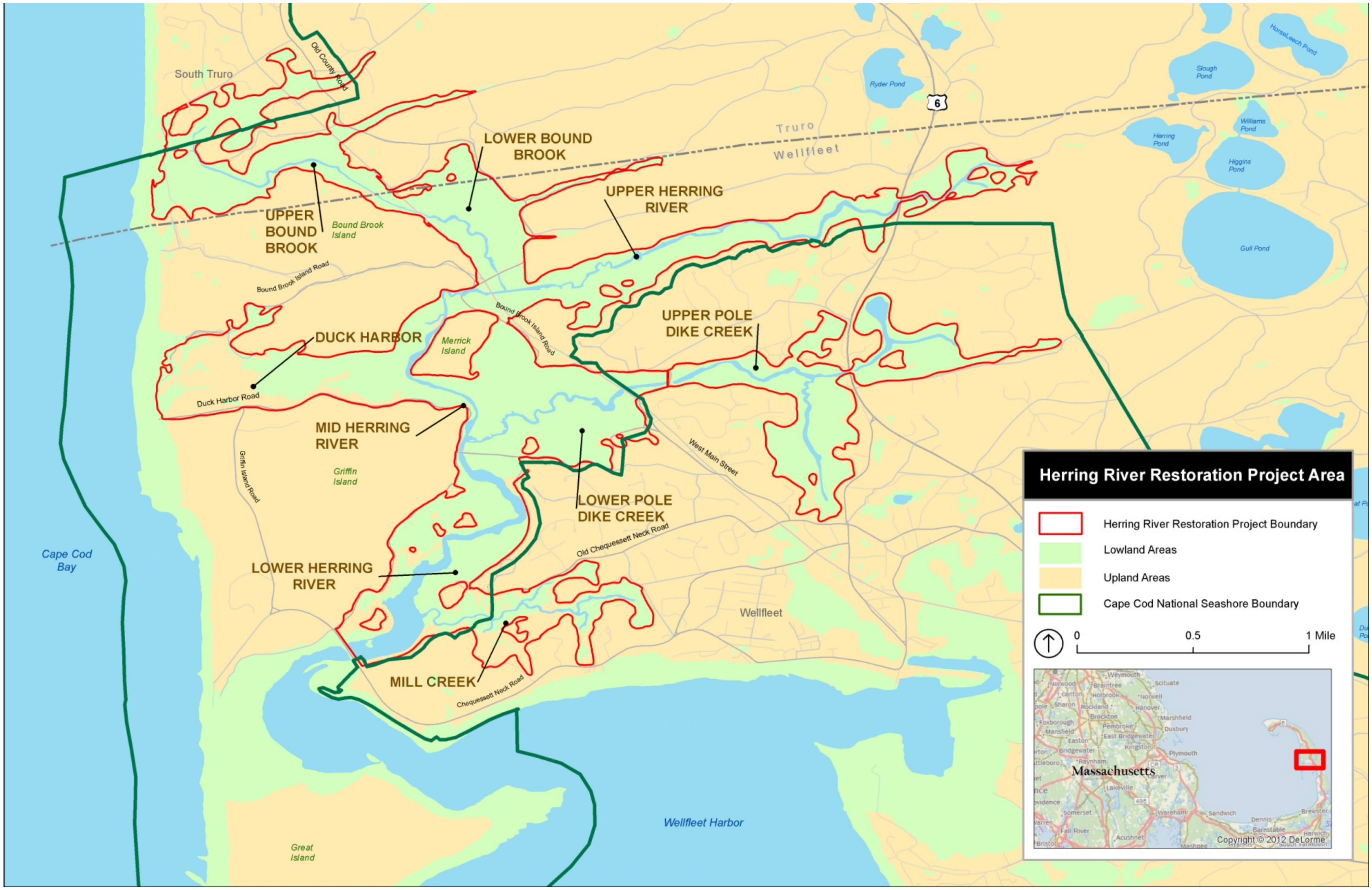
In accordance with the National Environmental Policy Act (NEPA) and the Massachusetts Environmental Policy Act (MEPA), the Herring River Restoration Committee (HRRC) and the National Park Service (NPS) have prepared and made available to the public a joint draft Environmental Impact Statement/Environmental Impact Report (EIS/EIR) for the project to restore the Herring River flood plain in and adjacent to Cape Cod National Seashore (the Seashore).

In addition to complying with NEPA and MEPA requirements, NPS Director's Order 77-1 and Procedural Manual 77-1 provide guidance regarding NPS policies and procedures for wetland protection. The purpose of this Director's Order is to establish NPS policies, requirements, and standards for implementing Executive Order (EO) 11990: Protection of Wetlands (42 Fed. Reg. 26961), which was issued by President Carter in 1977 "…to avoid to the extent possible the long and short term adverse impacts associated with the destruction or modification of wetlands and to avoid direct or indirect support of new construction in wetlands wherever there is a practicable alternative...."

Consistent with this order, the NPS has adopted a goal of "no net loss of wetlands." Additionally, the NPS will strive to achieve a longer-term goal of a net gain of wetlands Servicewide. When proposing new development or other new activities, plans, or programs located in or otherwise have the potential to result in adverse impacts on wetlands, the NPS will avoid adverse wetland impacts to the extent practicable, minimize impacts that cannot be avoided, and compensate for remaining unavoidable adverse wetland impacts via restoration of degraded wetlands.

EO 11988: Floodplain Management, also enacted by then President Jimmy Carter in 1977, requires the NPS and other federal agencies to avoid to the extent possible the short- and long-term adverse impacts associated with the occupancy and modification of flood plains and to avoid direct and indirect support of flood plain development wherever there is a practicable alternative. Under the EO, each agency shall provide leadership and shall take action to reduce the risk of flood loss, to minimize the impact of floods on human safety, health, and welfare, and to restore and preserve the natural and beneficial values served by floodplains (EO 11988). NPS Director's Order 77-2 Floodplain Management and Procedural Manual 77-2 provide NPS policies and procedures for complying with EO 11988.

The proposed project is intended to restore native tidal wetland habitat to large portions of the 1,100-acre Herring River flood plain (figure 1) by re-establishing tidal exchange in the river basin and its connected sub-basins. While the ecological goal is to restore the full natural tidal range in as much of the Herring River flood plain as practicable, tidal flooding in certain areas must be controlled to protect existing land uses. Where these considerations are relevant, the goal is to balance tidal restoration objectives with flood control by allowing the highest tide range practicable while also ensuring flood proofing and protection of vulnerable properties. As a result, flood plain functions would be altered from their current condition and adjacent landowners may be subject to a change in flood regimen of the Herring River.



Source: The Louis Berger Group, Inc., 2012.

FIGURE 1: PARK VICINITY MAP AND HERRING RIVER RESTORATION AREA

Increased tidal exchange would be achieved by reconstruction of the Chequessett Neck Road Dike (figure 2), which separates the former Herring River estuary from the marine waters of Wellfleet Harbor and Cape Cod Bay, and the construction of a new dike to control tidal inflows into the Mill Creek sub-basin of the project area. Tidal exchange would be increased incrementally, over time, using an adaptive management approach over several years to achieve desired conditions for native salt marsh habitats.

Source: NPS, 2011.

FIGURE 2: CHEQUESSETT NECK ROAD DIKE

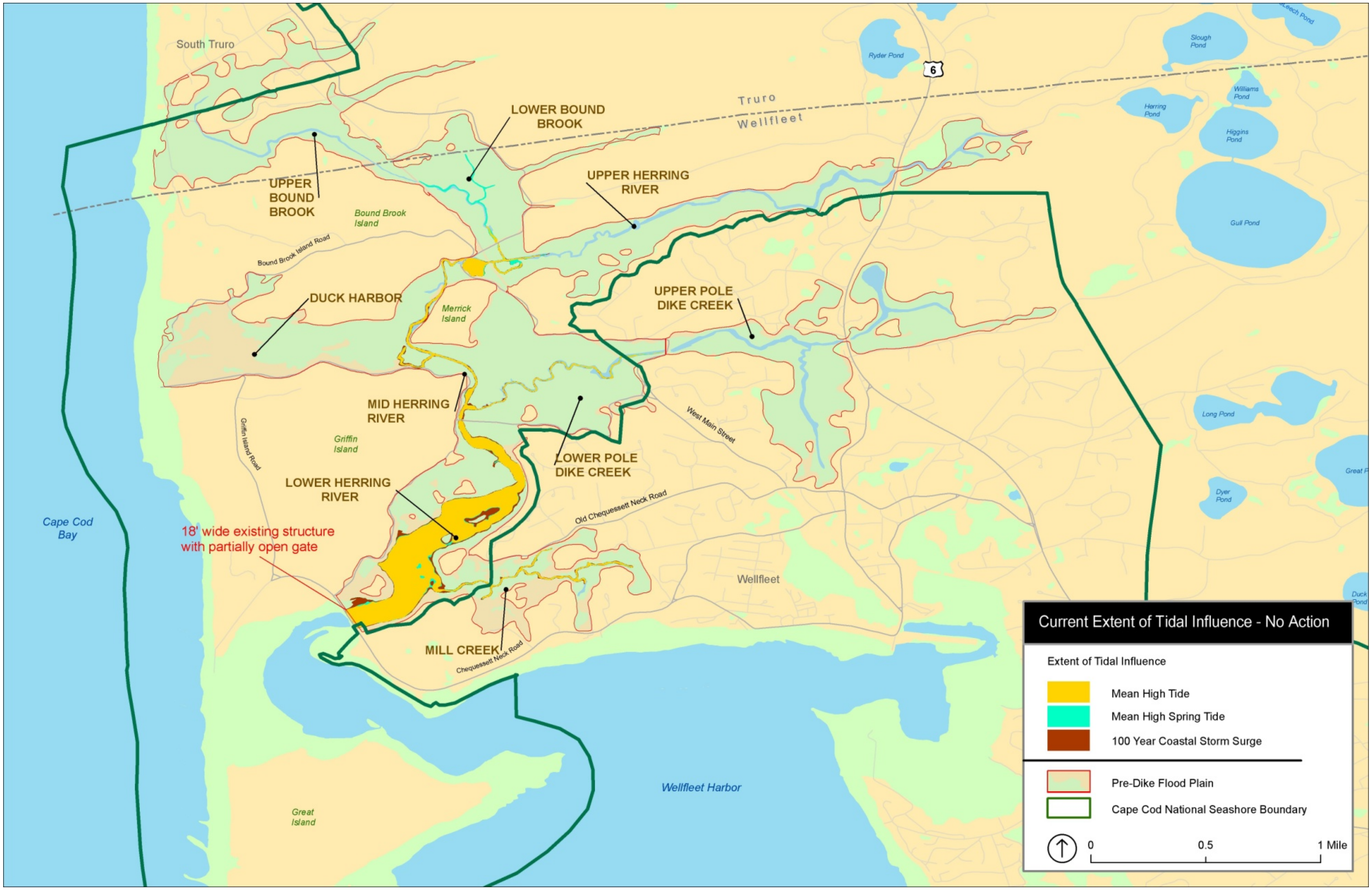
The proposed project would result in long-term wetland and flood plain impacts resulting from the transition of up to approximately 900 acres of man-made freshwater wetlands to native, salt marsh tidal wetlands. This would be achieved by construction of a new, tide-controlling dike that would allow tidal exchange while protecting the Herring River from flooding storm surge. Limited, short-term adverse effects to wetlands and flood plains would also occur as a result of construction activities, active management of vegetation during the adaptive management phase, and grading or other activities needed to ensure that both tidal inflows and drainage are adequate to achieve the desired future conditions.

This combined Wetlands and Floodplains Statement of Findings addresses both the long-term changes to natural processes and short-term construction and implementation impacts of the restoration project. It also identifies mitigation measures designed so that the proposed project is in compliance with NPS wetland and flood plain management procedures.

PROJECT BACKGROUND

Historically, the Herring River estuary and flood plain was the largest tidal river and estuary complex on the Outer Cape and included about 1,100 acres of salt marsh, intertidal flats, and open-water habitats (HRTC 2007). In 1909, the Town of Wellfleet constructed the Chequessett Neck Road Dike (figure 2) at the mouth of the Herring River to reduce the presence of salt marsh mosquitoes. The dike restricted tides in the Herring River from approximately 10 feet on the downstream harbor side to about 2 feet upstream of the dike (figure 3).

By the mid-1930s, the Herring River, now flowing with freshwater, was channelized and straightened. Between 1929 and 1933, developers associated with the Chequessett Yacht and Country Club (CYCC) constructed a nine-hole golf course in the adjoining Mill Creek flood plain. Several homes have also been built at low elevations in the flood plain.



Source: The Louis Berger Group, Inc., 2012.

FIGURE 3. CURRENT LEVEL OF TIDAL INUNDATION IN THE HERRING RIVER FLOOD PLAIN

By the 1960s, the dike tide gates had rusted open, increasing tidal range and salinity in the lower Herring River. This caused periodic flooding of the CYCC golf course and other private properties. In 1973, the Town of Wellfleet required that the dike be repaired to accommodate anadromous fish passage. As a result, the Massachusetts Department of Public Works rebuilt the dike in 1974 (HRTC 2007). Following reconstruction, tide height monitoring showed that the new tide gate opening was too small to achieve the required tide heights. In 1977, control of the dike was transferred to the Massachusetts Department of Environmental Protection (MassDEP) so that increased tidal flow could be attained in the interest of restoration (HRTC 2007).

In 1980, a large die-off of American eel (*Anguilla rostrata*) and other fish drew attention to the poor water quality in the Herring River. The Massachusetts Division of Marine Fisheries and NPS identified the cause of the fish kill as high acidity and aluminum toxicity resulting from diking and marsh drainage (Soukup and Portnoy 1986). The tide gate opening was increased to 20 inches in 1983. That year, Seashore scientists documented summertime dissolved oxygen depletions and river herring (*Alosa* spp.) kills for the first time (Portnoy 1991). The NPS then implemented measures to protect river herring by blocking their emigration from upstream ponds to prevent the fish from entering anoxic waters (HRTC 2007).

Concerns about flooding of private properties and increased mosquito populations prevented the town from opening the tide gate further. NPS mosquito breeding research conducted from 1981 to 1984 found that mosquitoes, *Aedes cantator* and *Ae. canadensis*, were breeding abundantly in the Herring River. However, estuarine fish, important mosquito predators, could not access breeding areas because of low tidal range, low salinity, and high acidity (Portnoy 1984). In 1984, the town increased the sluice gate opening to 24 inches, where it has since remained (HRTC 2007).

In 1985, the Massachusetts Division of Marine Fisheries classified shellfish beds in the river mouth as “prohibited” due to fecal coliform contamination. In 2003, water quality problems caused MassDEP to list Herring River as “impaired” under the federal Clean Water Act Section 303(d) for low pH and high metal concentrations. More recently, NPS researchers identified bacterial contamination as another result of restricted tidal flow and reduced salinity (Portnoy and Allen 2006).

Concentrations of nitrogen and phosphorus in the sediments of Herring River have remained high. Although there is no documentation of specific anthropogenic or natural inputs, potential sources of excessive nutrients in the watershed include agriculture, fertilized lawns, CYCC golf course, the nearby Coles Neck landfill, leaking septic systems, animal waste, and atmospheric deposition. The lack of tidal flushing has allowed nutrients to accumulate in the Herring River. In a normally functioning estuary, nutrients would be diluted and flushed out of the system with each tide cycle.

In addition, pesticides have likely been used throughout the Herring River watershed, including long-term use for mosquito control. Pesticide concentrations (dichloro-diphenyl-trichloroethane (DDT) and dieldrin) measured in the Herring River sediments downstream of the dike in 1969 (Curley et al. 1972) were found to be elevated, exceeding National Oceanic and Atmospheric Administration (NOAA) guideline values (Buchman 2008). However, samples analyzed for organics (including pesticides) from the Wellfleet Harbor by Hyland and Costa (1995) did not exceed NOAA guideline values. Quinn et al. (2001) analyzed the upper 2 cm of the marsh sediments at four stations upstream and downstream of the Chequessett Neck Road Dike for polychlorinated biphenyls (PCBs), DDT, total petroleum hydrocarbons (TPH), and polycyclic aromatic hydrocarbons (PAHs). PAHs were found to be below NOAA’s effects range low (ERL) guideline values while PCBs and DDT were found to be above NOAA’s ERL guidelines.

Because tidal restrictions radically affect the process of sedimentation on the salt marsh, much of the diked Herring River flood plain has subsided up to three feet (Portnoy and Giblin 1997a). Coastal marshes must increase in elevation at a rate equal to or greater than the rate of sea-level rise in order to persist. This increase in elevation (accretion) depends on several processes, including transport of sediment and its deposition onto the marsh surface during high tides. This sediment transport must occur to promote the growth of salt marsh vegetation and gradually increase the elevation of the marsh surface. Diking has effectively blocked sediment from reaching the Herring River flood plain. In addition, drainage has increased the rate of organic peat decomposition by aerating the sediment and caused sediment pore spaces to collapse. These processes have contributed to severe historic and continuing subsidence in the Herring River's diked wetlands.

STUDY AREA

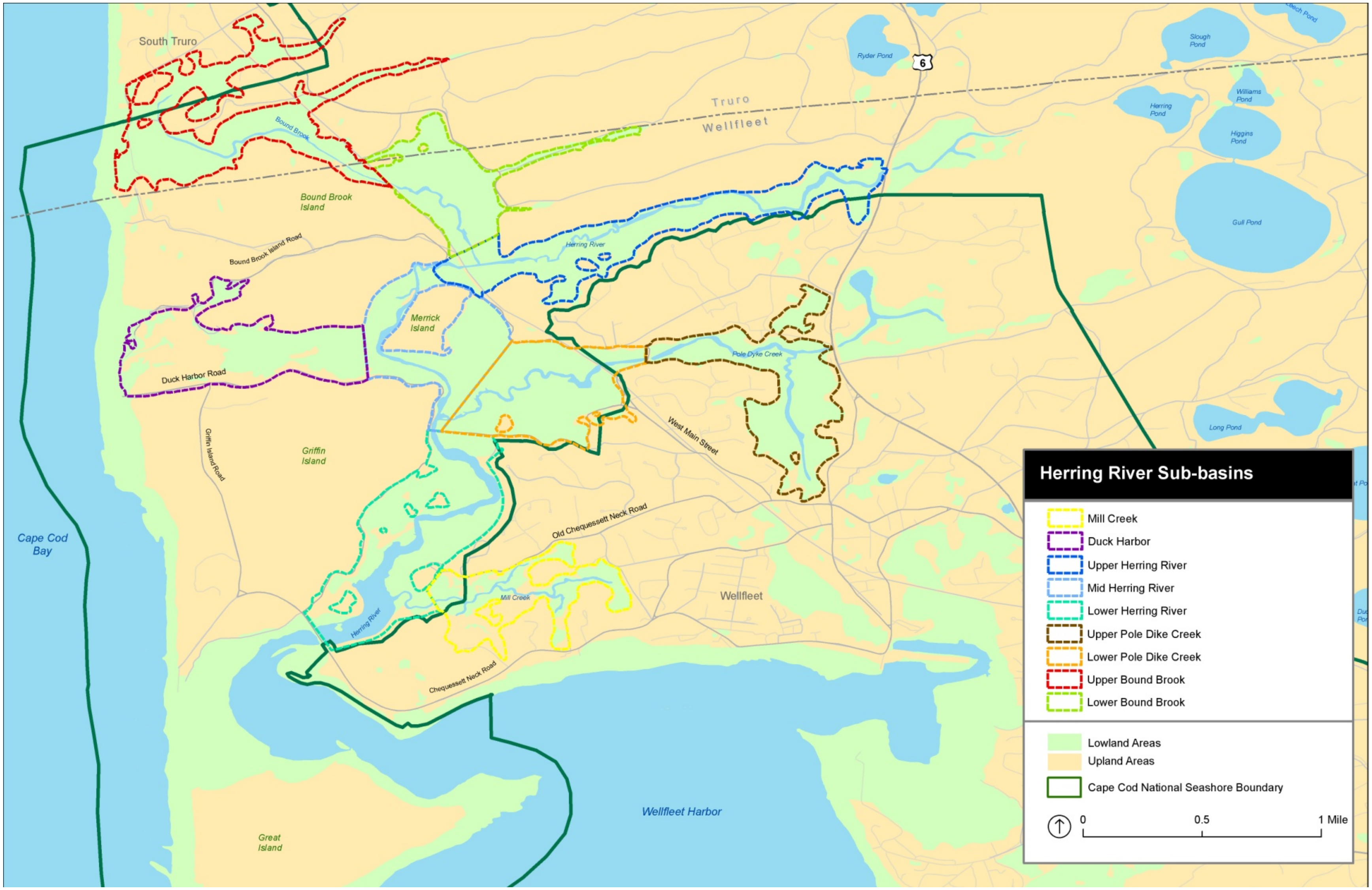
The geographic study area for this Statement of Findings is the Herring River estuary on Massachusetts' Cape Cod. The majority of the river's flood plain (approximately 80 percent) is within the boundary of Cape Cod National Seashore. The river itself extends from Wellfleet Harbor northeast for just under four miles to Herring Pond in north Wellfleet. The river system, generally defined by the landward limit of the historic flood plain of the river and its tributaries, encompasses approximately 1,100 acres.

In addition to the Herring River's upper, middle, and lower basins, the restoration project area is composed of important stream sub-basins (table 1 and figure 4). Each basin is distinct physically, chemically, and biologically, because of its elevation and distance from the Herring River and Wellfleet Harbor. Therefore, tidal restoration will influence each basin to a different degree.

TABLE 1. DESCRIPTION OF SUB-BASINS WITHIN HERRING RIVER RESTORATION AREA

Sub-Basin Name	Location and Acreage	Current Vegetation Type(s)
Herring River Basin	Approximately 396 acres are divided into three separate hydrologic units: Lower Herring River, Mid Herring River, and Upper Herring River.	The only remaining salt marsh in the Herring River system, approximately seven acres in size, is located just upstream of the dike in the Lower Herring River. The remaining sub-basin is dominated by non-native common reed (*Phragmites australis*) and freshwater wetland and upland species.
Mill Creek	This 80-acre sub-basin forms the southeastern portion of the project area, lying just upstream and east of the Chequessett Neck Road Dike.	*Phragmites* marsh and disturbed wooded wetland habitat cover much of the Mill Creek sub-basin. In the 100 years since the Herring River Dike was constructed, the CYCC and several private residences have been developed in the Mill Creek flood plain.
Pole Dike Creek	This sub-basin forms the east central portion of the project area, encompasses approximately 288 acres, and consists of two hydrologic units: Lower Pole Dike Creek and Upper Pole Dike Creek.	The sub-basin is dominated by mixed freshwater marsh. Private properties have been more intensely developed around the Upper Pole Dike Creek wetlands than in other Herring River sub-basins.
Duck Harbor	This 131-acre sub-basin basin extends west from the main stem of the Herring River to the Duck Harbor barrier beach. Today, Duck Harbor is separated from Cape Cod Bay by a vegetated duneline. Historic maps show a tidal channel connecting it to the bay as recently as 1848 (Tyler 1922).	Dry deciduous woodlands are typical in the eastern portion, while freshwater wetland shrubs dominate in the lower, wetter, western portion, except where the basin rises up to the barrier beach.

Sub-Basin Name	Location and Acreage	Current Vegetation Type(s)
Bound Brook	This 234-acre wetland extends to the north and west of Herring River above Old County Road. Consists of two hydrologic units: Lower Bound Brook and Upper Bound Brook. Today, Bound Brook is separated from Cape Cod Bay by a vegetated duneline. In the past, Bound Brook Basin was likely an estuary with a tidal connection to Cape Cod Bay.	Due to generally low elevations, the peat has remained saturated, albeit fresh, and the dominant vegetation is wetland shrubs and cattail.



Source: The Louis Berger Group, Inc., 2012.

FIGURE 4: HERRING RIVER SUB-BASIN MAP

DESCRIPTION OF WETLANDS WITHIN THE PROJECT AREA

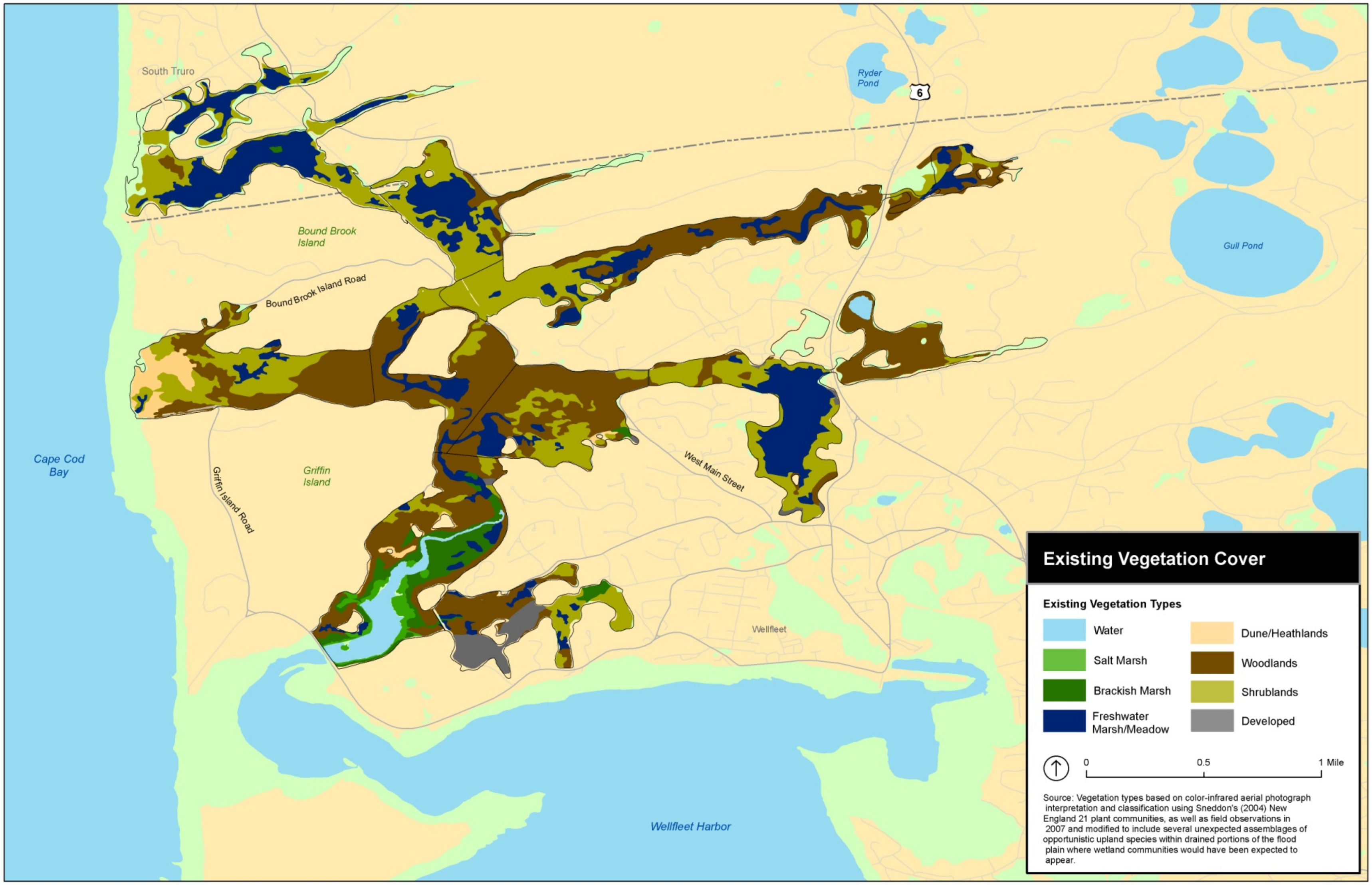
In order to achieve compliance with EO 11990, parks are directed to use the "Classification of Wetlands and Deepwater Habitats of the United States" (FWS/OBS-79/31; Cowardin et al. 1979) as the standard for defining, classifying, and inventorying wetlands. As a former extensive tidal marsh, the project area is currently comprised primarily of Palustrine (freshwater) wetlands with a smaller amount of remnant Estuarine (saltwater) in the lower sub-basins. Estuarine systems are those in which salinities during the period of average annual low flow exceeds 0.5 ppt (Cowardin et al. 1979). The project area also includes smaller areas of natural dune overwash onto former wetlands and developed areas (primarily golf course fairways on hydric soil).

Reduced salinity and marsh drainage have had a gradual but dramatic impact on the species composition of the Herring River salt marsh plant communities. Salt marsh plants, including salt marsh cordgrass (*Spartina alterniflora*), salt meadow cordgrass (*S. patens*), and salt meadow rush (*Juncus gerardii*) were denied their competitive edge over freshwater wetland species, such as cattail (*Typha* spp.). Cattail-dominated plant communities gradually replaced salt marsh vegetation. By the 1960s, continued drainage allowed upland grasses, forbs, and trees to replace cattails (Portnoy and Soukup 1982). Black cherry (*Prunus serotina*) and pitch pine (*Pinus rigida*) are now dominant in areas that were once naturally occurring salt marsh habitats. By the 1970s, much of the original Herring River was forest and shrublands dominated by opportunistic upland species (Portnoy and Soukup 1982). Concurrently, large portions of the original sub-tidal and intertidal substrates between the dike and High Toss Road had converted to monotypic stands of common reed (*Phragmites australis*).

No formal wetland delineation has been undertaken for the project area. However, the Seashore has vegetation cover type mapping for the project area. Table 2 and Figure 5 summarize existing vegetation types and classifications in the Herring River restoration area.

TABLE 2: EXISTING VEGETATION COVER TYPES WITHIN THE HERRING RIVER FLOOD PLAIN

Existing Cover Type	Existing Acreage	Cowardin Classification
Salt Marsh	13	E2EM1
Brackish Marsh	40	E2EM1
Freshwater Marsh/Meadow	222	PEM
Shrublands	299	PSS
Woodlands	403	PFO
Dune/Heathland	20	Upland
Developed	21	PEM
Total Area	**1,018-**	



Source: The Louis Berger Group, Inc., 2012.

FIGURE 5: CURRENT VEGETATION COMMUNITIES IN THE HERRING RIVER FLOOD PLAIN

Wetland Functional Assessment

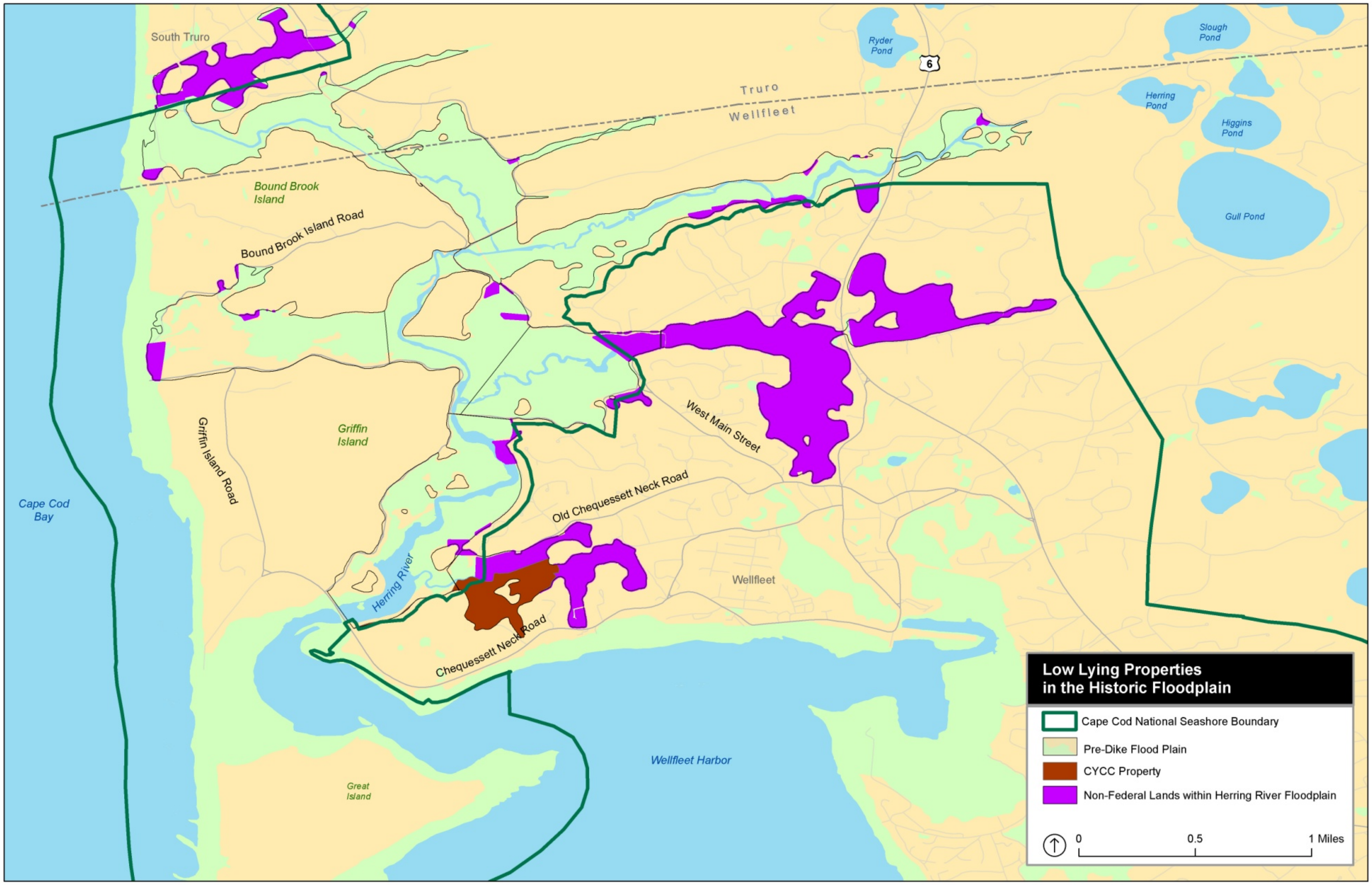
The United States Army Corps of Engineers (USACE) New England Division method for assessing wetland functions and values (The Highway Methodology Workbook Supplement, Wetland Functions and Values - a Descriptive Approach, USACE NED, 1999) considers many wetland functions and values as part of a Section 404 permit application. A functional assessment of the Herring River wetland complex up gradient of the Chequessett Neck Road Dike was conducted. A comparison of wetland functions and values under current conditions and following restoration implementation is provided under the impacts section.

DESCRIPTION OF FLOOD PLAINS WITHIN THE PROJECT AREA

The presence of the Chequessett Neck Road Dike has dramatically reduced flood plain functions in the project area. While the normal tidal range in Wellfleet Harbor just seaward of the dike is nine feet, the existing tidal range in the Herring River above the dike is only about two feet. As a result, seawater only reaches approximately 3,000 feet upstream of the dike. As a result, the project area has not been exposed to extreme high water events generally associated with northeaster (cold center cyclones) winter storms or other flood events as it would have been in a dike-free condition.

By eliminating flooding, the diking and drainage of the Herring River flood plain has allowed land uses and development of the former salt marsh and adjacent areas which would not be permitted today without regulatory oversight. Several dozen of these properties could potentially be affected by restored tidal exchange to some degree. The largest of these is the CYCC. Most of the other potentially affected properties are residential parcels within the Mill Creek and Upper Pole Dike Creek sub-basins.

A number of properties lie in the historic Herring River flood plain and may be affected by higher tide levels resulting from the restoration project. The area of the historic flood plain is approximately 1,100 acres. A total of 368 properties lie partially or fully within Herring River flood plain. These properties include private and municipal parcels; parcels owned by non-profit organizations; non-federal conservation land parcels; residential and commercial parcels (Town of Wellfleet 2009). In total, these parcels cover approximately 354 acres of land within the Herring River flood plain. Figure 6 identifies both NPS and non-NPS parcels within the flood plain.



Source: The Louis Berger Group, Inc., 2012.

FIGURE 6: LOW-LYING PROPERTIES IN THE HISTORIC HERRING RIVER FLOOD PLAIN

USE OF HYDRODYNAMIC MODELING TO DESCRIBE EXISTING CONDITIONS AND EXPECTED CHANGES

The Woods Hole Group developed a hydrodynamic model simulating the complexities of the Herring River system (WHG 2012). The model allows for the evaluation of specific questions regarding potential change to surface water elevations, flow velocities, salinity changes, and sediment processes in the estuary. Specifically, the numerical modeling has been used to evaluate the goals of the proposed project. Some of the modeling objectives include:

- Prediction of restored water surface elevations and salinities;
- Estimation of hydroperiod and wetting/drying of marsh surfaces;
- Assessment of potential change in the velocities and sedimentation patterns in the project area; and
- Assessment of impacts to low-lying properties and infrastructure.

Information regarding and results of the modeling process can be found in appendix C to the draft EIS/EIR (WHG 2012).

RANGE OF ALTERNATIVES ANALYZED

Alternative A: No Action – Retain Existing Tidal Control Structure at Chequessett Neck

Under alternative A, no action means that the existing 18-foot-wide structure composed of two flap gates and an adjustable tide gate would remain in place (shown in figure 2). Although no physical changes would be made, it is important to emphasize that "no action" is not a steady state. Physical factors acting on the dike will continue and the tide gates will entail maintenance costs during the next several years. Additionally, ecological conditions with the Herring River would continue to be affected by tidal restriction.

Alternative B: New Tidal Control Structure at Chequessett Neck – No Dike at Mill Creek

Under Alternative B, a 165-foot-wide series of culverts would be installed in the Chequessett Neck Road Dike to allow passage of Wellfleet Harbor tides (common to all action alternatives). The tide gates would be opened gradually and according to guidelines set forth in the Adaptive management plan with an objective to ultimately reach a mean high spring tide of 4.8[1] feet and 100-year storm driven tide of 6.0 feet in the Lower Herring River. These elevations reflect the maximum restoration possible without installing a secondary tidal control structure at Mill Creek and are based on the feasibility of addressing flood impacts within the Mill Creek sub-basin. Hydrodynamic modeling has demonstrated that a vertical tide gate opening of approximately three feet across the 165-foot culvert structure would result in this tidal regime. Tides in the upstream sub-basins would be lower because of natural tide attenuation.

This alternative would not require the construction of a dike at Mill Creek. Flood-proofing actions undertaken for the CYCC golf course and other low-lying properties would be designed to accommodate

---

[1] All tidal elevations cited are referenced to the North American Vertical Datum of 1988 (NAVD88), which in Wellfleet Harbor is approximately 0.3 feet above mean sea level and 5.2 feet above mean low water.

100-year storm driven tidal flooding up to 5.9 feet within the Mill Creek sub-basin and 5.3 feet in the Upper Pole Dike Creek sub-basin. The exact final maximum high tide elevations would be determined through the adaptive management process, but would not exceed these elevations.

Alternative B would also forego the ability to pursue higher inundation levels in the estuary as part of an adaptive management process. This would limit both horizontal effects (restored acreage) and vertical effects (restored elevation of the salt marsh surface) of tidal restoration.

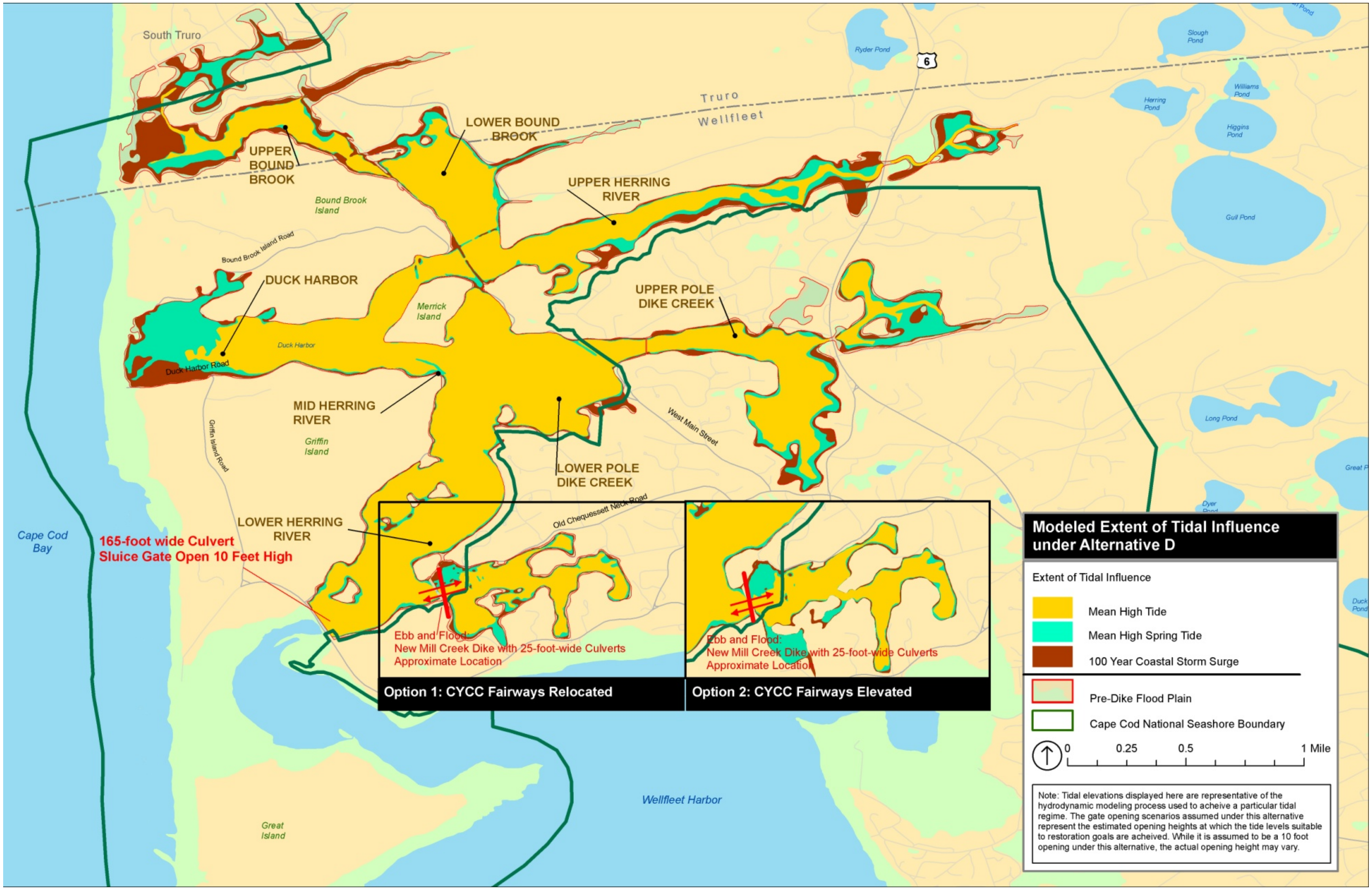
Alternative C: New Tidal Control Structure at Chequessett Neck – Dike at Mill Creek that Excludes Tidal Flow

Similar to the other action alternatives, tide gates at a rebuilt Chequessett Neck Road Dike would be opened gradually and in accordance to guidelines set forth in the Adaptive management plan. The objective for alternative C would be to fully open the gates to allow mean high water spring tides up to 5.6 feet and 100-year storm driven tides up to 7.5 feet in the Lower Herring River. These elevations reflect the maximum restoration feasible for most of the Herring River flood plain. A tidal exclusion dike would need to be constructed at the mouth of Mill Creek. Tides in the upstream sub-basins would be lower because of natural tide attenuation. Mitigation actions undertaken throughout the remainder of the Herring River estuary would be designed to accommodate flooding up to these maximum tidal elevations.

PROPOSED ACTION

Alternative D, the Preferred Alternative: New Tidal Control Structure at Chequessett Neck – Dike at Mill Creek that Partially Restores Tidal Flow

Tide elevations in the project area would reflect the maximum restoration possible for the majority of the Herring River flood plain (see table 3). The Chequessett Neck Road Dike would be reconstructed with a 165-foot tide gate opening that would be opened gradually and according to guidelines set forth in the adaptive management plan. The objective of alternative D is to fully open the gates to allow mean high water spring tides up to 5.6 feet and 100-year storm driven tides up to 7.5 feet in the Lower Herring River (see figure 7). Tides in the upstream sub-basins would be lower because of natural tide attenuation. With the exception of Mill Creek, mitigation measures undertaken throughout the estuary would be designed to accommodate flooding up to these maximum tidal elevations. Two options are possible under alternative D; Mill Creek option 1 would relocate portions of multiple low-lying golf holes to upland areas currently owned by the CYCC or, Mill Creek option 2 which would elevate the affected areas in place by filling and regrading. A new dike at the mouth of Mill Creek would be constructed to partially restore tidal flow to the sub-basin. Tidal flows would be *controlled* at this location using a combination tide gate to ensure mean high water spring tides to a maximum of 4.7 feet and 100-year storm driven events to a maximum of 5.9 feet in Mill Creek. Flood-proofing measures would be required for Mill Creek (e.g., golf course and private dwelling flood-proofing and well relocation). Alternative D, with Mill Creek option 2, which elevates the fairways and practice area at the CYCC, is the preferred alternative.



Source: The Louis Berger Group, Inc., 2012.

FIGURE 7. EXTENT OF TIDAL INUNDATION UNDER THE PREFERRED ALTERNATIVE FOR RESTORATION OF THE HERRING RIVER FLOOD PLAIN

Incremental Tidal Restoration and Adaptive Management

Reintroduction of tidal exchange would occur in phases over several years. Gradual opening of adjustable sluice gates would incrementally increase the tidal range and allow for monitoring so that unexpected and/or undesirable responses could be detected and appropriate response actions taken. Details of this process are described in appendix A.

The increased tidal exchange between the Herring River estuary and Wellfleet Harbor would change many characteristics of the flood plain. One of the most noticeable and desirable changes would be to the composition of plant communities. There would be a transition from one set of plant community types to another as changes occur to environmental parameters, such as tidal inundation, tide frequency, soil saturation, and most notably salinity. Management of flood plain vegetation would have the following objectives:

- Encourage re-establishment of *Spartina*-dominant marsh;
- Remove woody debris that might impede fish passage; and
- Remove large trees that will eventually die, topple and leave holes on the wetland surface where mosquitoes might breed.

Vegetation management activities would consist of cutting of the vegetation and processing and removal of the biomass that has been cut. Cutting would be accomplished with tools such as hand-held loppers, chain saws, mowers, brush hogs, or larger, wheeled or treaded machines that cut and chip. Removal would be accomplished by the sale of cut hardwood, removal of wood chips, and burning brush and branches.

Low-lying Roads and Culverts

Several segments of Pole Dike, Bound Brook Island, and Old County Roads where they cross the main Herring River and tributary streams are vulnerable to high tide flooding under the proposed restoration (ENSR 2007). To prevent this, road surfaces and culverts would need to be elevated or relocated. Preliminary engineering analysis shows that approximately 8,000 linear feet of road should be elevated to a minimum grade of 5.5 feet. Elevating these roads would also require widening the road bases and increasing culvert sizes. A second option for these road segments would be to relocate the alignment onto a nearby former railroad right-of-way. Preliminary engineering analysis shows this to be feasible with lower costs. Additional engineering studies and traffic analyses are needed to fully evaluate both of these options (CLE 2011).

Restoration of Tidal Channel and Marsh Surface Elevation

Several actions would be necessary to reverse other alterations of the system's topography, bathymetry, and drainage capacity. Diking and drainage have caused subsidence of the former salt marsh by up to three feet, reaches of the river have been channelized and straightened, mosquito ditches have been created, and spoil berms have been left along creek banks (HRTC 2007). These factors could limit or delay progress toward meeting the project objectives by inhibiting circulation of salt water, preventing recolonization of salt marsh vegetation, ponding fresh water, and expanding nuisance mosquito breeding habitat.

Several supplementary habitat management actions would be considered to address these issues. These actions and the conditions under which they would be employed are described and analyzed in detail in appendix A. In summary, potential actions include but are not limited to:

- Dredging of accumulated sediment to establish a natural bottom of the Herring River channel at the appropriate depth to maximize ebb tide drainage;

- Creation of small channels and ditches to improve tidal circulation;
- Restoring natural channel sinuosity;
- Removing lateral ditch dredge spoil berms and other anthropogenic material on the marsh surface to facilitate drainage of ponded water; and
- Applying a thin layer of dredged material to build up subsided marsh surfaces.

IMPACTS TO WETLANDS

Long-Term Impacts to Wetland Habitat and Vegetation

Restoration of the Herring River flood plain would result in the widespread change from degraded primarily freshwater (Palustrine) wetlands to Estuarine sub-tidal and inter-tidal habitats. Restored inter-tidal habitat subjected to higher salinity waters, generally 18 parts per thousand and higher, is expected to transition to salt marsh (E2EM1). However, lower salinities would likely occur on the periphery of the project area and in the upper reaches of many sub-basins where brackish (also E2EM1) and freshwater plants (Palustrine marsh, shrub swamp and forested wetland) are expected to persist. While changes in higher salinity areas are relatively clear and predictable, vegetation changes in restored inter-tidal areas with lower salinity are less certain and difficult to quantify.

To evaluate the changes in vegetation resulting from each of the action alternatives, the modeled areal extent of the mean high water spring tide was used to estimate the total area of restored inter-tidal habitat. The area of existing vegetation cover types affected up to the mean high water spring tide line for each alternative are summarized in table 3. In addition, a relatively small area of wetland-to-upland transitional habitat along the periphery of the mean high water spring tide line would be affected by AHW (the highest tide within a given year). Some vegetation change would be expected in these areas depending on the species present and the exact frequency and duration of tidal influence. The area encompassing the predicted limits of the mean high water spring tide line is greatest for alternative D option 1 (approximately 84 percent). This decreases to approximately 75 percent under alternative B option 2.

TABLE 3: AREA OF EXISTING WETLAND HABITAT AND VEGETATION COVER TYPES AFFECTED BY MEAN HIGH WATER SPRING TIDE FOR EACH ACTION ALTERNATIVE

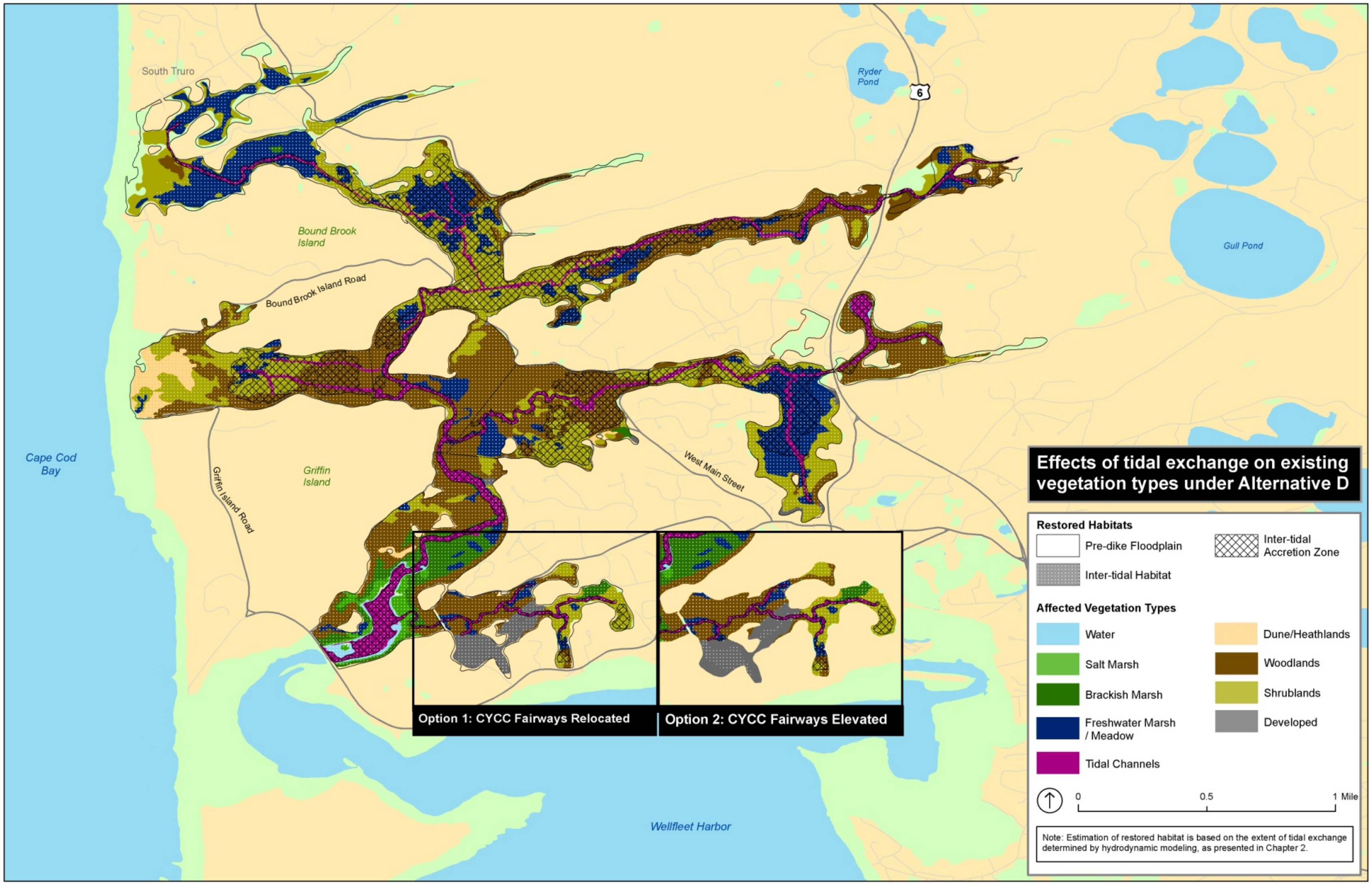
Existing Cover Type	Existing Acreage	Estimated Acreage				
		Alt B Option 1	Alt B Option 2	Alt C	Alt D Option 1	Alt D Option 2
Open Water	29	29	29	29	29	29
Salt Marsh	13	13	13	13	13	13
Brackish Marsh	40	39	39	37	40	40
Freshwater Marsh/ Meadow	222	176	178	189	194	196
Shrublands	299	203	204	217	231	232
Woodlands	403	314	314	321	342	342
Dune/ Heathland	20	6	6	14	14	14
Developed	21	17	7	0	17	7
Total Area	1047	797	790	820	880	873

[1] The extent of vegetation changes within sub-basins with limited tidal frequency and duration and lower salinities are less certain and difficult to quantify.

The majority of the project-wide restoration of inter-tidal habitat would occur within freshwater marsh/meadow, shrublands and woodlands. Approximately 79 to 88 percent of the existing 222 acres of freshwater marsh/meadow, 68 to 78 percent of the existing 299 acres of shrublands, and 78 to 85 percent of the existing 403 acres of woodlands would be encompassed by the predicted mean high water spring tide line. Lesser amounts of tidal habitat restoration would occur within brackish marsh, dune/heathlands, and developed lands. An increase in amount of developed lands encompassed by the predicted mean high water spring tide line from seven acres for alternative D, option 2 (elevation) to 17 acres for alternative D, option 1 (relocation) is primarily the result of the proposed raising of low-lying portions of the CYCC golf course with the preferred alternative. Habitat conditions would improve within the existing 42 acres of salt marsh or open water within the Lower Herring River sub-basin.

Under all of the action alternatives, there would be extensive vegetation change within the lower Herring River sub-basins. Over the long term, mean high spring tides with relatively high salinity levels would affect the existing freshwater and brackish marsh, woodland, and shrubland plant communities that have replaced the historic salt marsh habitats (see figure 7). This area would largely be restored to low and high salt marsh vegetative communities but would also include sub-tidal and inter-tidal channel habitats. The lowest of these areas would lie below mean low water if the current topography remains unchanged. However, sediment transport modeling indicates that these severely subsided areas are expected to receive large volumes of sediment as higher tides are incrementally restored. In the long term, these areas are anticipated to accrete and support salt marsh vegetation as the marsh surface reaches equilibrium with a restored tidal regime. A smaller portion of transitional habitat along the periphery of the sub-basins would be affected by annual high water. Some vegetation change would be expected in these areas depending on the species present and the exact frequency and duration of tidal influence.

Vegetation changes in the upper sub-basins would be limited in comparison to the lower sub-basins. Although most of these areas are thought to have been historically dominated by salt marsh vegetation, the relatively low mean high spring tidal elevations achieved by all the alternatives would not allow salt water to regularly propagate into these basins and salinity levels within both the channel and on the marsh surface are predicted to remain low (see figure 7). Although no salt marsh or brackish species likely would colonize the marsh surface under these conditions, pulses of tidally forced freshwater would favor the displacement of upland woodland species with vegetation more characteristic of a Palustrine wetland. The transitional habitat (extending up to annual high water) along the periphery of these upper basins would be expected to experience less habitat change as compared to the lower basins. Figure 8 and Table 4 summarize the anticipated wetland changes based upon the predicted extent of Mean High Water Spring.



Source: The Louis Berger Group, Inc., 2012.

FIGURE 8: RESTORED INTERTIDAL HABITAT COMPARED TO CURRENT VEGETATION COMMUNITIES IN THE HERRING RIVER FLOOD PLAIN

TABLE 4: ANTICIPATED VEGETATION CHANGE BY HERRING RIVER SUB-BASIN

Sub-basin	Summary of Vegetation Change	Summary of Changes in Wetland Type
Lower Herring River	There would be extensive vegetation change within the Lower Herring River sub-basin. Over the long term, tidal waters with salinity levels consistently in the mid-20s and higher would affect existing freshwater and brackish marsh (much of this area is dominated by Phragmites), woodland, and shrubland plant communities, which would be replaced by low and high salt marsh communities.	149 to 154 of the 162 acres in this sub-basin would transition to tidal marsh (E2EM1) over the long term.
Mill Creek	Salinity levels would consistently reach the mid-20s ppt and low and high salt marsh vegetation would eventually replace existing brackish marsh, freshwater marsh, shrubland, and woodland.	53 to 60 of the 72 acres in this sub-basin would transition to salt marsh (E2EM1) over the long term, depending on the flood mitigation strategy employed at the CYCC golf course. Alternative C would not impact existing vegetation within this subbasin.
Mid Herring River	Within the Mid Herring River sub-basin, vegetation changes would be significant under any of the action alternatives. Most of the change would occur within existing woodlands. Salinity levels would reach the mid-20 ppt range in, and within close proximity to, tidal channels, where existing woodlands and, to a lesser degree, shrublands and freshwater marsh, would be restored to low and high salt marsh.	85 to 87 of the 89 acres in this sub-basin would transition to salt marsh (E2EM1) over the long term.
Upper Herring River	Vegetation changes in the Upper Herring River would be limited compared to the lower sub-basins. Salinity levels in tidal channels could reach as high as 17 ppt and 14 ppt in portions of the marsh surface. Generally, higher salinities would occur closer to the channels and diminish landward. Uncertainty about salinity modeling in the upper sub-basins makes specific projections about vegetation change difficult.	104 to 113 of the 147 acres in this sub-basin would transition to salt marsh (E2EM1) over the long term.
Duck Harbor	Within the Duck Harbor sub-basin, vegetation changes would be extensive. Most of the change would occur within existing shrublands and woodlands. Salinity levels would reach the mid 20-ppt range in and within close proximity to tidal channels, where existing vegetated habitats would be restored to low and high salt marsh.	81 to 107 of the 129 acres in this sub-basin would transition to salt marsh (E2EM1) over the long term.
Lower Pole Dike Creek	There would be extensive vegetation change within the Lower Pole Dike Creek sub-basin. Over the long term, tidal waters with salinity levels consistently in the mid-20s and higher would affect existing freshwater marsh, woodland, and shrubland communities, which would be replaced by low and high salt marsh communities.	104 to 105 of the 109 acres in this sub-basin would transition to salt marsh (E2EM1) over the long term.

TABLE 4: ANTICIPATED VEGETATION CHANGE BY HERRING RIVER SUB-BASIN

Sub-basin	Summary of Vegetation Change	Summary of Changes in Wetland Type
Upper Pole Dike Creek	Vegetation changes in the Upper Pole Dike Creek sub-basin would be limited compared to the lower sub-basins. Salinity levels in tidal channels could reach as high as 12 ppt and 20 ppt in portions of the marsh surface. Uncertainty about salinity modeling in these upper sub-basins make specific projections about vegetation change difficult Generally, the salinity levels predicted by the model would not be high enough or occur consistently enough to support extensive salt marsh plant communities, although some salt marsh plants could appear proximate to the channels or portions of the marsh surface.	108 to 125 of the 146 acres in this sub-basin would transition to (E2EM1) salt marsh over the long term.
Lower Bound Brook	Within the Lower Bound Brook sub-basin, vegetation changes would be extensive under any of the action alternatives. Most of the change would occur within existing shrublands. Salinity levels would reach the mid 20-ppt range in and within close proximity to tidal channels, where existing shrublands and, to a lesser degree, woodlands and freshwater marsh, would be restored to low and high salt marsh.	67 to 71 of the 80 acres in this sub-basin would transition to (E2EM1) salt marsh over the long term.
Upper Bound Brook	Vegetation changes in the Upper Bound Brook would be limited compared to the lower sub-basins. Salinity levels in tidal channels could reach as high as 15 ppt. Uncertainty about salinity modeling in these upper sub-basins make specific projections about vegetation change difficult. Generally, the salinity levels predicted by the model would not be high enough or occur consistently enough to support extensive salt marsh plant communities, although some salt marsh plants could appear adjacent to and in close proximity of the channels.	39 to 56 of the 113 acres in this sub-basin would transition to (E2EM1) salt marsh over the long term.

Potential Changes in the Distribution of Phragmites

Intermediate salinity levels, between approximately five ppt and 18 ppt, could make some areas suitable for non-native common reed (*Phragmites australis*), particularly in the Bound Brook and the Upper Herring River sub-basins. Herbicide application would likely be used to reduce coverage of Phragmites prior to tidal restoration. As tidal exchange is restored, monitoring would be conducted to track vegetation change throughout the system. If Phragmites is observed to be expanding its range or colonizing new areas, management actions, including herbicide application, mechanical control, or hydrological (increased inundation and salinity) alterations could be implemented to limit or control its spread.

Woody Vegetation on the Flood Plain

Mortality of approximately 700 acres of shrubland/woodland vegetation is anticipated. Large volumes of standing dead and fallen woody debris may be undesirable because it could obstruct formation of tidal channels and delay the establishment of marsh grasses by decreasing seed dispersal and germination. Options for woody vegetation management include removal through cutting, chipping, and/or burning as well as processing the cut biomass (harvest for firewood or wood chips and burning brush and branches). A future vegetation management program would require the concurrence of landowners (both private and public) as well as regulatory agencies. The types of mechanized equipment allowed in the project area and time-of-year restrictions will be defined based on early findings of the adaptive management plan.

Impacts to Water and Sediment Quality

Restored tidal flushing is expected to reduce acidification, nutrient and fecal coliform concentrations and increase levels of dissolved oxygen in much of the project area. Tidal inundation would decrease the rate of aerobic decomposition and acid production within the soil while the pH of porewater and surface water would increase (Portnoy and Giblin 1997a). With restored salinities, aluminum and iron could no longer be leached from the soil in concentrations that stress aquatic life.

Tidewater residence times upstream of High Toss Road would be reduced by at least a factor of 25 (from 4,801 hours under current conditions to 191 hours after restoration flows are established) (see table 5). Regular tidal flushing of the Herring River estuary with well-oxygenated water from Wellfleet Harbor is expected to maintain dissolved oxygen concentrations above state water quality standards at all times. Adequate dissolved oxygen concentrations are expected to benefit migratory diadromous fish as well as resident fish and invertebrates.

TABLE 5: MODEL CALCULATED SYSTEM RESIDENCE TIMES* OF THE HERRING RIVER ESTUARY

Basin /Sub-basin	Alternatives	Residence Time (hrs)	Improved Flushing over Existing Conditions
Mill Creek with Wellfleet Harbor	No Action	12,553	
	D**	424	97%
Sub-Basins above High Toss Road with Wellfleet Harbor	No Action	4,801	
	D**	144	97%

Source; Woods Hole Group, 2011.

* System residence time is a measure of tidal exchange from a given sub-basin with Wellfleet Harbor

** Residence Times are identical for alternatives C and D; however, alternative C does not include tidal flushing in Mill Creek which would result in change from existing conditions.

During restoration, a tidal channel system would likely be re-established. Sediment would be mobilized in response to the increased volume of tidal exchange. Mobilized sediment is expected to mostly be transported upgradient onto the marsh surface and partially downgradient toward Wellfleet Harbor. Potential impacts on the aquatic ecosystem from chemicals bound to mobilized sediments will be assessed once background levels of pesticide have been determined by ongoing efforts of the Seashore.

Fecal coliform concentrations would be substantially reduced. Flushing rates would be increased (residence time would be decreased) (see table 5). Additionally, the survival time of fecal coliform bacteria would be reduced by higher salinity (e.g., Bordalo et al. 2002) as well as by higher dissolved oxygen and lower water temperature. Greatly reduced fecal coliform concentrations within Herring River and Wellfleet Harbor would likely allow for the removal of the river from the 303(d) list for impairment of pathogens increasing the potential for additional areas of shellfish beds to be reopened for harvesting.

IMPACTS TO WETLAND FUNCTIONS AND VALUES

As mentioned above, the USACE New England Division method for assessing wetland functions and values considers eight wetland functions and five wetland values. A comparison of the functions and vales provided by the Herring River wetland complex up gradient of the Chequessett Neck Road Dike is discussed below.

Floodflow Alteration (Storage/Desynchronization)

Wetlands can be important in the storage and desynchronization of floodwaters, protecting downstream resources from flood damage. Wetlands high in the watershed with constricted outlets or closed basins are generally important in capturing and detaining floodwaters. Other wetland characteristics that contribute to flood storage and desynchronization include broad flood plains and plant communities consisting of low, dense vegetation. Under existing conditions, broad, relatively flat local topography, large size, presence of ponded water, contiguous/branched channels, well vegetated flood plains, and numerous constricted outlets all contribute to the wetland complex's ability to retain floodwaters higher in the watershed. These physical characteristics would remain relatively unchanged under the action alternatives.

During coastal flooding events, any newly constructed dikes would continue to provide flood protection by meeting the Federal Emergency Management Agency's (FEMA) and other applicable agency requirements for construction and height (including necessary freeboard). As a result, the project area would be protected from extreme coastal floods. However with increased regular tidal exchange comes the opportunity to provide this function during some lesser storm events.

Fish and Shellfish Habitat (Aquatic Diversity / Abundance)

Large wetlands contiguous to a large, perennial stream or waterbody capable of supporting large fish and/or shellfish populations are important in providing Aquatic Diversity/Abundance. There are several factors that affect this function under existing conditions including water quality impairments and numerous barriers which limit fish movement. The restored estuarine waters and salt marsh would provide substantially more spawning and nursery habitat for both resident and transient fish species as well as for estuarine macroinvertebrates, greatly increasing their abundance and use of the estuary over existing conditions. The new dike at Chequessett Neck Road would provide improved fish passage for all fish including anadromous and catadromous species. Such changes coupled with improved water quality and access to the head waters of the river would likely enhance the river's herring run size and allow for the possible reintroduction of sea-run brook trout into the Herring River estuary. With increased salinity upstream of the dike, habitat for shellfish would also be enhanced.

Sediment / Toxicant Retention (Pollutant Attenuation)

Typically wetland systems with permeable soils that detain storm and flood waters and promote percolation reduce runoff rates sufficiently to allow sediments and adsorbed toxicants to settle from the water column. Diffuse channels, deep pools, and dense low vegetation are wetland characteristics that may also contribute to this process by slowing water velocities. While these characteristics are generally present under existing conditions, the waters associated with the wetland system have a number of water quality impairments. As mentioned above, restored tidal flushing is expected to reduce acidification, reduce nutrient and fecal coliform concentrations, and increase levels of dissolved oxygen in much of the project area. Tidal inundation is also expected to decrease the rate of aerobic decomposition and acid production within the soil which in the past has led to fish kills attributed to high acidity and aluminum toxicity.

The long-term water and sediment quality changes resulting from tidal restoration in the Herring River are generally positive and integral to achieving the ecological objectives of the proposed project. However, several potentially adverse effects on water and sediment quality are possible and, as such, will be components of a long-term monitoring program. Components included in the long-term monitoring program include but are not limited to:

- Continued low dissolved oxygen concentrations – Summertime dissolved oxygen levels could remain low in ponded areas until a tidal channel system becomes established. Targeted excavation of silted-in channels could be used to increase circulation and promote low-tide drainage.
- Temporary excessive release of nutrients – Renewed tidal flushing of acid sulfate soils would allow ammonium-nitrogen to be released into receiving waters in the short term (Portnoy and Giblin 1997a). Gradual reintroduction of tidal exchange is expected to allow ammonium-nitrogen to be slowly released (Portnoy 1999). Increased nutrient concentrations would likely be short-lived. Wellfleet Harbor is open to Cape Cod Bay and well-flushed, limiting the potential effects of temporary increases in nutrient loading.
- Elevated fecal coliform concentrations – Elevated bacteria concentrations could persist in upstream reaches of the system, particularly after rainstorms. Increasing salinity and flushing will reduce bacteria survival time and density prior to discharge into Wellfleet Harbor. Fecal coliform will continue to be monitored during the restoration process, particularly after rainstorms.

Nutrient Removal / Retention / Transformation (Pollutant Attenuation)

Wetlands can serve as a filter for the removal or detention of nutrients carried in surface water flows. Many wetland plants respond to high nutrient concentrations with accelerated uptake rates. Some nutrients are assimilated in plant material while others are trapped in organic sediments in wetlands by chemical, physical, and biotic actions. Typically wetlands designated as having nutrient removal functions are identified by the presence of large areas of open or ponded water with dense emergent vegetation, meandering streams with slow water velocities, and contiguous/branched channels. While these characteristics are generally present under existing conditions, the waters associated with the former Herring River estuary have a number of water quality impairments. Renewed tidal flushing of drained flood plain soils would allow nitrogen to be released into receiving waters in the short term. Over the long term, water and sediment quality changes resulting from tidal restoration in the Herring River are generally positive, integral to improving this wetland function, and the achievement of the ecological objectives of the proposed project.

Production Export (Nutrient)

Production export is the production of organic material and its subsequent transport out of a wetland to downstream areas or to deeper waters within the basin. This organic material is then added to the food chain where it is eaten by fish and other aquatic organisms. Wetlands with dense vegetation dominated by non-persistent emergent vegetation are important in supplying downstream wetlands with organic material. Wetlands dominated by shallow marshes with a perennial stream flowing from them are most important in providing production export. Wetlands designated as having production export functions are classified by the presence of high densities and diversity of hydrophytic vegetation, abundant fish and wildlife, and downstream/downgradient evidence of export. Under existing conditions, the function of production export is limited by the Chequessett Neck Road Dike configuration.

Wildlife Habitat

Factors that contribute to the provision of important wildlife habitat include large, undisturbed wetlands; the presence of shallow, permanent open water of good quality; proximity to undisturbed upland wildlife habitat; a high degree of interspersion of vegetation classes; a high degree of species and structural diversity within the vegetational community; high vegetation density; and the presence of wildlife food plants. Wetlands that are contiguous to other wetland areas may serve as travel or migratory corridors for wetland wildlife.

Even in its existing degraded state, the Herring River flood plain contains diverse habitats for a wide array of bird, mammal, reptile, and amphibian species. However, not undertaking the proposed project would result in the continued degradation of the Herring River estuary including continued encroachment of invasive plant species; loss of native plant communities and wildlife habitats; adverse impacts to water quality and associated effects to aquatic biota and associated water-dependent wildlife; and loss of natural wildlife habitat functions provided by the estuary.

Several high priority salt marsh- and tidal creek-dependent avian species are anticipated to benefit directly through restoration of nesting and/or foraging opportunities in the Herring River. Tidal restoration would also restore wetland and open-water habitats for resident and migratory waterfowl and shorebirds. Existing shrublands and woodlands dominated by upland vegetation, habitats widely used by generalist resident and migrating passerine species, would be reduced and replaced by tidally influenced brackish and freshwater marsh which would likely increase the amount and quality of habitat for wetland dependent avian species. Generalist populations would persist in the abundant uplands surrounding the project area and at the wetland/upland edge where some shrub thickets and relic tree stands would remain as suitable habitat after restoration.

Similarly, it is anticipated that adequate habitat elements (e.g., suitable food, cover, and den sites) would remain for most mammalian species as a result of tidal restoration. Initial restoration would result in gradual flooding of existing habitat and landward migration of many mammalian species. Affected species would likely readjust to the restored salt marsh system and shift their local range within and adjacent to the river and its flood plain. Eventual habitats for voles, mice, and other rodents would be dramatically expanded. As tidal restoration progresses, many mammals would continue to forage on the invertebrates, fish, and marsh vegetation and would continue to use surrounding wooded uplands for den sites and refugia. Increased tidal range and salinity coupled with restored marsh habitat may provide long-term benefits with improved water quality, more abundant and diverse prey species, and a more open, expansive habitat structure for mammals.

The Herring River flood plain also provides habitat for a variety of reptiles and amphibians such as snapping and spotted turtles and northern water snake. These species generally inhabit the freshwater areas upstream of High Toss Road but can also survive in brackish water and salt marsh habitats. Amphibians, such as green and wood frogs, Fowlers toad, and spotted salamander, generally are not present within high salinity portions of coastal environments and are more commonly found in the upper reaches of most sub-basins and in upland transitional habitats. Increases in tidal range and salinity associated with restoration may, in the short term, limit and disrupt reptile and amphibian breeding, foraging, and nesting in lower areas of the flood plain. However, these areas are less likely to be occupied initially and restoration will proceed at a gradual pace, allowing any affected populations to relocate to suitable habitat. In the long term, these populations are anticipated to shift and adjust their ranges with no significant declines in species diversity or abundance.

Uniqueness / Heritage / Listed Species

The Uniqueness/Heritage function includes the consideration of science, the endangerment of the wetland, and the importance of the wetland in the context of its local and regional environment. The wetland may contain areas of archaeological, historical, or social significance or it may represent the last fragment of its wetland type in an urbanized or agricultural environment. The presence of relatively scarce wetland habitats or wetland species contributes to the Uniqueness/Heritage function provided by the wetland. Areas containing Estimated Habitats of Rare Wildlife (Estimated Habitat) or Priority Habitats of Rare Species (Priority Habitat) mapped by the Massachusetts Natural Heritage and Endangered Species Program (NHESP) and/or federally-protected species confer a higher value in this category.

The Herring River is the largest tidal river and estuary complex on the Outer Cape and for that reason alone it is considered to provide this function. The restoration project as a whole would substantially improve this function by returning this important coastal ecosystem to a self-sustaining estuarine flood plain. With regard to listed species habitat, the restoration of tidal flow would increase salinity and inundation, resulting in changes to vegetation and ultimately wildlife species and their habitats. Tidal marsh restoration would likely allow for the recolonization of the protected diamondback terrapin in the Herring River. Changes in vegetation types would reduce the value of the wetland system for species that rely on habitats that are less salt-tolerant protected species, such as the Northern harrier, eastern box turtle, and water willow stem borer.

Restoration of the Herring River estuary could impact pre-contact and post-contact archeological sites, primarily associated with construction activities, as well as any other ground-disturbing activities, including borrow or construction staging areas. Although there are no listed historic structures in the Herring River estuary, a dike was located across Mill Creek near the confluence with the Herring River likely as part of a historical gristmill. Some low-lying structures may need further evaluation for historic significance. The precise location and extent of effects to archaeological sites cannot be fully identified at this time, as the design process is still ongoing, and the locations of ground-disturbing activities are not yet finalized. As these locations and actions are identified, potential impacts to archaeological sites will be assessed and any effects would be resolved through implementation of the Programmatic Agreement under Section 106 of the National Historic Preservation Act of 1966.

Recreation (Consumptive / Non Consumptive)

Wetlands designated as having recreational value are classified based on the suitability of the wetland and associated watercourses to provide opportunities such as hiking, canoeing, boating, fishing, and hunting, among others. Consumptive opportunities, such as fishing and hunting, consume or diminish the plants, animals, and/or other resources that are intrinsic to the wetland. Non consumptive opportunities do not diminish these resources of the wetland.

Numerous opportunities for public recreational activities, such as boating, fishing, and wildlife viewing, currently exist in the Herring River estuary. There are many recreational access points within the estuary, including parking areas, viewing locations, boat landings, and trailheads. Under the restoration project, this value would be enhanced through better access accommodations and improved habitat conditions. Both shellfishing and finfishing are important recreational activities throughout Wellfleet and outer Cape Cod and are an integral component of the region's natural and cultural history. Removal of the tidal restriction caused by the dike would dramatically improve habitat for the full range of fish species formerly found in the estuary and provide a corresponding improvement to the recreational fishery. Additionally, improvements to estuarine habitat and connectivity within Wellfleet Harbor would also improve the near shore fishery in Cape Cod Bay. The proposed project is anticipated to provide long-term benefits to shellfish populations and potentially provide increased opportunities for the harvesting of shellfish.

LONG-TERM IMPACTS TO FLOOD PLAINS

Although the proposed project would restore much of the natural tidal exchange water levels in the Herring River flood plain, any newly constructed dikes would continue to provide flood protection by meeting FEMA and other applicable agency requirements for construction and height (including necessary freeboard). As a result, the project area would be protected from extreme floods. However, with increased regular tidal exchange comes an increase in inundation levels associated with unusual storms. Under the preferred alternative, a 100-year storm event would inundate up to an elevation of 7.5 feet in the Lower Herring River and 5.9 feet in the Mill Creek sub-basin. Water levels in the upstream sub-basins would be lower because of natural tide attenuation. Flood protection actions undertaken throughout the estuary would be designed to accommodate flooding up to these maximum tidal elevations.

Chequessett Yacht and Country Club

All or portions of five CYCC fairways and the practice area would be impacted by tidal waters and require flood proofing. The preferred alternative would elevate the low lying golf holes and relocate the practice area to an upland site that would also serve as the borrow area for the fill needed to elevate the low-lying fairways. The current practice area would be restored to tidal wetland. This would result in filling 89,000 square feet (1.9 acres) that cannot be relocated due to its proximity to the clubhouse.

During flood proofing, use of the golf course would be interrupted, resulting in lost revenue to CYCC. After construction activities have been completed, the CYCC would have newer, improved golf holes, practice area, and appurtenances.

Low-lying Residential Properties

Hydrodynamic modeling results, aerial photography, topographic and ground survey data, and property records were used to compile a list of private properties within the project area potentially affected by restoration activities. Of the 322 properties that may be contacted by elevated tidewaters, 169 would experience no affect; 145 would experience impacts to natural vegetation; 2 would experience impacts to cultivated landscapes; and 20 would experience structural impacts. Impacts to properties were categorized based on the frequency of tidal water reaching the property and the nature of the land or structures impacted, as summarized in table 6.

TABLE 6: LOW LYING PROPERTIES AFFECTED BY RESTORATION OF THE HERRING RIVER

Impact Category	Number of Properties Affected	Description of Effect
No Affect	169	
Infrequent Effects on Natural Vegetation	54	Natural vegetation affected by tides, on average, one time per year or less frequently. Tidal influence would not be frequent enough to convert the vegetation type to salt or brackish marsh.

Impact Category	Number of Properties Affected	Description of Effect
Frequent Effects on Natural Vegetation	8	Natural vegetation affected by daily high tides or monthly high spring tides. This would stress and kill salt-intolerant species and convert the area to salt or brackish marsh.
Both Frequent and Infrequent Effects on Natural Vegetation	83	Parcels contain areas both above and below mean high spring tide. This would either temporarily or permanently stress salt-intolerant species to some extent.
Infrequent Effects on Cultivated Vegetation	1	Cultivated, landscaped vegetation affected, on average, one time per year or less frequently. Some species could be temporarily stressed, but would likely recover and persist.
Frequent Effects on Cultivated Vegetation	0	Cultivated, landscaped vegetation (affected by daily high tides or monthly high spring tides. This would occur frequently enough to stress and kill salt-intolerant species and convert the area to salt or brackish marsh.
Both Frequent and Infrequent Effects on Cultivated Vegetation	1	Parcels contain areas both above and below mean high spring tide. This would either temporarily or permanently stress salt-intolerant species to some extent.
Infrequent Effects on Structures	9	Buildings, driveways, private lanes, wells, and septic systems affected, on average, one time per year or less frequently. The potential for impacts would only occur during the highest predicted tide of the year or during coastal storm events.
Frequent Effects on Structures	11	Buildings, driveways, private lanes, wells, and septic systems affected, on average, by daily high tides or up to monthly high spring tides.

The NPS and HRRC are working with individual landowners on a case-by-case basis to determine site-specific mitigation needs. However no specific measures have been identified at this time and therefore cannot be quantified. It is anticipated that some of these actions would include the construction of a small berm or wall to protect a specific residential parcel, adding fill to a low driveway or lawn, and relocating a well or septic system, among others. Implementation of any of these measures would occur with close consultation of the landowners and would be subject to the regulatory review strategy and the adaptive management plan.

POTENTIAL SHORT-TERM ADVERSE IMPACTS TO WETLANDS AND FLOOD PLAINS

Implementation of the preferred alternative includes construction of two dikes to control tidal exchange in the Herring River flood plain, elevation or relocation of several road sections, installation of new culverts at road crossings in upstream project areas, and relocation or filling in place portions of the CYCC golf course. The various restoration actions included as components of restoration would result in short-term impacts and, in some cases, include a direct and permanent adverse impact to wetlands occurring within or adjacent to construction areas.

Construction activities would result in soil disturbance and loss of vegetative cover in the construction area. Heavy equipment may also be used in management of large wood debris during the adaptive management phase of the plan. This disturbance could lead to temporary adverse effects to water quality during stormwater runoff events. However, best management practices (BMPs) would be implemented to limit sediment movement and protect water quality. Areas of temporary disturbance, such as access roads and equipment and material staging areas, would be returned to natural grade and seeded with native vegetation.

Areas of disturbance that would persist after completion of the adaptive management phase include the areas occupied by (footprint of) infrastructure. As demonstrated in table 7, the expected footprint of the Chequessett Neck Road Dike, Mill Creek Dike, and road realignment actions (under alternative D) would result in up to 11 acres of long-term vegetation/wetland disturbance. This represents approximately one percent of the total restoration project area.

Secondary restoration actions are those needed to maximize the effects of restoring tidal flood beyond rebuilding the Chequessett Neck Road Dike and increasing tidal range. They include but are not limited to direct vegetation management, sediment management, channel improvements, and planting vegetation. Specific impacts associated with any of these actions cannot be quantified but are expected to include work within wetland areas to remove trees and shrubs, dredge and/or deposit sediment, excavate or fill channels, and other actions to maximize tidal circulation and hasten the recovery of native estuarine habitats. Some actions would include access for heavy equipment and similar wetland impacts. These activities would be similar to those of many regional mosquito control programs implementing Open Marsh Water Management or Integrated Mosquito Management in New England salt marshes.

Table 7 summarizes the anticipated acreage of short-term impacts anticipated from project actions.

TABLE 7. TEMPORARY AND PERMANENT WETLAND AND FLOOD PLAIN DISTURBANCE RESULTING FROM THE HERRING RIVER RESTORATION PROJECT

Location	Short-term Disturbance	Long-term Disturbance	Note
Chequessett Neck Road Dike	Up to 2.4 acre construction foot print (coffer dam, dewatering)	Up to 800 linear feet permanent intertidal (E2UB/EM) and sub-tidal (E1UB) habitat loss, if dike crest elevated (estimate up to one acre)	Final design of dike would determine width at the dike base and the total acreage occupied by the structure
Mill Creek Dike	Up to 2.4 acre construction footprint (coffer dam, dewatering)	Up to 12,500 square feet (approximately 0.3 acres) permanent estuarine (E2EM1) and palustrine (PEM/ PSS) permanent wetland loss	Final design of dike would determine the total acreage occupied by the structure
High Toss Road	Approximately 20 feet width of disturbance along 1,000 foot length of causeway (0.5 acre)	Up to 13,000 square feet (approximately 0.3 acres) palustrine (PEM/ PSS) permanent wetland loss if elevated; Up to 12,000 square feet (approximately 0.28 acres) gain of restored estuarine (E2EM1) wetland if removed	Independent of alternatives
Pole Dike/Bound Brook Island Roads	Construction corridor of approximately 20 feet along 6,200 linear feet adjacent to vegetated wetlands (2.85 acres)	Up to 4,000 square feet (0.1 acre) palustrine (PEM/ PSS) permanent wetland loss to elevate above 100-year storm surge, 2,300 square feet (just over 0.05 acre) lost to elevate to annual high water	Independent of alternatives

Location	Short-term Disturbance	Long-term Disturbance	Note
CYCC Golf Course		Elevation Option: 360,000 square feet (8.26 acres) wetland loss (most is existing maintained golf course- Palustrine wet meadow), ~5 acres potentially sensitive archeological resource disturbance Relocation Option: 89,000 square feet (just over 2 acres) Palustrine wet meadow wetland loss (all is existing maintained golf course), ~30 acres potentially sensitive archeological resource disturbance	Applies to alternatives B and D
Residential Flood Proofing	To be determined with input from landowners but could include wetland fill for elevation, berms, or walls		
Secondary Restoration Actions	Specific impacts cannot be identified or quantified at this time, but are expected to include work within wetland areas to remove trees and shrubs, dredge and/or deposit sediment, excavate or fill channels, and other actions to maximize tidal circulation and restoration benefits; would likely include access by heavy equipment for some restoration actions		
Total Disturbance Area	Minimum of 8.15 acres of temporary vegetation/wetland disturbance plus that needed to implement vegetation management during adaptive management phase	Up to approximately 11 acres of long-term deep water and wetland disturbance for dike(s), road elevation or realignment, and culvert installation	

The long-term water and sediment quality changes resulting from tidal restoration in the Herring River would generally be positive and are integral to achieving the ecological objectives of the proposed project. However, several potentially adverse effects to water and sediment quality are possible and as such will be included as components of a long-term monitoring program. Components included in the long-term monitoring program would include but not be limited to:

- Continued low dissolved oxygen concentrations – Summertime dissolved oxygen levels could remain low in ponded areas until a tidal channel system becomes established. Targeted excavation of silted-in channels could be used to increase circulation and promote low-tide drainage.
- Temporary excessive release of nutrients – Renewed tidal flushing of acid sulfate soils would allow ammonium-nitrogen to be released into receiving waters in the short term (Portnoy and Giblin 1997a). Gradual reintroduction of tidal exchange should allow ammonium-nitrogen to be slowly released (Portnoy 1999). The increase in nutrient concentrations would likely be of

relatively short duration. Wellfleet Harbor is open to Cape Cod Bay and well-flushed which limits the potential effects of temporary increases in nutrient loading.

- Increased turbidity – Sediment and soil could be mobilized during the reconstruction of the dike and in other areas of construction, potentially resulting in local increases in turbidity in adjacent water bodies. BMPs would be required and would include erosion control measures as well as maintenance of the current rate of tidal exchange through the dike.
- Elevated fecal coliform concentrations – Elevated bacteria concentrations could persist in upstream reaches of the system, especially after rainstorms. Increasing salinity and flushing will reduce bacteria survival time and density prior to discharge into Wellfleet Harbor. Fecal coliform would continue to be monitored during the restoration process, particularly after rainstorms.
- Porewater sulfide concentrations depress salt marsh plant colonization and growth – Flooding of the lowest organic sediments with seawater could result in elevated porewater sulfide, especially in areas with poor low-tide drainage. Porewater sulfide levels and salt marsh plant colonization will be monitored in these low areas. As part of the adaptive management plan, some channel excavation may be required to improve low-tide drainage and, consequently, peat aeration and sulfide oxidation.

COMPLIANCE

Compliance with Section 404 off the Clean Water Act and Section 10 of the Rivers and Harbors Act

Several components of the Herring River Restoration Project would include unavoidable impacts to wetlands under federal jurisdiction, primary by the discharge of fill into waters of the United States. These actions include but are not limited to the reconstruction of the Chequessett Neck Road Dike, potential construction of a dike at Mill Creek, work to elevate or otherwise flood-proof low-lying roadways, and potentially fill places in low-lying areas of the CYCC golf course. Given the nature and extent of these impacts to wetlands under USACE jurisdiction, it is anticipated that compliance under Section 404 and Section 10 would require the filing of an Individual Permit verses being eligible for review under a Massachusetts General Permit. A permit application for the discharge of dredged and/or fill material in waters of the United States is evaluated using the Environmental Policy Act's (EPA) Section 404(b) (1) guidelines. These guidelines are designed to avoid unnecessary filling of waters and wetlands. For the guidelines to be satisfied:

- There must be no practicable alternatives available which would have less adverse impact on the aquatic ecosystem and which do not have other significant adverse environmental consequences;
- The activity must not violate federal or state water quality standards or threaten a federally-listed endangered species;
- There must be no significant degradation of water and wetlands; and
- All reasonable steps must be taken to minimize adverse effects to the aquatic environment.

Action undertaken to restore the Herring River estuary will comply with the requirements of Section 404 of the Clean Water Act, Section 404(b) (1) guidelines, and Section 10 of the Rivers and Harbors Act.

Compliance with Section 401 off the Clean Water Act

Section 401 of the Federal Water Pollution Control Act of 1972 (Clean Water Act or CWA) requires that any applicant for a Section 404 (dredge and fill) permit also obtain a water quality certification from the state. The purpose of the certification is to confirm that the discharge of fill materials would comply with the state's applicable water quality standards. Section 401 gives the authority to the states either to concur with USACE approval of a section 404 permit or to place special conditions on the approval, or deny the activity by not issuing a 401 certification. Compliance with Section 401 would be addressed through Massachusetts Regulation and Consultation and Water Quality Certification prior to the implementation of project construction.

Compliance with the Coastal Zone Management Act of 1972, as amended

The Commonwealth of Massachusetts' Office of Coastal Zone Management implements the Coastal Zone Management Act (CZMA) through the Coastal Zone Management Policy Guide (October 2011) – the current official statement of the Massachusetts coastal program policies and legal authorities. Under the CZM program, all MEPA projects are reviewed for consistency with the management principles of CZM, which are intended as guidance for any activities proposed in the Coastal Zone. The overall goal of coastal zone management is to protect coastal resources from contamination or degradation, prevent the creation of coastal hazards, and maximize the public use and benefit of coastal areas. Compliance with the Massachusetts CZM will be achieved through review of this draft EIS/EIR chapter 5 (see section 5.3.5).

CONCLUSION

Wetlands

Long-Term Changes to Wetland Habitats

The project to restore the Herring River salt marsh habitats is consistent with the NPS policies and mandates to protect and improve wetland habitats in our nation's national park units as expressed in NPS Procedural Manual 77-1: Wetland Protection and under EO 11990: Protection of Wetlands. The proposed action would, over time, restore tidal inundation to up to 880 acres of degraded freshwater wetland habitats. This would be accomplished by construction of two new dikes – one at the main mouth of the Herring River and one at the Mill Creek sub-basin – and gradual increase of tidal elevations using an adaptive management approach (appendix A). Construction of these dikes, and other flood mitigation measures, would result in long-term loss of up to 11 acres of wetland habitat

Widespread change from degraded primarily freshwater (Palustrine) wetlands to Estuarine sub-tidal and inter-tidal habitats would be expected to occur over the several-year adaptive management period. Restored inter-tidal habitat subjected to higher salinity waters, generally 18 parts per thousand and higher, is expected to transition to salt marsh (E2EM1). The majority of the project-wide restoration of inter-tidal habitat would occur within freshwater marsh/meadow, shrublands and woodlands. Approximately 79 to 88 percent of the existing 222 acres of freshwater marsh/meadow, 68 to 78 percent of the existing 299 acres of shrublands, and 78 to 85 percent of the existing 403 acres of woodlands would be encompassed by the predicted mean high water spring tide line. Lesser amounts of tidal habitat restoration would occur within brackish marsh, dune/heathlands, and developed lands. An increase in amount of developed lands encompassed by the predicted mean high water spring tide line from seven acres for alternative D, option 2 (elevation) to 17 acres for alternative D, option 1 (relocation) is primarily the result of the proposed raising of low-lying portions of the CYCC golf course with the preferred alternative. Habitat conditions would improve within the existing 42 acres of salt marsh or open water within the Lower Herring River sub-basin. Lower salinities would likely occur on the periphery of the project area and in the upper reaches of many sub-basins where brackish (also E2EM1) and freshwater plants (Palustrine marsh, shrub swamp and forested wetland) are expected to persist.

The anticipated change from degraded primarily freshwater (Palustrine) wetlands to Estuarine sub-tidal and inter-tidal habitats preferred alternative (alternative D option 2) would include approximately 196 acres of freshwater marsh/meadow, 232 acres of shrublands, and 342 acres of woodlands. Habitat conditions would improve within the existing 42 acres of salt marsh or open water as well as 40 acres of brackish marsh and seven acres of CYCC fairways developed on wetland soils.

The construction of two new dikes – one at the main mouth of the Herring River and one at the Mill Creek sub-basin and other flood mitigation measures would result in long-term loss of up to 11 acres of wetland habitat. However, the increase in wetland function resulting from the restoration of 859 acres of degraded wetlands to estuarine intertidal emergent wetland (E2EM1) more than compensates for the 11 acres of wetland lost to infrastructure impacts that are necessary to implement the project and satisfy's the NPS no-net-loss policy with respect to no-net-loss of wetland functions as allowed for in NPS Procedural Manual 77-1: Wetland Protection).

Short-Term Impacts of Construction and Adaptive Management

Construction activities would result in soil disturbance and loss of vegetative cover in the construction area (see table 7, above). Heavy equipment may also be used in management of large wood debris during the adaptive management phase of the plan (appendix A). This disturbance could lead to temporary adverse effects to water quality during stormwater runoff events. However, best management practices (BMPs) would be implemented to limit sediment movement and protect water quality. Areas of temporary disturbance, such as access roads and equipment and material staging areas, would be returned to natural grade and seeded with native vegetation.

Areas of disturbance that would persist after completion of the adaptive management phase include the areas occupied by (footprint of) infrastructure. As demonstrated in table 7, the expected footprint of the Chequessett Neck Road Dike, Mill Creek Dike, and road realignment actions (under the preferred alternative) would result in up to 11 acres of long-term vegetation/wetland disturbance. This represents approximately one percent of the total restoration project area.

Floodplains

Long-Term Changes to Floodplain Functions

The project to restore the Herring River salt marsh habitats is consistent with the NPS policies and mandates to protect floodplain functions in our nation's national park units as expressed in NPS Procedural Manual 77-2 Floodplain Management and EO 11988: Floodplain Management. The project would increase regular tidal inundation across approximately 90 percent of the former Herring River tidal estuary. In addition, storm surges would reach higher elevations (7.5 feet in the Lower Herring River than under current conditions (2.1 feet in the Lower Herring River), restoring a portion of historic flood plain function under extreme events. However, full inundation of the historic 100-year flood plain would not be practicable because of development within and adjacent to the historic flood plain flood.

Up to 368 adjacent properties may be contacted by elevated tidewaters; 177 would experience no affect to structure or landscape; 149 would experience impacts to natural vegetation; 22 would experience impacts to cultivated landscapes; and 20 would experience structural impacts. Impacts to properties were categorized based on the frequency of tidal water reaching the property and the nature of the land or structures impacted. The NPS and HRRC are working with individual landowners on a case-by-case basis to determine site-specific mitigation needs.

Short-Term Impacts of Construction and Adaptive Management

Construction activities would result in soil disturbance and loss of vegetative cover in the construction area (see table 7, above). Heavy equipment may also be used in management of large wood debris during the adaptive management phase of the plan (appendix A). This disturbance could lead to temporary adverse effects to water quality during stormwater runoff events. However, best management practices (BMPs) would be implemented to limit sediment movement and protect water quality. Areas of temporary disturbance, such as access roads and equipment and material staging areas, would be returned to natural grade and seeded with native vegetation.

REFERENCES

Bordalo, A.R., R. Onrassami, and C. Dechsakulwatana

2002 Survival of faecal indicator bacteria in tropical estuarine waters (Ba River, Thailand). *J. Appl. Microbiol*., v. 93, p. 864-871.

Buchman, M.F.

2008 NOAA Screening Quick Reference Tables, NOAA OR&R Report 08-1, Seattle, WA, Office of Response and Restoration Division, National Oceanographic and Atmospheric Administration, 34p.

CLE Engineering, Inc. (CLE)

2011 Herring River Restoration Project Low-Lying Roads Report and Presentation, DRAFT. Prepared for the Cape Cod National Seashore. CLE Engineering, Inc. located in Marion, Massachusetts.

Cowardin, Lewis M.

1979 Classification of Wetlands and Deepwater Habitats of the United States. U.S. Department of the Interior, Fish and Wildlife Service, Office of Biological Services, Washington, D.C.

Curley, J.R., R.P. Lawton, D.K. Whittaker, and J.M. Hickey.

1972 A study of the marine resources of Wellfleet Harbor. Division of Marine Fisheries, Department of Natural Resources, the Commonwealth of Massachusetts, Monograph series number 12. 37 p.

ENSR Corporation (ENSR)

2007 Herring River Restoration Project- Low-lying Roadways Review and Discussion. Prepared for Herring River Technical Committee. Wellfleet, MA. June 25, 2007. Document No.: 04479-003-100.

Herring River Technical Committee (HRTC)

2006 Full Report of the Herring River Technical Committee. January 3, 2006.

2007 Herring River Tidal Restoration Project. Conceptual Restoration Plan. Report prepared for the Towns of Truro and Wellfleet and the Cape Cod National Seashore.

Hyland J.L. and H. Costa.

1995 Examining linkages between contaminant inputs and their impacts on living marine resources of the Massachusetts Bay ecosystem through application of the sediment quality triad method. Massachusetts Bays Program, MBP-95-03. Prepared by Arthur D. Little.

National Park Service

2004 Procedural Manual 77-2: Floodplain Management, U.S. Department of the Interior, National Park Service.

2012 Procedural Manual 77-1: Wetland Protection, U.S. Department of the Interior, National Park Service.

Portnoy, J.W. and J. Allen

2006 Effects of tidal restrictions and potential benefits of tidal restoration on fecal coliform and shellfish-water quality. *Journal of Shellfish Research*. 25(2):609–617.

Portnoy, J.W.

1999 Salt marsh diking and restoration: Biogeochemical implications of altered wetland hydrology. *Environ. Management*, v. 24, p. 111-120.

Portnoy, J.W. and A.E. Giblin

1997a Effects of historic tidal restrictions on saltmarsh sediment chemistry. *Biogeochemistry*. 36:275–303.

1997b Biogeochemical effects of seawater restoration to diked saltmarshes. *Ecological Applications*. 7:1054–1063.

Quinn, J.G., R.W. Cairns, P.C. Hartman, and J.W. King

2001 Study of organic contaminants in coastal ponds and marshes, Cape Cod National Seashore. Long-term Coastal Ecosystem Monitoring Program, Cape Cod National Seashore, Wellfleet, Massachusetts.

Town of Wellfleet

2009 Wellfleet Assessors Database, 2009. Accessed at: http://www.assessedvalues.com/index.zhtml?jurcode=318 on November 21, 2011.

Woods Hole Group

2011 Hydrodynamic Modeling Data for Herring River Restoration Plan. Prepared for the Cape Cod National Seashore.

As the nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering wise use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historic places, and providing for the enjoyment of life through outdoor recreation. The department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people. The department also promotes the goals of the Take Pride in America campaign by encouraging stewardship and citizen responsibility for the public lands and promoting citizen participation in their care. The department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

(2012)

National Park Service
U.S. Department of the Interior

U.S. Fish & Wildlife Service
U.S. Department of the Interior

Town of Wellfleet,
Massachusetts

Town of Truro,
Massachusetts

National Oceanic and Atmospheric Administration
U.S. Department of Commerce

Commonwealth of Massachusetts
Division of Ecological Restoration

Natural Resources Conservation Service
U.S. Department of Agriculture