Environmental Assessment

Muddy Creek Restoration Bridge Project

Towns of Chatham and Harwich, Massachusetts

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This Environmental Assessment becomes a federal document when evaluated and signed by the responsible Federal Officials.

2 July 2015
Date

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Executive Summary

This Environmental Assessment (EA) addresses a proposal by the U.S. Fish and Wildlife Service (Service) and project partners to restore Muddy Creek, a degraded and tidally restricted coastal wetland in the Towns of Chatham and Harwich, Massachusetts. This EA evaluates alternatives for tidal restoration within the 55-acre Muddy Creek Basin, inclusive of associated wetlands and a 1.5-mile-long tidal creek. The purpose of the Muddy Creek Bridge Restoration Project (Project) is to restore natural tidal flow and estuarine habitats, improve water quality, enhance fish passage, and reduce flood risk to public and private infrastructure during future storms.

This EA evaluates alternatives for tidal restoration of Muddy Creek and assesses the impacts that could result from the continuation of existing conditions (No Action Alternative) or implementation of two Action Alternatives. This EA has been prepared in accordance with the National Environmental Policy Act (NEPA) of 1969, the regulations of the Council on Environmental Quality (CEQ) for implementing NEPA [40Code of Federal Regulations (CRF) 1500-1508], and the implementing regulations (36 CFR 900).

Under the Proposed Action, existing undersized culverts at the Massachusetts Route 28 crossing of Muddy Creek will be replaced with a 22-foot-wide open channel within a 94-foot-long single span bridge to fully restore tidal exchange between Pleasant Bay and Muddy Creek. Re-establishing natural tidal flow will restore the primary ecological processes that shape and sustain coastal wetlands, restoring Muddy Creek from a degraded brackish wetland to a fully functional tidal wetland benefiting native salt marsh plant species, fish and shellfish populations, fish passage, instream habitat, and water quality, while concurrently improving coastal community resilience to storms.

The Proposed Action will have negligible, if any, impacts on air quality, soundscapes, land use, socioeconomics, energy resources, geology, lightscapes, Indian Trust resources, scenic resources, and prime and unique farmlands or cultural resources pursuant to Section 106 of the National Historic Preservation Act (16 W.S.C. 470f).

The Proposed Action will temporarily impact 69,600 square feet and 700 linear feet of coastal wetland, and permanently alter 1,900 square feet of salt marsh. Permanent impacts have been minimized to the greatest extent practicable and will ultimately result in an overall enhancement of the resources within the entire Muddy Creek system.

The Project team is made up of the following Federal, State, and local agencies, organizations, and groups: the Service, Massachusetts Department of Fish and Game's Division of Ecological Restoration, the Town of Chatham, the Town of Harwich, the Pleasant Bay Alliance, CDR Maguire, GZA GeoEnvironmental Consultants Inc., and Applied Coastal Research and Engineering, Inc.

The Service finds there will be no significant impacts resulting from the proposed restoration activities of the Project. The Proposed Action provides net benefits that far outweigh its potential impacts on the natural and human environment. Therefore, the

Service concludes that a Finding of No Significant Impact (FONSI) be issued for the proposed project.

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1.0 Introduction

This Environmental Assessment (EA) addresses environmental impacts associated with the Muddy Creek Restoration Bridge Project (Project). The Project is an ecological restoration effort undertaken by the Towns of Harwich and Chatham (Towns), Massachusetts, in partnership with the Massachusetts Division of Ecological Restoration (MassDER), Cape Cod Conservation District, and the U.S. Fish and Wildlife Service (Service) Partners for Fish and Wildlife Program. The Project is partially funded by the U.S. Department of the Interior through the Disaster Relief Appropriations Act of 2013 (Hurricane Sandy Relief) and a Service-funded National Coastal Wetlands Conservation Grant.

The goal of the Project is to restore natural tidal flow and improve water quality to benefit salt marsh and other wetland resources of Muddy Creek (a.k.a. Monomoy River). Tidal flow is currently impeded by two restrictive stone culverts located under Massachusetts Route 28, which convey flow between Muddy Creek and Pleasant Bay. The Preferred Alternative will construct a 94-foot-wide single-span bridge in place of the existing culverts and earthen embankment to permanently restore tidal exchange between Muddy Creek and Pleasant Bay. Improvements to tidal flow will restore more than 55 acres of Massachusetts Department of Environmental Protection (MassDEP)-regulated salt marsh and other estuarine wetland habitats, thereby providing benefits to wildlife, fish and shellfish and concurrently improving ecological and infrastructure resilience to future coastal storms.

In addition to the benefits of ecological restoration, the project will re-establish public waterway access between Muddy Creek and Pleasant Bay for non-motorized vessels and will provide public pedestrian access along Route 28 between two existing public beaches. The Project will provide infrastructure improvements to the management of stormwater. Implementation of the Project will involve the temporary closure of Massachusetts State Route 28, installation of temporary water control measures, excavation of the roadway embankment, demolition of the existing culverts, construction of a tidal creek channel, installation of a single-span bridge over Muddy Creek, and post-construction grading and restoration plantings.

1.1 Background

Muddy Creek is located in Barnstable County (Cape Cod), Massachusetts. The centerline of Muddy Creek is the town boundary between Harwich and Chatham, Massachusetts. The Creek is approximately 1.5 miles long from its headwaters to its confluence with the main basin of Pleasant Bay (Figure 1). Pleasant Bay is a 9,000-acre estuarine system that is designated as an Area of Critical Environmental Concern (ACEC) by the Commonwealth of Massachusetts. As a sub-embayment of Pleasant Bay, Muddy Creek is within the ACEC. Under existing conditions, Muddy Creek encompasses approximately 55 acres of degraded wetlands, and supports a limited diadromous fish run, limited shellfish resources, and provides foraging habitat for the State-endangered common tern

(*Sterna hirundo*). The adjacent upland provides breeding habitat for the Eastern box turtle (*Terrapene carolina*), a State Species of Special Concern.

Figure 1. Aerial overview of Muddy Creek, Harwich and Chatham, Massachusetts.

Route 28 crosses Muddy Creek where it meets Pleasant Bay, providing north-south road access between the Towns. A bridge existed at the site up to the turn of the 20th century, when it was replaced with an earthen dike and culvert system. Today, the roadway sits atop a 20-foot-tall earthen embankment with hydrologic connectivity between Muddy Creek and Pleasant Bay provided by two rectangular stone culverts. Each culvert is approximately 30 inches wide and 45 inches tall and is approximately 100 feet long. The culverts are severely undersized and restrict daily high tides landward of the road, adversely impacting salt marsh health and water quality. The severe restriction of tidal exchange exacerbates the adverse impacts to salt marsh and water quality due to bacterial contamination from storm run-off and wildlife sources, and nitrogen loading from watershed land uses. Sustained impairment in Muddy Creek has been linked to degraded water quality and wetlands, fish, shellfish and avian habitats and has led to the long-term closure of Muddy Creek to shellfishing.

The goal of the Project is to reverse Muddy Creek's poor water quality and degraded habitats by restoring tidal exchange to the entire Muddy Creek basin. Currently, daily tides are restricted by as much as 2 feet, and water residence times exceed 3.9 days. When the Project is complete, near natural tidal flows will be restored to Muddy Creek. Water surface elevations will mirror those in Pleasant Bay, and water residence time will be reduced to 0.5 day (Applied Coastal Research and Engineering, Inc. [ACRE] 2009).

1.2 Purpose and Need

An earthen embankment and associated culvert system at the Route 28 crossing over Muddy Creek severely restrict tidal flow from Pleasant Bay to Muddy Creek, adversely impacting the 55-acre coastal wetland. In addition, the prolonged tidal restriction has contributed to degradation of water quality in Muddy Creek, particularly as land development during the last century within the watershed has intensified. Water quality concerns in Muddy Creek include nutrient loading from watershed land uses, and bacterial (fecal coliform) contamination from stormwater runoff and wildlife sources. Total Maximum Daily Loads (TMDLs) have been issued for bacteria and total nitrogen. The TMDL for fecal coliform was established in 2005. In 2006, TMDLs for total nitrogen were established for upper and lower Muddy Creek, respectively. Muddy Creek is currently on the Environmental Protection Agency (EPA) 303(d) list as a Category 4(a) water body under the Massachusetts Year 2014 Integrated List of Waters, meaning that Muddy Creek is designated as impaired or threatened for one or more uses.

Over the past two decades, the communities of Harwich and Chatham have observed how sustained impairment of water quality in Muddy Creek has diminished the health of wetlands, encompassing important fish, shellfish and avian habitats. A once robust quahog bed in lower Muddy Creek also has been degraded by poor water quality, leading to a prohibition on the taking of shellfish upstream of Route 28 beginning in 1995, and harvest restricted to only the cold weather months seaward of the Route 28 crossing. Restricted tidal flow has resulted in depressed salinities, particularly in upper Muddy Creek (<13 parts per thousand [ppt]). This has led to conversion of salt tolerant wetland species (*i.e., Spartina*) to freshwater and brackish wetland species, including common reed (*Phragmites australis*), a non-native, invasive species. In 2003, the sustained degradation prompted the Towns, along with the Pleasant Bay Alliance (Alliance), to begin exploring comprehensive strategies to restore resource health in Muddy Creek. The Alliance is an organization formed by the Towns of Orleans, Chatham, Harwich and Brewster to oversee the resource management plan for Pleasant Bay.

The purpose of this Project is to restore approximately 55 acres of coastal wetland through restoring natural tidal flow to the Muddy Creek system. These efforts will result in improved water quality within Muddy Creek and restoration of salt marsh and shellfish beds, and improved habitat and connectivity for fish, including migratory species such as the American eel (*Anguilla rostrata*) and alewife (*Alosa pseudoharengus*).

1.3 Project Partners and Chronology of Studies

The Muddy Creek Restoration Bridge Project builds on a decade of public actions undertaken by the Towns, the Alliance, MassDER, the Cape Cod Conservation District and the Service to study ways to restore water quality and wetland habitat in Muddy Creek, while concurrently increasing resiliency to future coastal storms.

In 2008, the Alliance petitioned MassDER to name the Muddy Creek restoration as a Priority Wetlands Restoration Project. The Muddy Creek restoration was designated a Priority Wetlands Restoration Project in 2012.

In 2008, the Alliance commissioned the School for Marine Science and Technology (SMAST) at UMASS Dartmouth to evaluate the construction of a mid-embayment dike to partition Muddy Creek into lower and upper sub-basins. The study found that nitrogen attenuation in upper Muddy Creek would increase 30 percent with a water control structure in place and indicated that bioactive nitrogen concentrations would decrease 11.6 percent in the lower basin of Muddy Creek below the water control structure, due to an increase tidal flushing.

In 2009, MassDER commissioned hydrodynamic modeling to determine the optimal inlet size necessary to restore tidal exchange. Modeling indicated that a single 24-foot-wide opening would fully restore tidal exchange and maintain optimal current velocities to prevent shoaling within the new channel.

In 2010, the Alliance commissioned the SMAST at UMASS Dartmouth to assess changes in water quality resulting from a 24-foot-wide rectangular opening. Significant water quality improvements were demonstrated as a result of the wider opening due to increased tidal flushing and associated reduction in water residence time from 3.9 days to 0.5 day.

In 2011, the Towns and the Alliance obtained funds from the Cape Cod Conservation District through the Cape Cod Water Resources Restoration Project to study impacts to wetlands, shellfish, finfish, rare species and water quality associated with a new 24-foot-wide tidal opening. The study confirmed that a wider opening would significantly improve degraded wetlands, water quality and the overall ecological health in Muddy Creek without negatively impacting the rest of Pleasant Bay (Fuss and O'Neill 2012). This report also concluded that the excessive nitrogen levels in Muddy Creek could be improved by replacing the existing culverts with a larger channel that would increase tidal flushing.

The study (Fuss & O'Neill 2012) also incorporated analysis of design alternatives for achieving the targeted tidal exchange associated with a 24-foot-wide opening. Design alternatives were assessed based on restoration benefits, construction impacts, public access through the channel opening, cost and feasibility of construction. Through this process, construction of a bridge with a restored creek channel was selected as the preferred alternative. Additional hydrodynamic modeling was undertaken to identify the trapezoidal channel configuration with the same hydraulic effects as the 24-foot rectangular opening. It was determined that a trapezoidal channel with a 22-foot bottom width and 1.7:1 side slope would result in tidal characteristics comparable to the 24-foot rectangular opening. A 94-foot span was necessary to traverse the channel.

In the spring of 2012, the Towns agreed to pursue the building of the bridge as a joint project. In 2012, the Towns entered into an inter-municipal agreement to undertake the bridge as a joint project, and allocated funds for bridge design and permitting, and for the

identification and pursuit of potential grant sources. A request for proposals for design and permitting services was issued in late 2012, and a contract for services was awarded to CDR Maguire in March 2013.

Since 2013, the Project has been undergoing engineering design and permitting. The Project is subject to MGL Chapter 85, Section 35, requiring review of the Project design for conformance with the AASHTO Bridge Design Specifications and Massachusetts Department of Transportation (MassDOT) Standards. The Project received 25 percent design approval from MassDOT in April 2015. Final (100 percent) design plans were submitted to MassDOT in May 2015, and it is expected that MassDOT will issue its final approval and issue an Access Permit by July 2015 once all environmental permits are in place.

Numerous State and Federal environmental permits are in process for this Project. To date, the Project has received the following permits and determinations:

- Massachusetts Historical Commission (MHC) – determination that the Project is unlikely to affect significant historic or archaeological resources (2012);
- Massachusetts Environmental Policy Act (MEPA) - A Public Benefit Determination, Final Record of Decision and Secretarial Certificate from the Executive Office of Environmental Affairs for the Notice of Project Change (April 2014);
- Massachusetts Division of Fisheries and Wildlife, Natural Heritage and Endangered Species Program - A "No Take" Determination (March 2014);
- Orders of Condition from the Town of Chatham Conservation Commission and from the Town of Harwich Conservation Commission, respectively (April 2015); and
- Massachusetts Coastal Zone Management - determination that No Individual Consistency Review is required.

The following permits have been filed, with determinations expected in July 2015:

- Chapter 91 Waterways Public Waterways License Application to MassDEP;
- Section 401 Water Certificate Application to MassDEP; and
- Section 404 Clean Water Act Application under the Massachusetts General Permit Category 2 Application to U.S. Army Corps of Engineers.

2.0 Alternatives Considered

Over the past decade, the Towns, the Alliance, and other Project partners have reviewed the previously completed studies (see Section 1.3) and evaluated several alternatives to improve water quality, wetland resources and habitat within Muddy Creek. This EA evaluates the following three alternatives:

Alternative 1: Channel and Bridge Construction (Proposed Action) - Complete Tidal Restoration – Culvert replacement with a 22-foot wide open channel with 1.7:1 side slopes and 94-foot-long single-span bridge.

Alternative 2: No Action – Retain existing MA Route 28 embankment and restrictive stone culverts.

Alternative 3: Tidal Segregation – Reconstruction of an historic embankment and sluice gate across the middle of the Muddy Creek Basin to segregate Muddy Creek into two basins, *i.e.*, saltwater lower basin and freshwater upper basin. This would increase tidal flushing of the lower basin, while providing for enhanced nitrogen attenuation in the freshwater upper Muddy Creek Basin (see Figure 1).

2.1 Alternative 1: Channel and Bridge Construction (Proposed Action)

This alternative (Proposed Action) would fully restore tidal hydrology to Muddy Creek through replacement of the existing undersized 3-foot-by-4-foot culverts and a portion of the Route 28 earthen embankment with a 22-foot bottom width channel with 1.7:1 side slopes, constructed within a new 94-foot-long single-span steel bridge. Hydrodynamic analysis was used to determine the optimal size of the hydraulic opening to restore tidal hydrology and maintain sufficient flow velocities to avoid silt deposition in the channel.

A design alternatives analysis (Fuss & O'Neill 2012) was conducted to compare resource benefits, construction costs, life expectancy, construction impacts to the environment, construction timeline, and aesthetics. The design team examined four design alternatives: pre-cast concrete box culverts; pre-cast three-sided culvert; deck beam bridge on cast in place abutments over a 24-foot-wide channel; and a deck beam bridge on cast in place abutments over a trapezoidal channel.

The deck beam bridge over a trapezoidal channel obtained the highest ranking among the alternatives tested. This option recorded the lowest construction cost, lowest negative impact on adjacent wetlands, and highest score for public access through the inlet. This design concept is being advanced as the Proposed Action by the Project proponents.

More detail on proposed construction methods for the Proposed Action is found in Appendix A.

2.2 Alternative 2: No Action

NEPA regulations require measuring all alternatives against a future condition without the Project. In this case, no action means that the existing, twin 3-foot-by-4-foot stone culverts would remain in place, and no tidal restoration would occur. Although no changes to infrastructure would occur, it is important to emphasize that "no action" is not a steady state from an environmental prospective.

With no change in tidal flow, there would be no improvement in water quality. In fact, bacterial and nitrogen loads from surrounding land uses and wildlife would continue and concentrations of these pollutants could increase. Progress toward achieving TMDLs for either bacteria or total nitrogen would be foregone and the creek would be expected to remain as impaired on the EPA 303(d) list. The Towns, which are in different stages of planning and implementing wastewater management infrastructure to achieve total nitrogen TMDLs for Muddy Creek and the remaining Pleasant Bay watershed, would need to increase the amount of wastewater infrastructure necessary to achieve threshold nitrogen concentrations.

Without an increase in tidal exchange, salinity concentrations would continue to be depressed in upper Muddy Creek as freshwater inflows remain the dominant source of inflowing water. The freshwater character of upper Muddy Creek would aid in the attenuation of nitrogen to some extent, but this attenuation would not compensate for the higher nitrogen concentrations experienced throughout the Muddy Creek system due to restricted tidal flow.

Without improvements to water quality and increased salinity due to the restoration of tidal influence in upper Muddy Creek, the benefits to estuarine wetland resources, including the colonization and restoration of salt marsh and other estuarine wetland vegetation, would not take place. The No Action Alternative would not improve passage for diadromous fish, shellfish habitat, or improve the degraded water quality. The replacement of freshwater and invasive vegetation due to increased salinity also would not occur and enhanced public access to Muddy Creek would not be achieved. Additionally, ecological and infrastructure resiliency to future coastal storms would not occur.

2.3 Alternative 3: Segregation of Upper Muddy Creek

In this alternative, an earthen dike and sluiceway system would be reconstructed in the upper watershed to impound freshwater for the purposes of enhancing nitrogen attenuation. This alternative would utilize the location of a former cranberry bog embankment and sluiceway system destroyed during the 1938 Hurricane (see Figure 1). Prior to its destruction, the embankment and sluiceway served to manage water levels in commercial cranberry bogs located upstream.

This approach, to segregate Muddy Creek into an impounded freshwater wetland upper basin and tidally influenced lower basin, was proposed to the Towns by SMAST at UMASS Dartmouth in 2008 as a cost-effective means to improve water quality within Muddy Creek.

SMAST examined the potential water quality and habitat benefits that could result from reinstallation of a water control structure at that site. The SMAST report, entitled a *Resource Assessment to Evaluate Ecological and Hydrodynamic Responses to Reinstalling a Water Control Structure in the Muddy Creek Dike* (2008), modeled water quality improvements to upper Muddy Creek. The study found that nitrogen attenuation

in upper Muddy Creek would increase 30 percent with a water control structure in place. Improvements to water quality were not modeled in lower Muddy Creek. However the study indicated that water quality would be expected to improve in the lower basin also, since segregation would significantly increase tidal flushing of the lower basin. Residence time would be reduced and water quality would improve. Increased tidal flushing and improved water quality would in turn help to restore shellfish habitat over time.

SMAST also looked at the response of wetland resources, and provided wetland delineations in the Muddy Creek system. SMAST's study indicated that some expansion of salt marsh could occur in lower Muddy Creek due to improved tidal exchange. In upper Muddy Creek, lower salinities would result in a transition of any salt or brackish communities to freshwater wetland resources.

The public's response to the segregation of Muddy Creek into two sub-basins, including nearby property owners, area conservation organizations, and some regulatory agencies, was overwhelmingly negative. Concern focused on the potential for stagnant and degrading bacterial water quality conditions in upper Muddy Creek. Loss of marine habitat and marine wetland resources also was raised as a significant concern, leading to questions about the ability to obtain permits for this approach. Overall, the potential water quality benefits from freshwater nitrogen attenuation were viewed as very modest in comparison to strong public opposition and regulatory resistance to loss of coastal wetlands. **This restoration approach was abandoned and therefore the alternative was eliminated from further evaluation and consideration as a viable alternative.**

2.4 Environmentally Preferred Alternative

From the three alternatives evaluated, the removal of existing culverts and installation of a single-beam steel bridge over a restored channel was selected as the environmentally preferred alternative. A channel with a 22-foot bottom width and 1.7:1 side slopes provides hydraulic effects comparable to the 24-foot-wide culvert opening.

The environmental advantages of this approach over the other two alternatives evaluated include:

- restoration of the entire 55-acre tidal wetland complex;
- improvements in water quality, through reductions in concentrations of nitrogen and bacteria;
- no adverse water quality impacts to the remaining Pleasant Bay system;
- restoration of coastal wetlands, including salt marsh and other estuarine wetlands;
- reduction in density of invasive non-native vegetation;
- improved shellfish habitat,
- improved fish habitat and improved passage for diadromous species;
- improved habitat for migratory birds, including waterfowl, wading birds and shorebirds;

- improved opportunities for shellfishing;
- improved recreational water access between Muddy Creek and Pleasant Bay; and
- improved ecological and infrastructure resiliency in the face of future coastal storm events.

3.0 Affected Environment

This section describes the current condition of natural resources, existing structures and cultural resources located in and around Muddy Creek in the vicinity of the Muddy Creek Restoration Bridge Project.

3.1 Natural Resources

Muddy Creek is a 55-acre estuarine wetland resource area within the State-designated Pleasant Bay ACEC. This tidal river extends approximately 1.5 miles from its headwaters to its confluence with Pleasant Bay at the site of the existing culverts located under Route 28.

The centerline of Muddy Creek serves as a boundary between the Towns. Land use adjacent to lower Muddy Creek in Harwich is predominantly undeveloped and in ownership of the Harwich Conservation Trust or Town of Harwich. Moderately dense residential development is located adjacent to upper Muddy Creek in Harwich. Land south of Muddy Creek in Chatham is developed predominantly as single-family residences.

3.1.1 Area of Critical Environmental Concern

The Pleasant Bay watershed consists of more than 15,000 acres of land located in four towns. The greater Pleasant Bay watershed is comprised of sub-watersheds and sub-embayments. Muddy Creek is a sub-embayment of the 9,000-acre Pleasant Bay ACEC which encompasses the basins of Big and Little Pleasant Bay, several tidal ponds and rivers, and eleven freshwater ponds, each with hydrological connections to the Bay. The Muddy Creek sub-embayment is partitioned into the upper Muddy Creek watershed and the lower Muddy Creek watershed.

3.1.2 Water Quality

As part of the Pleasant Bay ACEC, Muddy Creek is classified by Massachusetts Surface Water Quality Standards (314 CMR 4.05(4)) as Outstanding Resource Waters (Class SA). Class SA waters are to provide excellent habitat value for fish, other aquatic life and wildlife, including migration, growth, reproduction and other critical life stages. Where designated for shellfishing, these waters are to support shellfish harvesting without need for purification. Class SA waters are also intended for primary and secondary recreation, and excellent aesthetic value.

Over the past century, restricted tidal exchange and intensified land uses within the Muddy Creek watershed have exacerbated water quality concerns. Muddy Creek is currently on the EPA 303(d) list as a Category 4(a) water body under the Massachusetts Integrated List of Waters, meaning that Muddy Creek is designated as impaired or threatened for one or more uses (MassDEP 2012). Three TMDLs have been established for Muddy Creek. One is for fecal coliform bacteria, and two for Total Nitrogen. More detail on these TMDLs is provided below.

3.1.2.1 Bacterial Contamination

In Massachusetts, fecal coliform is the indicator organism for protecting shellfish from bacterial contamination and the bacterial TMDL for Muddy Creek specifically addresses fecal coliform. Bacterial water quality data used to develop the TMDL were collected by Town of Chatham, the Massachusetts Division of Marine Fisheries (MassDMF), and SMAST from 1985-2003 (Fuss & O'Neill 2012).

The TMDL assessment concluded that summer bacterial inputs to Muddy Creek were greater than winter inputs, especially at the Route 28 culvert and the upstream portions of Muddy Creek. Because fecal coliform levels exceed the Massachusetts water quality standards for shellfishing habitat, Muddy Creek has been closed to shellfishing since 1995 (MassDEP 2005; Fuss & O'Neill 2012).

3.1.2.2 Total Nitrogen

Since 2000, the Alliance has been monitoring water quality including nitrogen concentrations throughout Pleasant Bay.[1] The Alliance maintains two water quality monitoring stations in Muddy Creek: one in lower Muddy Creek, and one in upper Muddy Creek. Summary analysis of data collected over the first eight years of the program (2000-2008) showed that water quality at both Muddy Creek stations was highly eutrophic with dissolved oxygen often well below the level specified for Class SA waters.

The data generated by the Alliance were used by the Massachusetts Estuaries Project (MEP) to determine threshold concentrations and required watershed nitrogen load reductions that would be needed to achieve the thresholds. The threshold bioactive nitrogen concentration and load removal calculations were used by MassDEP to establish TMDLs for nineteen locations in Pleasant Bay. Separate TMDLs were established for upper and lower Muddy Creek, respectively (Bowles 2007). The TMDLs call for substantial reductions in watershed septic loading to achieve nitrogen threshold levels in upper and lower Muddy Creek.

1 More information on the Pleasant Bay Citizen Water Quality Monitoring Program is found on the Alliance website: www.pleasantbay.org (accessed June 2015).

3.1.3 Hydraulic Conditions

3.1.3.1 Tidal Benchmarks

Tidal exchange between Muddy Creek and the main basin of Pleasant Bay is severely restricted by the existing embankment and culvert system. Table 1 provides tidal benchmarks for Pleasant Bay and Muddy Creek under existing conditions and shows the tidal attenuation created by the restrictive culverts at the Route 28 crossing. High tides within Muddy Creek are up to 2 feet lower, and low tides are up to 2.5 feet higher, than in Pleasant Bay. The mean tide range within Muddy Creek is approximately 0.6 feet, whereas the mean tide range in Pleasant Bay is 4.2 feet.

Table 1. Tidal Benchmarks for Pleasant Bay and Muddy Creek, Existing Conditions

	Pleasant Bay (feet, NAVD88)	Muddy Creek With Existing Culverts (feet, NAVD88)
Spring Tide	4.0	2.0
Mean High High Water	3.3	1.6
Mean High Water	3.0	1.6
Mean Low Water	-1.2	1.0
Mean Low Low Water	-1.4	1.0
Minimum Tide	-1.5	1.0

Source: Applied Coastal Research and Engineering, Inc. December 2011

3.1.3.2 Flood Elevations

Route 28 over Muddy Creek is a low-lying roadway susceptible to coastal storm overwash, and is overtopped by storms exceeding the intensity of the 10-year return interval storm (Federal Emergency Management Agency [FEMA 2014]). During the 100-year return interval storm, when predicted FEMA stillwater elevations reach 13.9 feet (NAVD88), Route 28 would be 5.9 feet under water (Table 2). During large storm events, inundation of Route 28 and its overtopping by flood flows quickly overcome any tidal restriction created by undersized culverts, and the Muddy Creek Basin equilibrates with Pleasant Bay, with floodwaters propagating unimpeded throughout the system. When the storm surge abates, floodwaters are retained by the restrictive culverts and embankment and it takes several days for water to drain to Pleasant Bay.

Table 2. Effective (2014) FEMA Flood Profiles for Muddy Creek (feet, NAVD 88)

Hydraulic Connection	10-Year	50-Year	100-Year	500-Year
With Existing Culverts	4.7	12.4	13.9	17.0

Source: FEMA (2014)

3.1.4 Wetlands

Muddy Creek is a 55-acre tidal basin stretching approximately 1.5 miles from its headwaters to its confluence with Pleasant Bay. The basin is narrow and steeply sloped, except near its headwaters, where the basin broadens and supports a number of fringing fresh and brackish wetlands. The entire basin was once completely tidal, but modifications in the 19th and early 20th centuries to facilitate cranberry cultivation significantly altered tidal hydrology. Cranberry operations have long since been abandoned and the former cranberry cells have reverted to a mix of fresh and brackish emergent wetland and shrub swamp.

Muddy Creek can be broadly divided into an upper and lower basin, the divide located at a narrows midway in the drainage. An earthen dike and sluiceway were constructed at this location in the late 1800s to exclude tidal influence to facilitate cranberry cultivation in the upper basin (see Figure 1). The dike was destroyed during the 1938 hurricane.

The lower basin, downstream of the remnant dike, is flanked by steeply sloping banks that grade quickly to a pitch pine – oak woodland. A narrow band of wetland vegetation boarders the lower basin and is a mix of salt marsh halophytes smooth cordgrass (*Spartina alterniflora*), brackish species including the invasive common reed (*Phragmites australis*), and freshwater wetland shrubs including highbush blueberry *(Vaccinium corymbosum*), wild raisin (*Viburnum cassinoides*) and shadbush (*Amelanchier* sp.). All grade quickly to forested upland. The exception is along the Route 28 embankment where the wetland community is more extensive and includes 2.7 acres of salt marsh and fringing shrub and forested swamp.

The upper basin, upstream of the relic dike, broadens into an extensive complex of brackish and freshwater emergent wetlands and shrub and forested swamp. Much of the upper basin was once in cranberry production, and these areas are crossed by the lateral and perimeter ditches typical of cranberry cultivation. Common species include red maple (*Acer rubrum*) winterberry (*Illex verticillata*) highbush blueberry, sweet pepperbush (*Clethra alnifolia*) wild raisin, narrow-leaved cattail (*Typha angustifolia*), broad-leaved cattail (*Typha lattifolia*), and sensitive fern (*Oneclea sensibilis*). In addition, extensive stands of invasive, non-native *Phragmites* dominate many areas.

The wetland community seaward of Route 28 is unaffected by tidal restriction and is a classic coastal community including sandy beach, dune, tidal flat, and salt marsh.

MassDEP classification of the 55-acre Muddy Creek system includes 34 acres of Land Under Water, 18.6 acres of Bordering Vegetated Wetlands (BVW), and a small (<3-acre) area of salt marsh located near the Creek's confluence with Pleasant Bay (Table 3).

Table 3. Existing DEP Wetland Cover and Resource Area Types

Wetland Vegetation Classification	Resource Area Type	Area
Open Water	Land Under Water	32.1 acres
Deep marsh	Land Under Water	1.9 acres
Salt Marsh	Salt Marsh	2.7 acres
Shallow Marsh / Fen	BVW	2.0 acres
Shrub Swamp	BVW	13.4 acres
Wooded Swamp Coniferous	BVW	2.3 acres
Wooded Swamp Mixed	BVW	0.9 acres
Total		**55.3 acres**

Source: F. Ingelfinger, MA DER 2013

3.1.5 Rare Species

No federally listed threatened or endangered species have been documented within the Project area. However, the federally threatened subspecies of the red knot (*Calidris canutus rufa*) could utilize tidal wetland habitat in Muddy Creek during spring and fall migration. The threatened northern long-eared bat (*Myotis septentrionalis*) also could utilize tidal wetlands for foraging and adjacent forested uplands as summer roosting habitat within the Project area.

Red Knot

Effective December 11, 2014, the rufa red knot was federally listed as a threatened species under the Endangered Species Act (79 FR 73706). Although the red knot is present as a mid-summer-early-fall migrant on Cape Cod, there are no records confirming their presence in the Project area. During their southward migration to wintering areas, red knots typically feed on small clams and mussels found along coastal beaches and intertidal flats.

Northern Long-eared Bat

Effective May, 4, 2015, the northern long-eared bat was federally listed as a threatened species under the Endangered Species Act (80 FR 17974). Although the northern long-eared bat may be present in the Project area, there are no recent records confirming their presence. During the summer, northern long-eared bats roost singly or in colonies in forested habitat underneath bark, in cavities or in crevices of both live trees and snags (dead trees). Northern long-eared bats seem to be flexible in selecting roosts, choosing roost trees based on suitability to retain bark or provide cavities or crevices. During the evening, northern long-eared bats can be found foraging in a variety of forested and non-forested habitats, including wetlands. During the winter, northern long-eared bats hibernate in caves and mines (hibernacula) with constant temperatures, high humidity,

and no air currents. Factors affecting the species include modifications to bat hibernacula, disturbance of hibernating bats, and loss of forest habitat, including forest fragmentation.

Muddy Creek provides foraging habitat for the State-endangered common tern. The adjacent upland provides breeding habitat for the Eastern box turtle, a State Species of Special Concern.

3.1.6 Fisheries

3.1.6.1 Fin Fish

Diadromous fishes within Muddy Creek include American eel and alewife. Both fish are species of emphasis for the Muddy Creek Restoration Project. Information about the occurrence of both of these fish has been summarized in the *Final Technical Memorandum Muddy Creek Restoration Chatham and Harwich Massachusetts* (Fuss & O'Neill 2012). The culverts at Route 28 are a significant obstacle to juvenile eels as they attempt to enter Muddy Creek, although some make their way through the culverts assisted by flood tides. Local natural resource officials and MassDMF scientists have observed adult and juvenile eels within Muddy Creek. MassDMF has also observed large numbers of juvenile eels congregating at a freshwater outflow pipe which connects upper Muddy Creek to freshwater ponds farther upstream. MassDMF has installed a passive flow eel ramp to assist eel passage and has stated continued interest in improving eel passage, water quality and other conditions that would improve the eel population in Muddy Creek.

Muddy Creek was historically known as an alewife run. The 1990 Cape Cod Critical Habitats Atlas shows Muddy Creek as a significant or critical habitat based on the fish run. Alewives have been observed schooling at the mouth of the freshwater outflow pipe in upper Muddy Creek. Local and MassDMF officials report that the present alewife run in Muddy Creek is likely to be small because of several factors, including the undersized Route 28 culverts which act as a barrier to alewives attempting to spawn in the calmer, less saline headwaters. Currently, successful alewife spawning in Muddy Creek is unknown. Existing substrate in the upper reaches of Muddy Creek is fine silt with high organic content which is not suitable substrate for alewife eggs, suggesting that successful spawning is limited. It is also unlikely that under current conditions, alewives are able to traverse upstream to freshwater ponds through the narrow pipe located at the upstream end of Muddy Creek.

3.1.6.2 Shellfish

Softshell clams (*Mya arenaria*) and quahogs (*Mercenaria mercenaria*) were historically abundant and commercially harvested both upstream and downstream of the existing Route 28 culverts. The lower basin of Muddy Creek was prolific quahog habitat as recently as the 1950s. However, poor water quality severely diminished shellfish habitat and in 1988, MassDMF restricted harvesting in Muddy Creek due to high bacteria counts in the water column. In 1995, the area was classified as prohibited for taking of shellfish.

During the assessment of existing conditions in Muddy Creek, a shellfish survey was undertaken (Fuss & O'Neill 2012). Two transects were established in lower Muddy Creek just upstream of the Route 28 culverts Softshell clams were found in moderate densities, (5.6 and 9/ft^2), whereas other species, including quahogs, false angel wings (*Petriolaria pholadiformis)*, and blue mussels (*Mytilus edulis)*, were found in much smaller numbers.

3.1.7 Adjacent Upland Woodland Habitat

The upland vegetation community along the Muddy Creek corridor consists of mainly a Pitch Pine – Oak Forest Woodland community. Found on moraines, till, outwash, southerly exposures, and rocky slopes, this community is the matrix forest of southeastern Massachusetts. The canopy can range from predominantly pine with scattered oaks to predominantly oak with scattered pines. Vegetative structure can either be an open canopy with a thick understory or a closed canopy with scattered clumps of shrubs. Typical species consist of a mix of pitch pine (*Pinus rigida*) and oaks such as black oak, *(Quercus velutina)*, scarlet oak *(Q. coccinea)*, and white oak *(Q. alba)*, with blueberries (*Vaccinium angustifolium* and *V. pallidum*), black huckleberry (*Gaylussacia baccata*) and other ericaceous shrubs forming an often continuous low shrub layer. Scattered patches of scrub oak (*Quercus ilicifolia*) and bear oak (*Q. prinoides*) can be dense. Green briar *(Smilax rotundifolia)* and catbriar *(Smilax glauca)* often form dense barriers around low, damp openings. The herbaceous layer is generally sparse, composed of bracken fern (*Pteridium aquilinum*), wild sarsaparilla (*Aralia nudicaulis*), wintergreen (*Gaultheria procumbens*), Pennsylvania sedge (*Carex pensylvanica*), and, less commonly, pink lady's slipper (*Cypripedium acaule*). Occasional white pine (*Pinus strobus*) and red maple (*Acer rubrum*) contribute to the canopy (Fuss and O'Neill 2012).

Through the collective efforts of local citizens and private partners, much of the upland buffer around Muddy Creek is protected open space. These efforts have combined to protect 120 acres of contiguous wildlife habitat and wetland buffer in the Muddy Creek watershed with parcels owned by the Town of Harwich, the Town of Harwich Water Department, the Town of Chatham, and the Chatham Conservation Foundation. Recently, the Harwich Conservation Trust purchased the Pleasant Bay Woodlands, a 49-acre parcel located in close proximity to the Project site.

3.2 Existing Structures

Existing structures in Muddy Creek and at the Project site include the MassDOT right-of-way encompassing the Route 28 roadway and associated embankment and culvert system. Remnants of a historic dike and sluiceway are located mid-way up Muddy Creek (see Figure 1), and a MassDMF-managed eel ramp is located at the headwaters. Each of these structures is described in more detail below.

3.2.1 Route 28

Route 28 is a State highway owned by MassDOT. Route 28 is a major thoroughfare extending along the south side of Cape Cod from the Falmouth to Orleans. Route 28 in the vicinity of the Project site is a two-lane roadway with 10-foot travel lanes, minimal (< 1 foot) shoulder widths, and no sidewalks.

3.2.2 Earthen Dike and Culverts

As noted previously, Route 28 crosses Muddy Creek where it flows into Pleasant Bay. A wooden bridge provided north-south access across Muddy Creek until it was replaced with a 20-foot-tall earthen embankment and single culvert, circa 1900. This wooden bridge (Figure 2) likely permitted unrestricted tidal exchange between Pleasant Bay and lower Muddy Creek. The twin stone culverts within the embankment were constructed in the 1930s. Each culvert is approximately 30 inches wide and 45 inches tall with a span length of approximately 100 feet. The culverts convey restricted tidal flows between Pleasant Bay and Muddy Creek.

Figure 2. Historic Muddy Creek Bridge, circa 1890.

3.2.3 Earthen Dike mid-stream

Additional hydrologic modifications to Muddy Creek reportedly occurred in the upper basin in the 1890s with the construction of an earthen dike with a 3-to-4-foot-wide adjustable sluiceway near the midpoint of the Creek (Figure 1). The dike and sluiceway reportedly allowed the flooding of commercial cranberry bogs located within the upper

basin of Muddy Creek. The dike was breached during the 1938 hurricane and was not repaired. Today, Muddy Creek is more than 40 feet wide at this location, but remnants of the earthen dike remain visible along both shorelines.

3.2.4 Eel Ramp and Culvert to Ministers Pond

A MassDMF-installed fish passage structure is located at the headwaters of upper Muddy Creek where an old corrugated pipe has been installed under Queen Anne Road to provide eel access to Minister's and Mill Ponds. The eel ladder has improved eel passage between Muddy Creek and the upstream freshwater ponds. At low tide, the eel ramp provides a substrate for young eels to enter the culvert, where they are reportedly able to continue swimming upstream to Minister's Pond and Mill Pond.

3.3 Historic and Archaeological Resources

The region around Pleasant Bay was part of the Monomoyik Tribal Lands. The Monomoyiks took their name from their main village located on the Monomoyik River, now called the Monomoy River, which is another local name for Muddy Creek. Wading Place Path is a Native American footpath that is roughly traced by Route 28 between Chatham and Orleans. Numerous Native American sites are located within the Pleasant Bay watershed, but none are located within the Project construction site. The proposed construction area (within the MassDOT Route 28 right-of-way) has been previously disturbed with the construction of the embankment at the turn of the 20th century, and the subsequent installation of culverts. MHC has determined that the proposed project is unlikely to affect significant archaeological or historical resources (see Appendix B, MHC Correspondence).

3.4 Health and Human Safety

Water quality impairment of Muddy Creek effectively prohibits its use for swimming or the taking of shellfish. The lower portion of Muddy Creek had been used for shellfishing as late as the 1950s.

The shoreline of Muddy Creek is a mix of privately owned residential property and conservation land. There is currently no boat or public access to the Muddy Creek waterway. The lack of boat access poses a public safety issue as many would-be boaters haul their kayaks over the Route 28 guardrail and then lower them through a brushy area to the Creek. At this point of entry, there is less than one foot width of shoulder on a steep and sharply curved road with limited sight lines. The existing practice of transporting kayaks to Muddy Creek is especially dangerous during the summer months when traffic volumes are high.

Currently, the culverts restrict the drainage of floodwaters after large storm events, retaining elevated floodwaters for multiple tidal cycles on private properties.

4.0 Environmental Consequences

Section 4.0 contains a discussion of how resources will benefit from or be altered by the Proposed Action.

4.1 Natural Resources

The rise and fall of the tide is the primary abiotic factor shaping the structure, productivity, and function of the coastal environment. The tides control key physical, chemical, and biological processes such as sediment deposition and scouring, mineral and organic transport, flushing of toxins, and control of sediment chemistry. The proposed replacement of existing box culverts with an open channel having a 22-foot bottom width and 1.7:1 side slopes will reconnect Muddy Creek to Pleasant Bay, restoring near-natural tidal hydrology. The restoration of tidal hydrology to the currently degraded system will initiate a recovery trajectory toward healthier, naturally self-sustaining conditions and higher ecological functions. Channel and bridge construction will restore tidal exchange, enhance water quality, improve fish passage, and restore habitat for a number of marine and estuarine species of fish, shellfish, and wildlife. Project construction will address aging State highway infrastructure, improve community resilience to coastal storms, and provide public recreational access to Muddy Creek.

The Proposed Action will have negligible, if any, impacts on air quality, soundscapes, land use, socioeconomics, energy resources, geology, lightscapes, Indian Trust resources, scenic resources, and prime and unique farmlands or cultural resources pursuant to Section 106 of the National Historic Preservation Act (16 W.S.C. 470f).

4.1.1 Area of Critical Environmental Concern

Muddy Creek is a sub-embayment of the State-designated Pleasant Bay ACEC. This designation reflects the significant ecological and cultural resources contained in the area. As described more fully below, the Proposed Action will improve water quality, increase the health and quantity of wetland resources, and enhance habitat for fish, shellfish, birds and other animals within Muddy Creek which will provide significant benefits to the ACEC.

4.1.2 Water Quality

Restricted tidal exchange and intensified land use within Muddy Creek have contributed to impaired water quality conditions in the watershed. Muddy Creek is currently on the EPA 303(d) list as a Category 4(a) water body under the Massachusetts Year 2014 Integrated List of Waters. Improvements to tidal exchange resulting from the Proposed Action are expected to significantly improve water quality making it likely that the Muddy Creek designation as impaired for fecal coliform and nitrogen could be removed in the future.

4.1.2.1 Bacterial Contamination

Fuss & O'Neill (2012) used a mass balance model to estimate bacterial concentrations under current and post-Project conditions. The model results, summarized in Table 4, predict significant reductions in bacterial concentrations after implementation of the Proposed Action. The modeled reduction in fecal coliform achieves most of the 95 percent reduction required to meet the TMDL for Muddy Creek.

Table 4. Summary of Modeled Percent Reduction of Bacteria Concentrations Under Existing and Future Conditions

	Fecal Coliform		Enterococcus	
	Summer	Winter	Summer	Winter
Range % Reduction	76%-80%	77%-82%	78%-82%	79%-85%

Source: Fuss & O'Neill 2012

4.1.2.2 Total Nitrogen

Significant reductions in nitrogen concentrations in the water column are expected to result from the increase in tidal exchange through the replacement of the existing culverts with a single-span bridge. In 2010, using new attenuation rates for nitrogen, and updated land use coverages and water quality data, SMAST modeled the changes in water quality that would result from replacing the existing culverts with a 24-foot-wide culvert opening (similar to the Proposed Action). The model found that the amount of septic nitrogen that would need to be removed to achieve TMDL threshold levels of nitrogen was reduced for both the upper Muddy Creek and lower Muddy Creek basins. Thus, while implementation of the Proposed Action is not enough to achieve targeted nitrogen thresholds, the resulting water quality improvements would augment land-based measures to limit watershed nitrogen loading. System-wide, there is also expected to be a small reduction in bioactive nitrogen due to the increased tidal exchange enabled by the Proposed Action.

4.1.3 Hydraulic Conditions

Implementation of the Proposed Action will result in the restoration of near natural tidal conditions to Muddy Creek which will then closely approximate conditions in the adjacent main basin of Pleasant Bay.

4.1.3.1 Tidal Benchmarks

In 2014, modeling was conducted by ACRE to provide detailed information on hydrodynamic conditions and predict storm surge water elevations in Muddy Creek under the Proposed Action. This assessment also was used to determine potential flood impacts to low-lying properties and structures upstream of the Muddy Creek tidal opening during various storm return intervals. ACRE used a one-dimensional HEC-RAS model, which is widely accepted for analysis of estuaries and is approved by MassDOT for bridge

evaluations. Topographic data, channel bathymetry and tide data from both upstream and downstream of the channel opening was used for the modeling.

Table 5. Change in tidal datums in Muddy Creek comparing existing conditions with those of the Proposed Action

Tidal Datum	Existing Conditions (Culverts) (feet NAVD88)	Proposed Conditions (Bridge and Channel) (feet NAVD88)
Annual High Water	2.0	4.0
Spring Tide	2.0	3.8
Mean High High Water	1.6	3.2
Mean High Water	1.6	2.7
Mean Low Water	1.0	0.0
Mean Low Low Water	1.0	-0.1
Minimum Tide	0.7	-0.1
Mean Tide Range	0.6	2.7
Mean Tidal Volume	713,000 ft^3	5,059,000 ft^3

Applied Coastal Research and Engineering, Inc. December 2011

Tidal conditions in Muddy Creek under the Proposed Action show an increase in mean high water by 1.1 feet, and a decrease in mean low water by 1.0 foot, thereby increasing mean tide range by 2.1 feet. Mean tidal volume (prism), *i.e.*, the volume of water exchanged in a single tidal cycle, would increase seven-fold.

4.1.3.2 Flood Elevations

Hydraulic modeling was used to evaluate the Project's effect on water surface elevations in Muddy Creek during coastal storm events. Predicted storm surge water surface elevations in Muddy Creek were based on FEMA Flood Profiles for coastal Massachusetts (effective July 16, 2014) and were developed for existing and proposed conditions (Table 6). For storms of greater magnitude than an estimated 35-year return frequency, the FEMA Base Flood Elevation within Muddy Creek is not predicted to change as a result of replacing the existing culverts with the proposed single-span bridge and restored tidal channel.

Table 6 shows modeled still water elevations under existing and proposed conditions for the FEMA 10-year, 50-year, 100-year, and 500-year storm events. Whereas floodwaters propagate largely unattenuated throughout Muddy Creek under the proposed restored conditions, the existing culvert and embankment configuration significantly dampens the effect of smaller (< 10-year) coastal storm events. Once Massachusetts Route 28 is overtopped, around elevation 8 feet, (NAVD88), coastal storm surge waters bypass the culverts and begin to fill the Muddy Creek Basin. The rate at which water levels in Muddy Creek equilibrate with flood waters in Pleasant Bay is dependent upon the duration and depth of the Route 28 inundation. In a comparison of existing conditions and those of the Proposed Action, modeling predicts a 4.1-foot difference in water surface elevations between Muddy Creek and Pleasant Bay during the 10-year storm

event. During the 25-year event (Pleasant Bay still water elevation of 10.8 feet, NAVD88), there is a 0.9-foot difference between existing and proposed water surface elevations within the Muddy Creek Basin. For the 50-year storm event (still water elevation of 12.4 feet, NAVD88), there is no predicted difference in water surface elevations between lower Muddy Creek and Pleasant Bay for either the existing or proposed condition (Table 6).

Table 6. Comparison of Modeled Still Water Elevations in Muddy Creek Existing vs. Proposed Conditions

FEMA Flood Interval	Still Water Condition in Pleasant Bay (feet, NAVD88)	Existing Conditions Double Barrel Box Culvert (feet, NAVD88)	Proposed Conditions Single-Span Bridge with Restored Tidal Channel (feet, NAVD88)
10-Year	8.8	4.7	8.8
25-Year	10.8	9.9	10.8
50-Year	12.4	12.4	12.4
100-Year	13.9	13.9	13.9
500-Year	17	17	17

Applied Coastal Research and Engineering, Inc. (2014)

The Proposed Action will also enhance Muddy Creek drainage. With the existing culverts, the drainage of floodwaters after a storm surge within Muddy Creek can take several tide cycles (upwards of five days following a 50-year storm), whereas under the proposed conditions, the restored tidal channel allows the storm waters to recede at the same rate as the waters in Pleasant Bay (ACRE 2014).

4.1.3.3 Channel Location

The proposed replacement of culverts with a bridge at Muddy Creek will substantially increase the volume of water entering the upstream estuarine system during typical tidal conditions, and also alter tidal currents in the channel crossing the beach system seaward of Route 28. As shown in Figure 1, the "natural" channel seaward of the Route 28 embankment consists of a meandering tidal channel across the coastal beach system that also contains fringing salt marsh. Due to the magnitude of planned alterations to the tidal flow through the channel, analyses were performed to examine the potential for channel widening seaward of Route 28 (ACRE 2015).

ACRE determined that the Proposed Action would increase the tidal exchange to Muddy Creek by approximately 700 percent. Intuitively, an increase in flow can be expected to cause an increase in channel width and/or channel depth and lead to a concurrent decrease in channel sinuosity. However, after reviewing existing channel geometry, the

ACRE (2015) evaluation concluded that channel meanders will not shift significantly due to the proposed restoration efforts taking place at Muddy Creek. Rather, channel width and depth may be influenced slightly by the planned alterations, but the overall meander and channel configuration would remain stable. A monitoring protocol has been established to assess change in channel conditions over time.

4.1.4 Influence on Wetland Resource Areas

The Proposed Action of tidal restoration in Muddy Creek will transform the Basin into a more functional estuarine system due to an increase in tidal range, lateral extent of tidal flooding, and increased tidal prism. Fresh and brackish communities will transition into salt marsh habitats defined by the duration and frequency of restored tidal inundation. Because the Muddy Creek Basin is steeply sloped, vegetative changes will be largely restricted to existing wetland resource areas which are on the periphery of the Basin. Little transition of upland communities is anticipated. Despite a 2-foot increase in the elevation of annual high water under the Proposed Action, there is only a modest, concurrent 16.6-acre increase in the lateral extent of high water (Table 7), which largely affects existing wetlands. Areas lying above proposed annual high water (elevation 4.0 feet, NAVD88) will not receive sufficiently frequent tidal influence to undergo vegetation change.

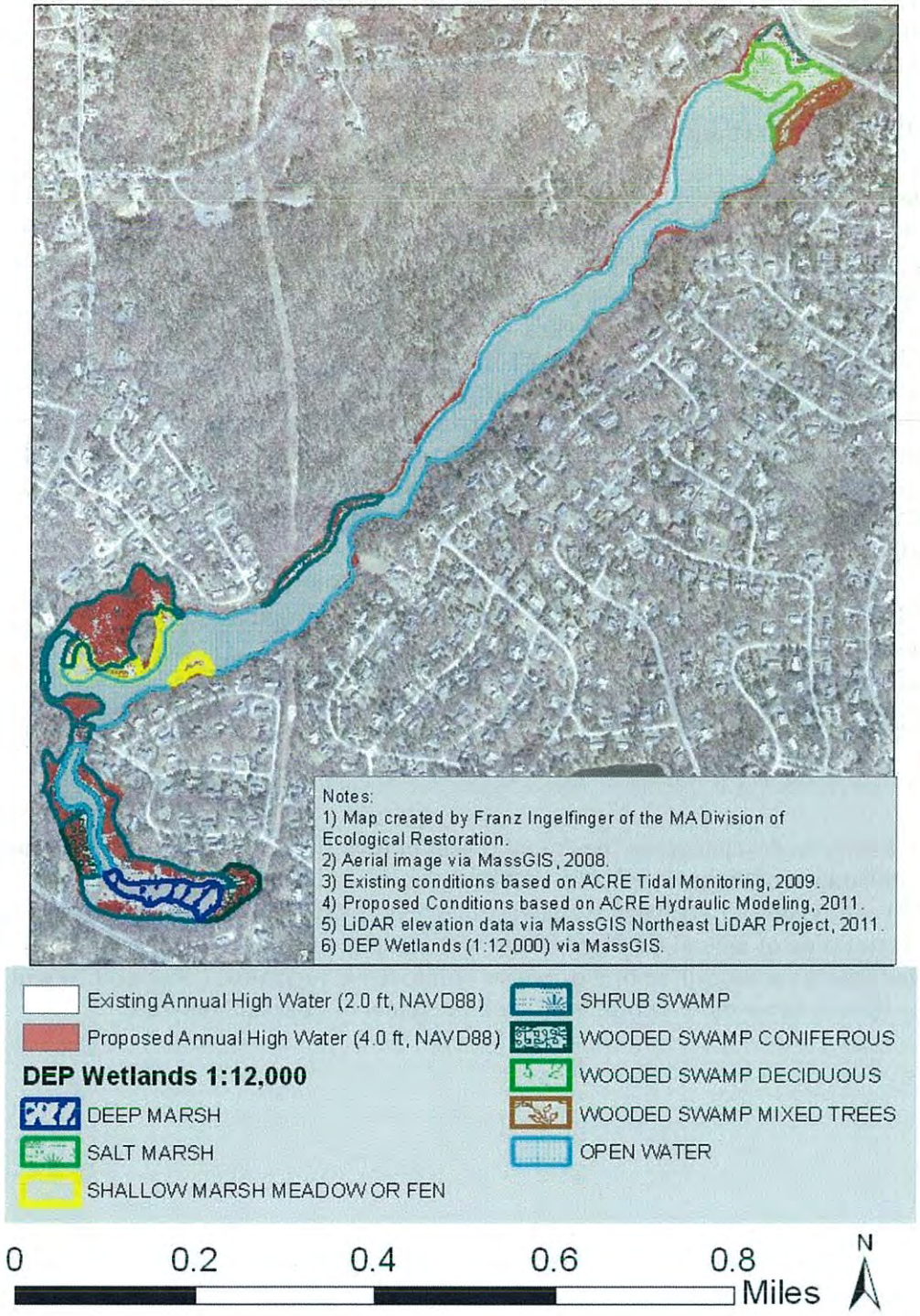
Table 7. Lateral Extent of Inundation under Existing and Proposed Conditions

Extent of Annual High Water	Area
Existing Conditions (2.0 feet, NAVD88)	45.6 ac
Proposed Conditions (4.0 feet, NAVD88)	62.2 ac
Change in Lateral Extent	16.6 ac

Analysis provided by F. Ingelfinger, Massachusetts Division of Ecological Restoration, 2014

Figure 3 illustrates the changes in the lateral extent of tidal flooding at annual high water between existing conditions (2 feet, NAVD88) and proposed conditions (4 feet, NAVD88) and relates it to existing wetland resources (MassDEP Wetlands 1:12,000 data layer). Restoration of natural tidal hydrology will increase saltwater influence and it is anticipated that the composition of the species within these vegetative communities will shift over time to favor more salt-tolerant species typical of tidal salt marshes.

Figure 3. Muddy Creek Restoration Project area overview of wetland resource area inundation under existing and proposed tidal conditions.



Changes to Wetland Resource Areas by Wetland Type

Salt Marshes

Implementation of the Proposed Action is expected to result in an expansion of salt marsh. As shown in Table 8, 2.7 acres of existing salt marsh will benefit from increased salinity and tidal flushing as a result of increased tidal elevations up to the annual high water line.

Table 8. Predicted Effects from Implementation of the Proposed Action to Existing Mapped MassDEP Wetland Cover and Resource Area Types

Wetland Vegetation Classification	Resource Area Type	Existing Area (Acres)	Relative Change in Area
Open Water	Land Under Water	32.1	Decrease
Deep Marsh	Land Under Water	1.9	Decrease
Tidal Flat	Coastal Beach	0	Increase
Salt Marsh	Salt Marsh	2.7	Increase
Shallow Marsh/Fen	BVW	2.0	Decrease
Scrub Swamp	BVW	13.4	Decrease
Wooded Swamp Coniferous	BVW	2.3	Decrease
Wooded Swamp Mixed	BVW	0.9	Decrease
Total		**55.3**	

Source: F. Ingelfinger, Massachusetts Division of Ecological Restoration 2014

Bordering Vegetated Wetland

Under existing conditions, Bordering Vegetated Wetland consisting of Shallow Marsh/Fen, Shrub Swamp, Wooded Coniferous Swamp, and Wooded Mixed Swamp encompass approximately 18.6 acres along Muddy Creek's shoreline. To quantify changes to these wetland resources as a result of restored natural tidal hydrology, the elevation of existing (2.0 feet, NAVD88) and proposed annual high water line (4.0 feet, NAVD88) were superimposed on the MassDEP Wetlands Layer using LiDAR elevation data available from MassGIS. Salinities within upper Muddy Creek will rise and it is anticipated that this area will receive increased frequency of tidal inundation. The composition of the species within these BVW vegetative communities will shift over time to favor the more salt-tolerant species typical of salt marsh communities. Higher inundation levels resulting from less frequent storm events are not expected to have a significant impact on mapped BVW adjacent to Muddy Creek.

Land Under Water

Upstream of Route 28, 34 acres are mapped by MassDEP as Land Under Water including Open Water (32.1 acres) and Deep Marsh (1.9 acres). Water quality within Muddy Creek will dramatically improve as a result of increased tidal flushing (MEP Study Reference).

The ACRE (2011) analysis indicated that the mean low water elevation will decrease from 1.0 foot to -0.4 feet and mean high water will increase from 1.5 feet to 2.9 feet within Muddy Creek (referenced elevations are in feet, NAVD88). This increase in tidal range will result in a seven-fold increase in tidal volume and significantly enhance water quality within Muddy Creek. It is anticipated that in many areas Open Water will convert to Tidal Flat.

4.1.5 Rare Species

No federally listed threatened or endangered species have been documented in the Project area. However, the federally threatened subspecies of the red knot could utilize tidal wetland habitat in Muddy Creek during spring and fall migration. The threatened northern long-eared bat also could utilize tidal wetlands for foraging and adjacent forested uplands as summer roosting habitat within the Project area. Pursuant to the Endangered Species Act, a section 7 Biological Evaluation for both species was conducted within the Service.

Red Knot

Although the Project is located within a known fall migration area (Cape Cod) for the red knot (78 FR 60024), existing conditions within Muddy Creek are not suitable for the species. Because the restricted tidal influence limits the range of mean daily tides to 0.6 feet (low tides are elevated and high tides are reduced when compared to the tides in Pleasant Bay), there is essentially no exposed intertidal habitat within the Project area. The Proposed Action will increase the mean tide range to 2.7 feet. The increases in water salinity and tidal influence that result from the Proposed Action will restore intertidal habitat that would benefit foraging opportunity for the red knot (exposed intertidal flats, tidal creeks, and salt marsh).

Northern Long-eared Bat

Although the Project is within the mapped range of the northern long-eared bat (80 FR 17974), the degraded wetland habitat in the Project area provides limited suitable roost trees within the approximate 3 acres of forested wetlands that currently are found in upper Muddy Creek (see Table 8). Additionally, the Proposed Action likely will cause a narrow band of forested and shrub habitat on the perimeter of Muddy Creek (approximately 5 acres) to transition to tidal wetlands. No tree cutting is anticipated as part of the Proposed Action and all trees that succumb to tidal influence will be left standing. There are no known hibernacula or maternity roost trees in the Project area. The long-term trajectory for the area is a self-sustaining estuarine wetland complex which is expected to provide increased bat foraging opportunities in the restored wetland. Project construction is scheduled from fall through early spring when northern long-eared bats are not expected to present in the Project area. It is likely that the Proposed Action will not diminish the northern long-eared bat's ability to feed, breed, and shelter.

The Proposed Action is expected to directly benefit two declining species of fish by increasing access to spawning and juvenile habitats and improving water quality for the alewife, a National Oceanic and Atmospheric Administration Species of Concern, and the American eel, currently undergoing consideration for listing under the Endangered Species Act by the Service.

The Massachusetts Natural Heritage and Endangered Species Program (NHESP) identified two State-listed species, which are protected under the Massachusetts Endangered Species Act (M.G.L. Ch. 131A or MESA), as likely to be found near the project site: common tern and Eastern box turtle. The NHESP formally reviewed the proposed project in 2014 and determined that the Project will not adversely affect Resource Area Habitat(s) of State-protected rare wildlife species (Appendix C).

4.1.6 Improved Fisheries Habitat

The Proposed Action of restoring Muddy Creek will remove the existing undersized culverts that impede migratory passage for diadromous fish, and replace them with a single-span bridge. This action will improve passage for migratory American eels and alewives by replacing long, narrow, dark culverts with a well-lit open channel. As a result, both diadromous species will have unimpeded passage between the marine waters of Pleasant Bay and the Muddy Creek tidal river and its more quiescent headwaters. MassDMF and the Town of Chatham are expected to continue to improve eel and alewife passage between upper Muddy Creek and the upstream freshwater ponds.

The Proposed Action will also improve habitat in the Muddy Creek Basin for American eel and alewife by increasing tidal exchange and in turn, improving water quality. Changes in salinity resulting from increased tidal exchange are not expected to have an adverse impact on the eels, which can tolerate a range of salinities. However, the increased salinity may limit the availability of suitable spawning habitat in Muddy Creek for alewives.

As a consequence of restored tidal exchange, habitat for other diadromous species such as white perch (*Morone americana*) and tomcod (also known as frost fish) (*Microgadus tomcod*) will be enhanced by the Proposed Action.

4.1.7 Waterfowl and Other Migratory Birds

A restored Muddy Creek will provide a diversity of habitats: salt marsh, mudflats, muddy creek banks, fresh and brackish open water, and forested habitat. The Project will restore habitats essential to migratory birds. Increased tidal range and volume, and improved water quality will restore estuarine vegetation and shellfish areas. Low marsh vegetative communities, dominated by smooth cordgrass (*Spartina alterniflora*) will see greatest expansion in the downstream portions of Muddy Creek, with subtidal areas expected to become mudflats and high marsh areas transitioning to low marsh. It is likely that low marsh vegetation will colonize a portion of the exposed mudflats. As flooding and salinity levels increase with greater tidal exchange, stands of cattail (*Typha* spp.) and

non-native *Phragmites* are expected to retract. Improved water quality is expected to restore shellfish habitat near the Route 28 bridge site. Expanded mudflats and restored shellfish abundance will enhance food supply for migratory birds, which are priority management objectives of the Northern Atlantic Regional Shorebird Plan and New England/Mid Atlantic Coast Bird Conservation Region.

The Project is expected to improve habitat for High Priority Species of waterfowl, including the American black duck, Canada goose, mallard, lesser and greater scaup, especially during migration and as a wintering refuge area during coastal storms.

The Proposed Action will enhance saltmarsh and intertidal flats habitats, which is expected to directly benefit the saltmarsh (sharp-tailed) sparrow, a species of conservation concern along the east coast, as well as other migratory birds, including the pied-billed grebe, great blue heron, American bittern, snowy egret, bald eagle, American oystercatcher, black-bellied plover, semipalmated plover, greater and lesser yellowlegs, willet, least sandpiper, whimbrel, marbled godwit, red knot, semipalmated sandpiper, buff-breasted sandpiper, short-billed dowitcher, and least tern.

4.2 Impacts to Structures

4.2.1 MassDOT Route 28 Embankment

The Proposed Action is designed to allow removal of the culverts and portions of the Route 28 embankment while maintaining the existing roadway profile, alignment, and traffic design speed. To implement the Project, a MassDOT highway access permit is required and the Project must comply with AASHTO Bridge Design Specifications, MassDOT Standards, and the Commonwealth of Massachusetts Healthy Transportation Initiative (E-14-001), which requires that sidewalks and wider shoulder widths be incorporated into designs for new State roadway projects. To minimize impacts to wetland resources along the Route 28 corridor, MassDOT granted approval for a Design Exception Request to allow the Project to proceed with only partial compliance with new requirements pursuant to the Healthy Transportation Initiative Standards. Accordingly, to minimize impacts to wetland resources, the Project incorporates a single 5.5-foot-wide sidewalk on the northern side of Route 28, and 5-foot wide shoulders on either side of the roadway. These improvements are located on the 94-foot bridge span, as well as 400 feet to the west and 150 feet to the east of the bridge. The sidewalk will provide a recreational connection between two publicly accessible community beaches in Chatham and Harwich that are located immediately to the east and west of Muddy Creek.

4.2.2 Abutting Property Impacts

Anticipated changes in hydrology and propagation of coastal storm surge (ACRE 2014) in Muddy Creek as a result of implementing the Proposed Action were evaluated by Louis Berger and Bryant Associates through analysis of LiDAR elevation data and topographic survey. Properties lying below elevation 20 feet (NAVD88) elevation were surveyed using conventional and RTK GPS survey technologies to document the

elevations of structures, septic systems, roads and landscape features. Thirty-four properties were surveyed and maps were created to assess anticipated changes in water levels in Muddy Creek on the target properties as a result of the Proposed Action (Louis Berger Group 2014).

The survey documented the following potential for flooding of properties resulting from the Proposed Action:

- No structures would experience additional flooding during Annual High Water conditions.
- One property, with a basement egress below elevation 7.4 feet (NAVD88), would require mitigation to avoid flood impacts during a coastal storm exceeding the 10-year return interval storm. The Town of Harwich is working with the affected property owner to implement actions to remediate the impact.
- Four additional properties with ancillary structures (wooden walkways and ornamental features), already impacted by flooding under existing conditions, would experience additional flooding as a result of the Proposed Action. The property owners have been informed by the Towns and no mitigation is proposed.

The Towns are undertaking an outreach program within the local communities and specifically with individual private landowners to address the impacts to the affected properties.

4.3 Historic and Archaeological Resources

A Project Notification Form was submitted to MHC in 2012. After review of the form, MHC issued its determination that the Project is unlikely to affect significant historic or archaeological resources (see Appendix B). In March 2015, letters were sent by the Service to the Mashpee Wampanoag Tribe and the Wampanoag Tribe of Gay Head (Aquinnah) inviting them for input on the Proposed Action. The Service has not received any responses from the Tribes.

4.4 Human Health and Safety

4.4.1 Water Quality Improvements

By restoring tidal flow the Proposed Action will greatly improve water quality. Concentrations of total nitrogen and bacteria will be reduced, helping to bring water quality into compliance with TMDLs established in accordance with the Clean Water Act. As a result of water quality improvements, it is anticipated that shellfish habitat could be restored in lower Muddy Creek and, in the future, could support a harvestable shellfishery.

4.4.2 Public Access and Safety

The Proposed Action will result in safe public access from Pleasant Bay to Muddy Creek for kayaks, canoes and other non-motorized vessels for the first time since the Route 28 earthen embankment was installed in the early 1900s.

Currently, there is no public landing on Muddy Creek to provide land-based access, and no way for the public to access Muddy Creek from the water. The lack of access has posed a challenge for the Alliance water quality monitoring program, which must rely on private property owners to provide access for collection of water quality samples. Lack of access is also a complaint of the general public who view Muddy Creek as a desirable venue for kayaking or canoeing. Currently, intrepid users carry their boats through heavily wooded private parcels or, alternately, drop their kayaks over the steep embankment on Route 28 adjacent to the proposed bridge site. Either option for access poses safety hazards.

There are two public access points seaward of the Pleasant Bay inlet that could provide access into Muddy Creek as a result of the Proposed Action. The Jackknife Beach landing in Chatham, located south of the proposed bridge, is a heavily-used swimming area and provides access to a mooring field and for launching small trailered vessels. Bay Road Beach in Harwich, located just north of the inlet, is open for public swimming only. Both areas are heavily used during the spring, summer and fall seasons. The sidewalk associated with the Proposed Action will provide a safe connection between the two public access locations. With the bridge in place, small non-motorized vessels will be able to put in at the Jackknife Beach landing and safely enter Muddy Creek.

The Pleasant Bay Resource Management Plan (Pleasant Bay Alliance and Ridley & Associates, Inc. 2013) approved by the Towns of Orleans, Chatham, Harwich and Brewster, has identified Muddy Creek as an Area of Critical Marine Habitat. As a result of this designation, the following policies for Muddy Creek are agreed to:

- the existing MassDEP restriction on new licenses for private piers in Muddy Creek is to be continued; and
- motorized vessels are to be prohibited and in accordance with State laws, must maintain required setbacks from swimming and mooring areas.

These policies are intended to support safe public access to Muddy Creek for non-motorized vessels, and to discourage boating activity or structures that could diminish or interfere with the habitat value of Muddy Creek for wildlife, birds, and fish.

Public safety will be improved by the Proposed Action. Currently, there is no public boat access, and boaters dangerously attempt access to the creek from Route 28. The Proposed Action will provide a sidewalk on the east (Pleasant Bay side) of the bridge which will connect two public access points and provide safe pedestrian access where none currently exists.

Because the Proposed Action will allow unrestricted drainage on the ebb tide, elevated water levels in Muddy Creek from storm surge events that currently last over multiple tide cycles and adversely affect upstream properties will be ameliorated.

5.0 Proposed Mitigation

The Towns continue to work with property owners in the Muddy Creek watershed to inform them of the status of the Proposed Action and address any mitigation actions that will be needed.

The Federal, State, and municipal agencies continue to work closely with the Town of Harwich and Town of Chatham Conservation Commissions, MassDEP and the U.S. Army Corps of Engineers for the pre-construction, construction, and post-construction phases of the Proposed Action to ensure the protection of regulated salt marsh and other wetland resources. As part of the permitting process, an approved water control plan that will protect water quality and the passage of diadromous and other fish species during construction will be implemented.

6.0 Consultation and Coordination

As described in Section 1.3, the Towns have a history of cooperation and public involvement in researching and evaluating restoration alternatives for Muddy Creek and in pursuing the Proposed Action. The application to the Massachusetts Department of Fish and Game - MassDER for Priority Wetland Restoration Project status and many of the early assessment studies leading to the Project were undertaken by the Alliance. The Alliance is charged with oversight of the resource management plan for the Pleasant Bay ACEC. The four towns that make up the Alliance include Chatham and Harwich as well as Orleans and Brewster.

In addition to the Alliance, the following organizations and individuals have provided technical assistance in the design or review of studies for this project: MassDER, the Cape Cod Commission, Cape Cod Conservation District, MassDEP, MassDOT, and numerous local officials in the two Towns: Selectmen, Natural Resources Departments, Water Quality Committee members, Conservation Commissioners, Harbormasters, Shellfish Officers and Departments of Public Works. MassDER has also provided funding for hydraulic analyses.

Federal partners for the Project include the Service's Partners for Fish and Wildlife Program. The Project is partially funded by the US Department of Interior through the Disaster Relief Appropriations Act of 2013 (Hurricane Sandy Relief) and a Service-funded National Coastal Wetlands Conservation Grant.

The Project Oversight Committee established by the Towns consists of three members from each town: the Town Manager or Administrator, a Selectman, and a town staff participant. The Project Oversight Committee meetings are regularly attended by the officials representing the following agencies: MassDER, the Cape Cod Conservation

District, Conservation Agents for Harwich and Chatham, and the Service. Representatives of MassDEP and MassDOT periodically participate in Project Oversight Committee meetings.

Several public meetings and hearings were held to provide local officials and community residents an opportunity to comment on the Project. Community involvement, which is described more fully in section 7.2, included regulatory hearings held by the Chatham and Harwich Conservation Commission. A public hearing was opened by the Harwich Conservation Commission, and attended by the Chatham Conservation Commission, on February 27, 2014. That public hearing was continued, and re-opened as a joint hearing of the Conservation Commissions of Harwich and Chatham, on April 9, 2015. Following the closing of the hearing, each Commission voted to issue its Order of Conditions at its respective regularly scheduled public meeting on April 15, 2015.

7.0 Compliance with Federal, State and Local Laws and Policies

The Proposed Action has been evaluated for consistency with applicable Federal, State, and local laws, regulations, and programs. A brief description of the Project's compliance with these governing bodies is provided in Table 9.

Table 9. Consistency with Federal Laws, Regulations, and Programs

Law, Regulation or Program	Compliance Description
Clean Water Act of 1977 (Federal Water Pollution Control Act Amendments of 1972)	Temporary impacts to wetlands subject to jurisdiction of the Clean Water Act Section 404 will be minimized. The Project has been designed to avoid unnecessary impacts and to minimize unavoidable impacts as practicable.
Endangered Species Act of 1973, as Amended (16 USC 1531 *et seq.*)	Impacts to identified state- and federally-protected species will be minimized during the construction phase of the Proposed Action, which has been designed to enhance habitat value.
Rivers and Harbors Act of 1899	An application has been filed for a General Permit to the U.S. Army Corps of Engineers in compliance with this act. Permit is expected to be issued in summer 2015
Presidential Executive Order 12898 – Environmental Justice	The Proposed Action will enhance recreational opportunities for all residents and visitors, regardless of ethnic background. Public hearings and comments are open to the public. Local Native American Tribes have been contacted to solicit their input.
Fish and Wildlife Coordination Act	The Service is the lead federal agency for the Proposed Action and has played an integral role in the development of the design plans and alternatives analysis.
Presidential Executive Order 11990 – Protection of Wetlands	The Proposed Action avoids, to the extent possible, the long- and short-term adverse impacts associated with the alteration of wetlands and new construction in wetlands wherever there is a practicable

	alternative.
Presidential Executive Order 11988 – Floodplain Management	Project impacts to the mapped 100-year floodplain resulting from dredging will be minimized to the greatest extent practicable.
National Historic Preservation Act of 1966 as amended (16 USC 470 et seq.)	The Proposed Action has been determined to result in No Adverse Effect to the National Register-eligible or listed cultural resources.
Water Resources Development Act of 1990	The Proposed Action seeks to increase acreage and enhance the quality of wetland resources. This goal is aligned with the WRDA directive of a "no overall net loss" of wetlands.
National Coastal Wetlands Conservation Grant (NCWCG) Program - Coastal Wetlands Planning, Protection and Restoration Act of 1990	NCWCG Program encourages partnerships among federal agencies and others to protect, restore, enhance, and manage coastal wetlands, and other habitats for migratory birds, fish, and wildlife. The Proposed Action involves federal, state, and non-governmental agencies and groups for the purpose of habitat restoration and enhanced ecological function.
Massachusetts Historical Commission Act and regulations at 950 CMR 71.00	MHC has been consulted and has determined that the project is "unlikely to affect significant historic or archaeological resources".
Massachusetts Clean Water Act and regulations at 314 CMR 4.00: Surface Water Quality Standards; 401 Water Quality Certification at 314 CMR 9.00.	The Project will comply with the MA Stormwater Standards through the implementation of a sedimentation and erosion control program throughout the construction process, as outlined in the proposed Site Plans. The Project will not exceed the required surface water quality standard. Submitted 401 WQC application - approval pending.
Massachusetts Office of CZM and regulations at 301 CMR 20.00-26.00	CZM has determined that an individual consistency review with the Coastal Zone Management Act is not necessary.
Massachusetts Wetlands Protection Act and regulations at 310 CMR 10.00	The Project proponent has received an Order of Conditions from the Harwich and Chatham Conservation Commissions, respectively, in compliance with MA WPA (3/27/09).
Massachusetts Endangered Species Act	The Project team has consulted with NHESP, which has issued a "No Take" determination letter. Impacts to sensitive species have been taken into account during the design process, and will continue to be monitored throughout the construction process.
Massachusetts Rivers Protection Act 1996	The proposed Project is in compliance with the following goals of this act: protect the private or public water supply; protect the groundwater; provide flood control; prevent storm damage; prevent pollution; and protect wildlife habitat.

7.1 Required Permits and Approvals

The Proposed Action is subject to MGL Chapter 85, Section 35, requiring review of the project design for conformance with the AASHTO Bridge Design Specifications and Massachusetts Department of Transportation (MassDOT) Standards. The Project received 25 percent design approval from MassDOT in April 2015. Final (100 percent) design plans were submitted to MassDOT in May 2015, and it is expected that MassDOT will issue its final approval and issue an Access Permit by July 2015 once all environmental permits are in place.

Numerous State and Federal environmental permits are in process for this Project. To date, the Project has received the following permits and determinations:

- MHC – determination that the Project is unlikely to affect significant historic or archaeological resources (2012);
- MEPA - A Public Benefit Determination, Final Record of Decision and Secretarial Certificate from the Executive Office of Environmental Affairs for the Notice of Project Change (April 2014);
- Massachusetts Division of Fisheries and Wildlife, NHESP - A "No Take" Determination (March 2014);
- Orders of Condition from the Town of Chatham Conservation Commission and from the Town of Harwich Conservation Commission, respectively (April 2015); and
- Section 401 Water Certificate Application to MassDEP.

The following permits have been filed, with determinations expected in July 2015:

- Chapter 91 Waterways Public Waterways License Application to MassDEP;
- Massachusetts Coastal Zone Management - determination that No Individual Consistency Review is required; and
- Section 404 Clean Water Act Application under the Massachusetts General Permit Category 2 Application to U.S. Army Corps of Engineers.

The Project also is consistent with the Pleasant Bay Resource Management Plan (Ridley and Associates, Inc. 2013) for the Pleasant Bay ACEC and watershed approved by the Towns and the Executive Office of Energy and Environmental Affairs.

7.2 Public Involvement

The Proposed Action had received a high degree of public support. The conceptual bridge design and resource assessment was first presented at a public informational meeting in March 2012. Approximately 100 abutters, local and State officials, land protection organizations, fishermen and interested citizens attended. Strong public support for the replacement of the culverts with a bridge was voiced at the meeting, and wide media coverage resulted.

Since then, Boards of Selectmen in Harwich and Chatham have been briefed on the Project status numerous times during their public meetings, which are broadcast on local cable access stations. Each Board approved an inter-municipal agreement outlining terms for pursing the restoration bridge as a joint municipal project.

In addition, the Town of Harwich brought two successful funding requests to annual Town Meetings. The first request (May 2012) was to approve funds for design and permitting. In May 2013, the Harwich Town Meeting approved the contribution of $187,500 as a match for the Project. This was funded as a debt exclusion, which also required and was obtained approval through a town-wide vote. In 2014, the Harwich Town Meeting approved the broad terms for easements associated with the bridge construction. Chatham Selectmen also have discussed and voted for the dedication of funds in open public meetings that have been broadcast throughout the two communities. On multiple occasions, the citizens of both Towns have demonstrated clear public support for this important Project. In 2015, the Harwich Town Meeting approved an additional $500,000 for project construction and this was funded as a debt exclusion, which also required and was obtained approval through a town-wide vote. Chatham agreed to dedicate a comparable amount.

Ongoing public input was sought through public presentations of the bridge design and a traffic management plan at the 25 percent design stage, and ongoing public input is expected to continue through the 75 percent and 100 percent design stages. The Traffic Management Plan and updated Project plans were presented and open for public comment at a public informational forum held on April 2, 2015.

Post-construction, the Towns and other partners will publicize results of monitoring efforts to convey information about improvement in wetlands, water quality, and fisheries habitat resulting from the Proposed Action.

7.3 Decision Framework

There will be no significant impacts resulting from the proposed restoration activities of the Project. The Proposed Action provides net benefits that far outweigh its potential impacts on the natural and human environment. Therefore, the Service concludes that a Finding of No Significant Impact (FONSI) be issued for the Proposed Action.

8.0 References

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Appendices

Appendix A: Construction Methods

Appendix B: Letter from Massachusetts Historical Commission

Appendix C: Letter from Massachusetts Department of Fish and Game, Natural Heritage and Endangered Species Program

Appendix D: Final Design Plans