DRAFT RESTORATION PLAN
AND ENVIRONMENTAL ASSESSMENT
FOR THE
LORDSHIP POINT GUN CLUB SITE
AND
RAYMARK INDUSTRIES SITE
STRATFORD, CONNECTICUT

October 2018

Prepared by:
EA Engineering, Science, Technology, Inc., PBC

On behalf of:
National Oceanic and Atmospheric Administration
U.S. Fish and Wildlife Service
Connecticut Department of Energy and Environmental Protection

EXECUTIVE SUMMARY

This Draft Restoration Plan and Environmental Assessment (RP/EA) has been prepared by the Natural Resource Trustees "Trustees" (National Oceanic and Atmospheric Administration on behalf of the U.S. Department of Commerce, the U.S. Fish and Wildlife Service on behalf of the U.S. Department of the Interior, and the Department of Energy and Environmental Protection on behalf of the state of Connecticut) to restore natural resource injuries from releases of hazardous substances at or from the Lordship Point Gun Club Site and the Raymark Industries Site (the Sites) which are both located in Stratford, Connecticut. In this Draft RP/EA, the Trustees address the natural resources, including ecological services that were injured or lost due to releases of hazardous substances at or from these two Sites, and identify and describe a set of restoration alternatives, including the preferred alternative for restoring the injured natural resources.

The Lordship Point Gun Club (Lordship Point) Site (formerly known as the Remington Gun Club) is a 30-acre site located at Stratford Point, on the west side of the mouth of the Housatonic River which discharges into Long Island Sound. Trap and skeet shooting began at the Site in the 1920s. During the operation of the gun club through 1986, an estimated 48 million clay targets and 3 million pounds of lead shot were deposited on or into the tidal waters of the Housatonic River and Long Island Sound. Lead was identified as the principal contaminant of concern at this Site. Lead shot was found in the sediment from the intertidal zone and extending into sub-tidal waters. Resource injuries at the Site include impacts to surface waters, sediment, salt marshes, estuarine fishes, shellfish, and other macro-invertebrates, and migratory waterfowl.

The Raymark Industries Site is located in an urban/industrial area of Stratford, Connecticut. Raymark Industries was a manufacturer of friction materials containing asbestos and non-asbestos materials, metals, phenol-formaldehyde resins, and various adhesives. The Site once covered approximately 33 acres; additional remote disposal areas in Stratford comprised more than 100 acres. Contamination associated with the Site was identified at the Raymark facility, at numerous distinct locations throughout the Town of Stratford, where waste sludge from onsite settling lagoons was disposed, and in surface waters that receive runoff from the former facility or the disposal sites. The contaminants of primary concern to natural resources include lead, copper, zinc, polychlorinated biphenyls, and dioxins. Habitats injured by the contamination include tidal marshes and inter-tidal and sub-tidal surface waters.

This Draft RP/EA has been prepared by the Trustees to restore the natural resources, including ecological services, injured or lost due to releases of hazardous substances at or from these two Sites, both of which are within the Town of Stratford. In preparing and releasing this Draft RP/EA, the Trustees concurred that since the natural resource damages arising from both the Lordship Point Gun Club Site and the Raymark Industries Site are in close geographical proximity to one another, and are of similar injury type, it is appropriate to combine the settlement funds and the restoration planning process for the two Sites, and releasing the single draft document for efficient public review. Further, by combining the restoration funds from the two cases, the Trustees expect to implement a more ecologically significant action to accomplish restoration for both Sites in a timely, efficient manner. The goal of implementing the selected restoration action is to restore injured natural resources affected by these two cases, and restore ecological services resulting from project implementation.

The Trustees consulted with numerous agency staff, town officials, and local conservation and natural resource organizations to identify a number of potential restoration alternatives to compensate the public for injuries to natural resources resulting from contamination from the two Sites. After conducting numerous site visits and evaluating the alternatives, the Trustees selected a set of six marsh restoration projects situated in the Stewart B. McKinney National Wildlife Refuge (NWR) Great Meadows Marsh Unit (GMMU) as the Preferred Alternative, based on the anticipated ecological benefits from restored salt marsh habitat, including cover, foraging and spawning habitats for fish and shellfish, feeding and breeding habitat for waterfowl and other wildlife, and increased community resiliency, as well as project cost-effectiveness and overall need for restoration within the lower Housatonic River watershed. The Trustees are proposing marsh restoration as the preferred alternative to be implemented with the combined restoration funds from the Lordship Point settlement and Raymark Industries bankruptcy agreement.

Overall, implementation of the preferred alternative would result in greater long-term restoration of injured resources in comparison to ecological benefits derived by the non-preferred alternatives. The proposed GMMU salt marsh restoration is expected to restore or rehabilitate important fish and wildlife habitats, contribute to water quality improvements, provide shoreline stabilization, enhance public recreation at the McKinney NWR, and reduce nuisance mosquito problems and potential human health concerns in the local area.

The Trustees are releasing this Draft RP/EA to the public for a 30-day comment period, seeking input from the public on the proposed action. Comments received during the public review period will be fully considered by the Trustees in preparing and releasing the Final RP/EA. The Trustees will also determine whether the proposed action would have a potential significant impact to the environment. Following the release of an anticipated Final RP/EA, the Trustees will implement the selected action utilizing the collective restoration funds available.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACRONYMS AND ABBREVIATIONS

AR	Administrative Record
Battelle	Battelle Ocean Sciences
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CT DEEP	Connecticut Department of Energy and Environmental Protection
CZMA	Coastal Zone Management Act
EA	Environmental Assessment
EFH	Essential Fish Habitat
EIS	Environmental impact statement
EPA	United States Environmental Protection Agency
ER-M	Effects Range-Median
ESA	Endangered Species Act
ft	Foot (feet)
FONSI	Finding of No Significant Impact
GMMU	Great Meadows Marsh Unit
HEA	Habitat Equivalency Analysis
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NRDA	Natural Resource Damage Assessment
NWR	National Wildlife Refuge
PAH	Polynuclear aromatic hydrocarbon
PCB	Polychlorinated biphenyl
PRP	Potentially Responsible Parties
RP	Restoration Plan
RP/EA	Restoration Plan and Environmental Assessment
U.S.C.	United States Code
USFWS	United States Fish and Wildlife Service

1. INTRODUCTION

This Draft Restoration Plan and Environmental Assessment (Draft RP/EA) was prepared by federal and state natural resource trustees including the National Oceanic and Atmospheric Administration (NOAA) of the U.S. Department of Commerce, the U.S. Fish and Wildlife Service (USFWS) on behalf of the U.S. Department of the Interior, and the Connecticut Department of Energy and Environmental Protection (CT DEEP) on behalf of the state of Connecticut (collectively, the "Trustees") to address natural resource injuries, including ecological services injured, lost, or destroyed due to releases of hazardous substances in areas at or adjacent to the Lordship Point Gun Club Site and the Raymark Industries Site (the Sites) located in Stratford, Connecticut (Figure 1). The purpose of the proposed restoration, as described in this Draft RP/EA, is to compensate the public for injuries to natural resources and services resulting from the release of hazardous substances from the two Sites.

This Draft RP/EA describes the process that the Trustees have completed to identify and evaluate restoration alternatives and propose a preferred alternative for implementation. The Trustees' preferred alternative is then presented and discussed in detail. The Trustees seek public input and comment on the proposed restoration alternative presented in this Draft RP/EA. Following the end of the public comment period, the Trustees will fully consider all comments received during the public meeting or written comments received during the comment period in developing and releasing an anticipated Final RP/EA.

1.1 SITE LOCATIONS AND BACKGROUND

1.1.1 Lordship Point Gun Club

The Lordship Point Gun Club Site (hereafter, "Lordship Point") (former Remington Gun Club) is a 30-acre site located at Stratford Point, Stratford, Connecticut, at the mouth of the Housatonic River on the Connecticut shore of Long Island Sound (Figure 2). It is bounded by a residential neighborhood to the west and the river borders the remainder of the Site. Trap and skeet practice shooting began in the 1920s and ended in 1986. During its operation, an estimated 48 million clay targets and 3 million pounds of lead shot were deposited on or near the Site. The trap and skeet fields at the Site were positioned so that most of the targets and shot were deposited along the shoreline or into the waters where the Housatonic River discharges to Long Island Sound (American Marine Contractors 1997).

1.1.2 Raymark Industries

Raymark Industries (hereafter "Raymark") is located in an urban/industrial area of Stratford, Connecticut (Figure 3). The property is bordered by Interstate 95 to the south and Amtrak's New York-New Haven Railroad to the north. A number of residential properties border the former facility footprint to the east, and several commercial and industrial facilities are located to the west. The Raymark "Site" includes both the 33-acre former facility footprint, and the creeks and ponds outside of this footprint (Ferry Creek, Long Brook, Unnamed Brook, and Brewster's Pond), where contaminated materials were dumped during the period of facility operation (Figure 3). These disposal areas are further described in Section 2.1.2.

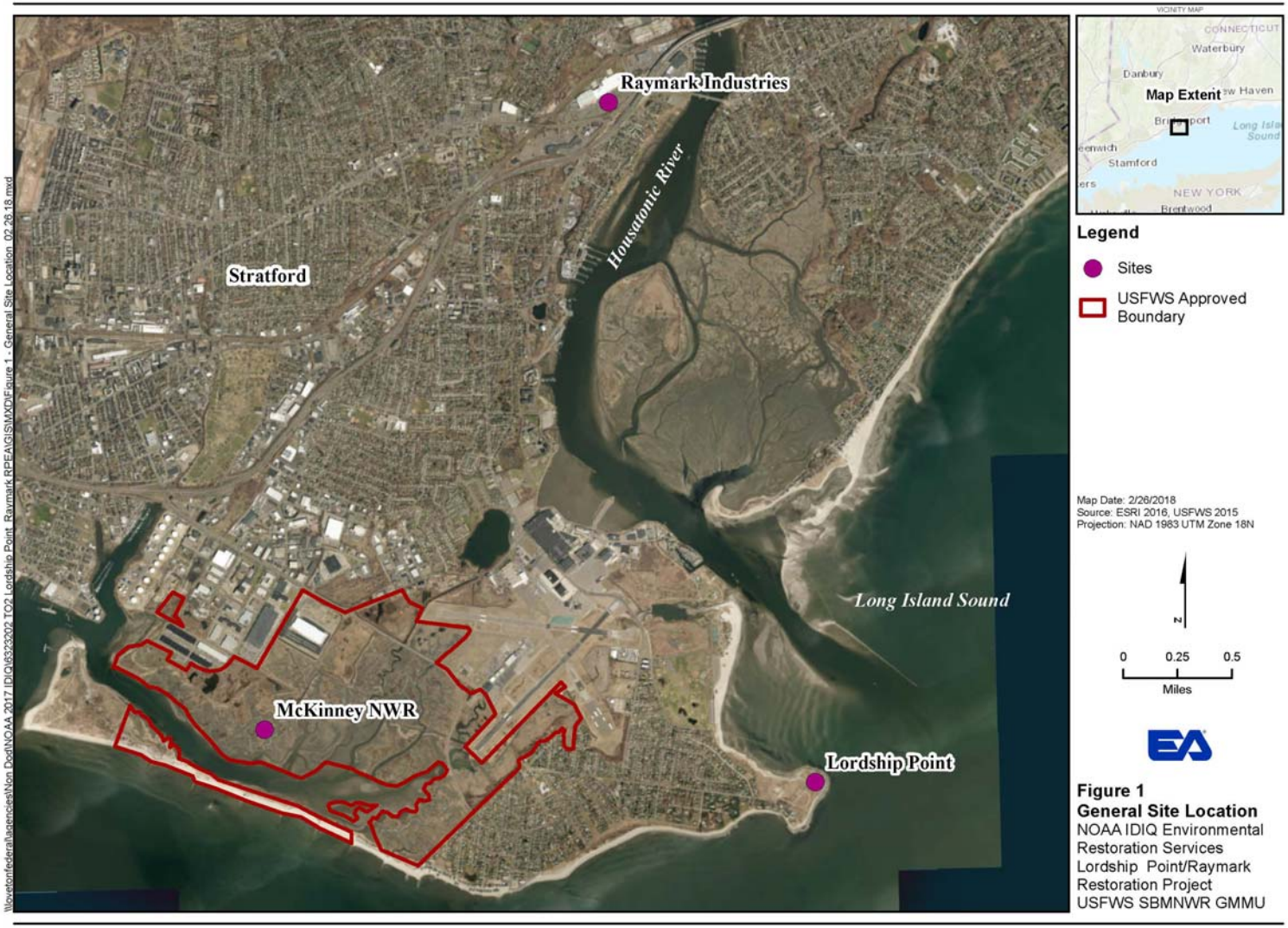


Figure 1
General Site Location
NOAA IDIQ Environmental Restoration Services
Lordship Point/Raymark Restoration Project
USFWS SBMNWR GMMU

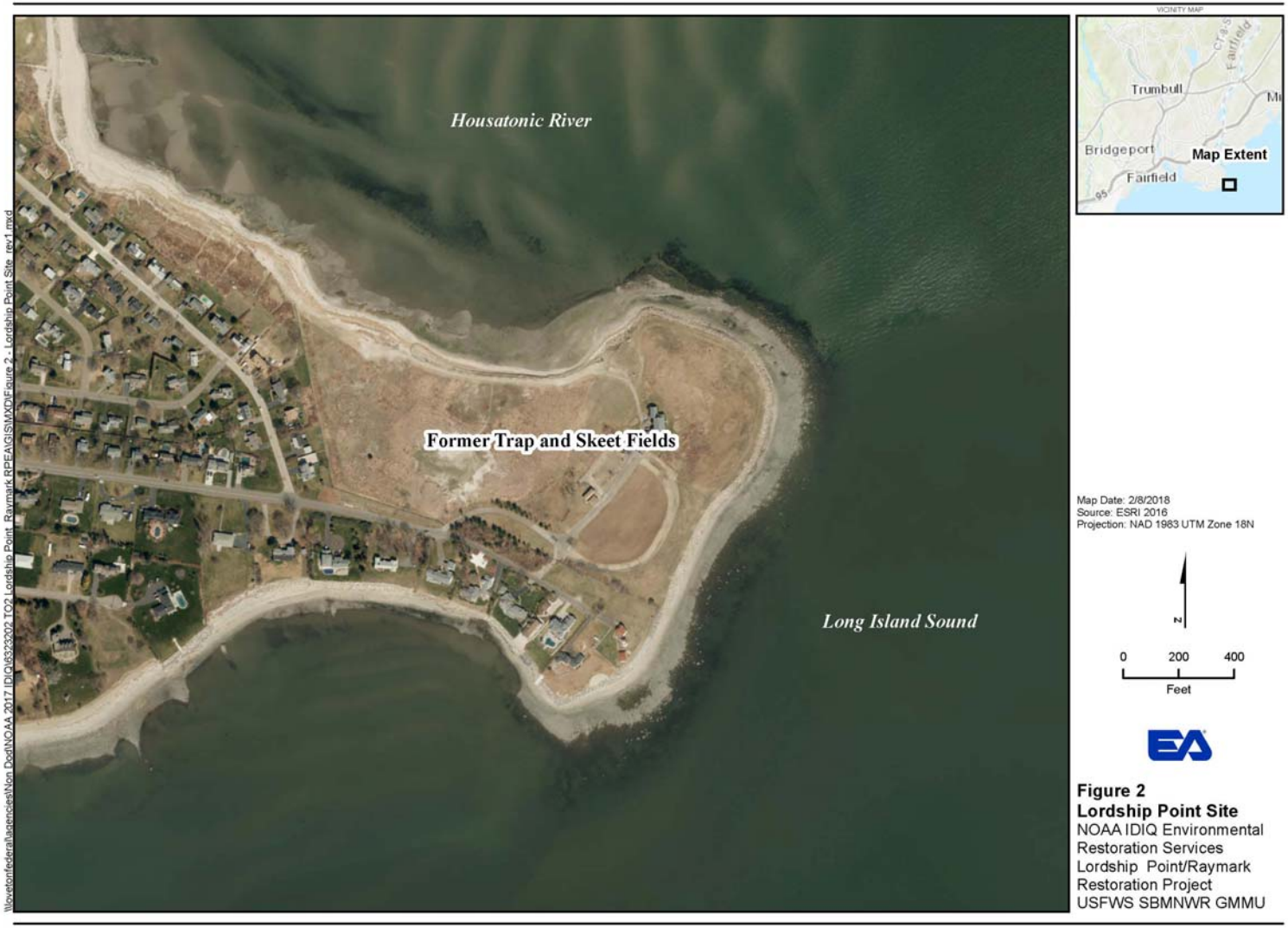
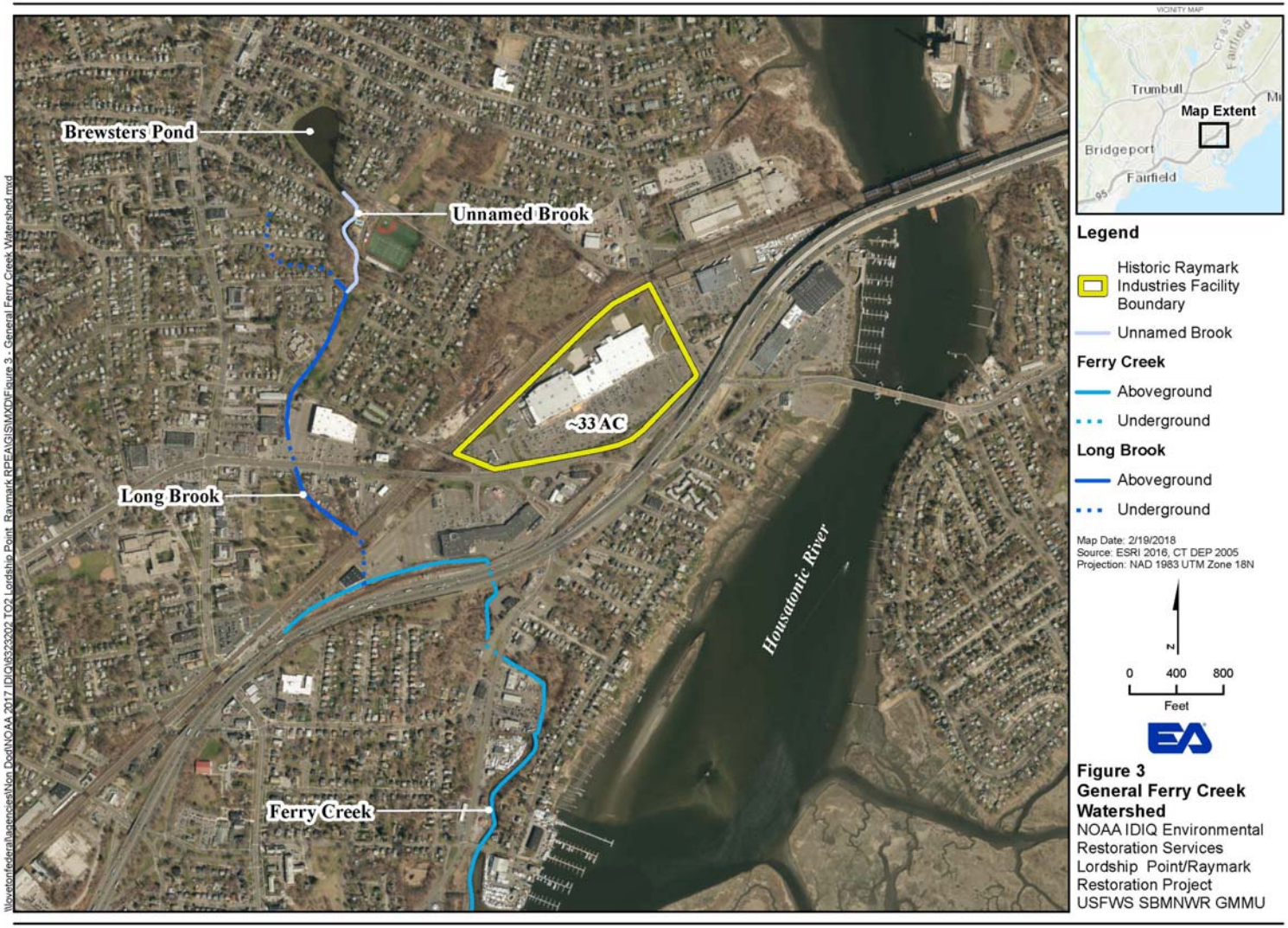


Figure 2
Lordship Point Site
NOAA IDIQ Environmental Restoration Services
Lordship Point/Raymark Restoration Project
USFWS SBMNWR GMMU


Brewsters Pond
Unnamed Brook
~33 AC
Long Brook
Housatonic River
Ferry Creek
VICINITY MAP
Trumbull
Map Extent
Bridgeport
Fairfield
Legend
Historic Raymark Industries Facility Boundary
Unnamed Brook
Ferry Creek
Aboveground
Underground
Long Brook
Aboveground
Underground
Map Date: 2/19/2018
Source: ESRI 2016, CT DEP 2005
Projection: NAD 1983 UTM Zone 18N
N
0 400 800
Feet
Figure 3
General Ferry Creek Watershed
NOAA IDIQ Environmental Restoration Services
Lordship Point/Raymark Restoration Project
USFWS SBMNWR GMMU

Raymark was a manufacturer of vehicle friction materials containing asbestos and non-asbestos materials, metals, phenol-formaldehyde resins, and various adhesives. Raymark produced gasket materials, sheet packing, and automobile friction materials including clutch facings, transmission plates, and brake linings (Weston 1993). The plant was in operation from 1919 through 1989, when it was shut down and permanently closed. Since 1989, several studies revealed that the Site may be a potential threat to nearby human populations and the environment. Contamination associated with the activities performed at Raymark is found both within the former Raymark facility footprint (Figure 4), and at multiple individual locations (largely, ponds and creeks) throughout the town where waste sludge from settling lagoons was once disposed, and in surface waters that receive runoff from the former facility footprint or the disposal sites (Figure 4). In total, the Raymark disposal areas comprise more than 100 acres.

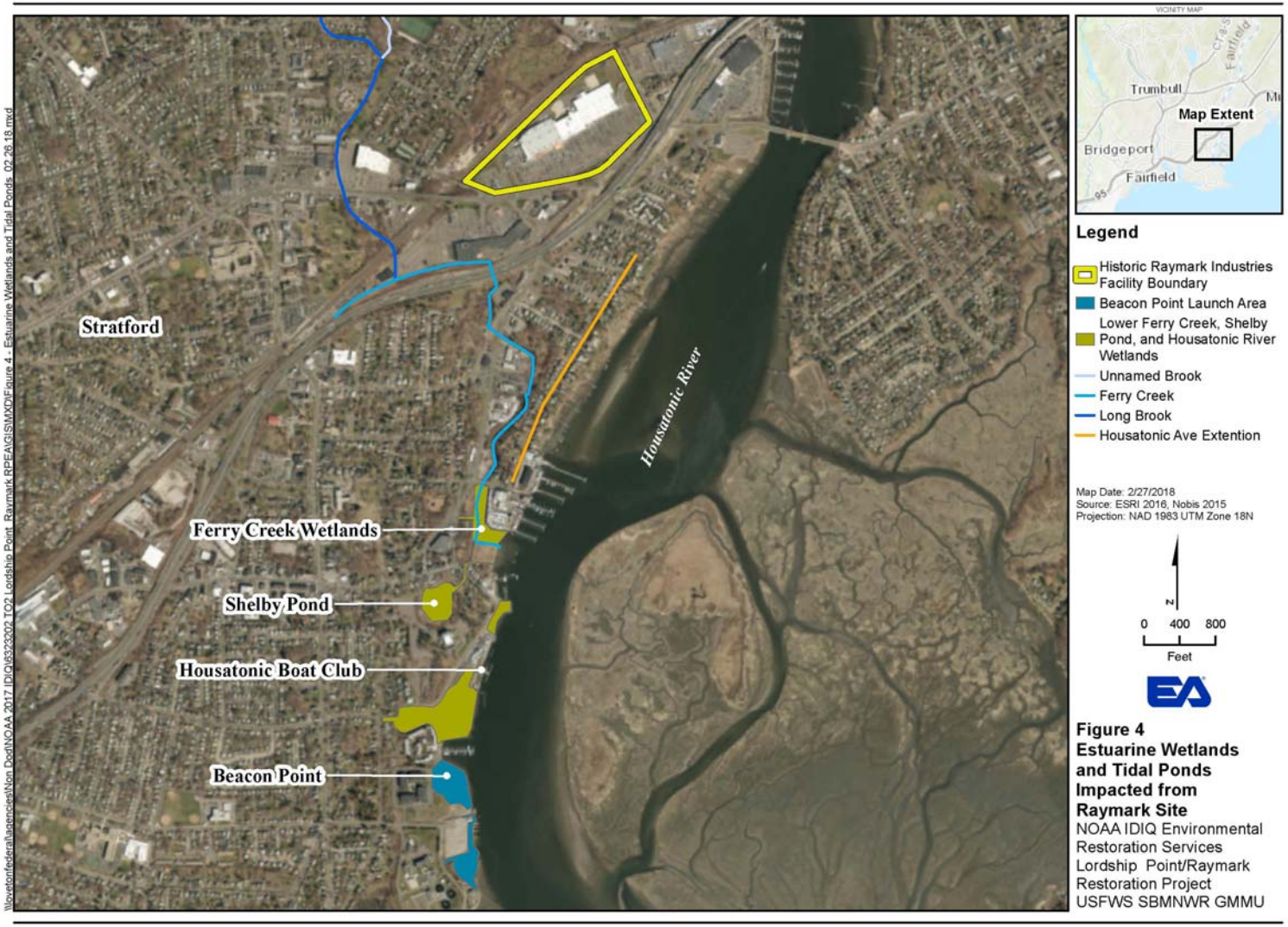
1.2 TRUSTEE CASE ADMINISTRATION

For the Lordship Point settlement, NOAA, USFWS and CT DEEP are Trustees, while NOAA and USFWS serve as Trustees for the Raymark Industries bankruptcy agreement. Working collaboratively, the Trustees propose to implement injury restoration using case funds from the two contaminant releases since the natural resources that were injured were similar, the settlement amounts were relatively small, and the two Sites are in close geographic proximity to one another. Combining the restoration settlement funds from the two cases ($218,000 from Lordship Pt and $526,000 from Raymark Industries) will allow the Trustees to implement more ecologically significant restoration projects cost effectively. Further, to increase the injury restoration action, the Trustees propose to combine the funds from these two Sites with funds previously secured and allocated from the Housatonic River Natural Resource Damages, Connecticut settlement. The Trustees for the Housatonic River previously proposed to combine $300,000 from that settlement with the current settlement funds, as described in the June 2013 Amendment to the Housatonic River Final Natural Resources Restoration Plan, Environmental Assessment, and Environmental Impact Evaluation for Connecticut (CT DEEP 2013). In total, the Trustees will use the combined funds of $1.04 million to undertake restoration planning, engineering design and permitting, project implementation, oversight and management, and restoration performance monitoring activities.

The Trustees have maintained records documenting the information considered and actions taken during this injury assessment and restoration planning process, and these records collectively comprise the Trustees' Administrative Record (AR) supporting this Draft RP/EA. Public comments submitted on this Draft RP/EA, as well as the Final RP/EA, will be included in the AR. The AR records are available for review by interested members of the public. Interested persons can access or view these records at the following address:

NOAA National Marine Fisheries Service
28 Tarzwell Drive
Narragansett, Rhode Island, 02882
c/o: Mr. James G. Turek
Phone: 401-782-3338
Fax: 401-782-3201
Email: James.G.Turek@noaa.gov

Arrangements must be made in advance to review or obtain copies of these records by contacting the person listed above. Access to and copying of these records is subject to all applicable laws and policies including, but not limited to, laws and policies relating to copying fees and the reproduction or use of any material that is copyrighted.


Stratford
Housatonic River
Ferry Creek Wetlands
Shelby Pond
Housatonic Boat Club
Beacon Point
VICINITY MAP
Trumbull
Map Extent
Bridgeport
Fairfield
Legend
Historic Raymark Industries Facility Boundary
Beacon Point Launch Area
Lower Ferry Creek, Shelby Pond, and Housatonic River Wetlands
Unnamed Brook
Ferry Creek
Long Brook
Housatonic Ave Extention
Map Date: 2/27/2018
Source: ESRI 2016, Nobis 2015
Projection: NAD 1983 UTM Zone 18N
N
0 400 800
Feet
Figure 4
Estuarine Wetlands and Tidal Ponds Impacted from Raymark Site
NOAA IDIQ Environmental Restoration Services
Lordship Point/Raymark Restoration Project
USFWS SBMNWR GMMU

1.3 PURPOSE AND NEED FOR RESTORATION

Purpose: The purpose of the proposed restoration is to compensate the public for related injuries to natural resources including tidal marshes and inter-tidal and sub-tidal waters and their biota including fish, shellfish and waterfowl in the Town of Stratford, Connecticut, resulting from the Lordship Point and Raymark Sites contamination releases.

Need: To address this purpose, the Trustees are required to evaluate a reasonable set of potential alternatives for the proposed restoration that will restore, rehabilitate, or improve estuarine habitats and their ecological functions to address injuries to tidal marsh and inter-tidal and sub-tidal waters and aquatic biota including fish, shellfish and waterfowl inhabiting these habitats.

1.4 SUMMARY OF CASE SETTLEMENT AND BANKRUPTCY AGREEMENT

The Trustees combined the settlement funds from the two Sites since the natural resource injuries at the Sites were similar, the settlement amounts were relatively small, and the two Sites are in close geographic proximity to one another. Combining the settlement monies from the two Sites allows the Trustees to implement a more ecologically significant restoration project and to increase cost effectiveness. Details of the legal decisions for each Site are described below.

1.4.1 Lordship Point Agreement

As part of the 2004 settlement agreement with the Trustees, the Potentially Responsible Parties (PRPs) of Lordship Point agreed to provide a total of approximately $218,000 to plan and implement projects to restore natural resources and reimburse costs incurred by the Trustees. These funds, including any accrued interest, will be used for restoration planning, implementation and monitoring and oversight costs. Additionally, as part of the settlement, the PRPs were required to plant 8.2 acres of grassland vegetation within an upland area with native coastal grasses and secure a conservation easement for the Lordship Point property. The conservation easement provides for the property to be maintained as public open space, and is managed by the Connecticut Audubon Society.

1.4.2 Raymark Industries Agreement

Based on the findings from the injury assessment, the Trustees initially presented a claim for $20 million in natural resource damages to the PRP; however, in 1998 (Case File 222 B.R. 19) the PRP filed for bankruptcy. The Raymark Industries available funds and assets were severely limited. In 2005, through court-ordered mediation, the Trustees negotiated a natural resource damages agreement with the PRP based on the limited assets available from the debtor at the time. The agreement was approved by the court on October 16, 2005. Under the terms of the negotiated settlement, the Trustees recovered approximately $526,000 to be used for restoring the injured natural resources and to reimburse Trustees' administrative costs (Case File 89-00293). The Trustees will use the available funds, including any accrued interest, for restoration planning, implementation, and performance monitoring and project oversight costs.

1.5 AUTHORITIES AND LEGAL REQUIREMENTS

This Draft RP/EA was prepared jointly by the Trustees pursuant to their respective authority and responsibilities as natural resource Trustees under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (42 U.S. Code [U.S.C.] § 9601, *et seq.*); the Federal Water Pollution Control Act (33 U.S.C. § 1251, *et seq.*) (also known as the Clean Water Act); and other applicable federal or state laws, including Subpart G of the National Oil and Hazardous Substances Contingency Plan (40 Code of Federal Regulations [CFR] §§ 300.600 through 300.615) and the U.S. Department of the Interior's CERCLA natural resource damage assessment (NRDA) regulations (43 CFR Part 11) which provide guidance for this restoration planning process under CERCLA. As a designated Trustee, each agency is authorized to act on behalf of the public to protect and restore natural resources that have been injured at each Site.

Actions undertaken by the Trustees to restore natural resources or services under CERCLA and other federal laws are subject to the National Environmental Policy Act (NEPA), 42 U.S.C. § 4321 *et seq.*, and the regulations guiding its implementation at 40 CFR Parts 1500 through 1517. NEPA and the implementing regulations outline the responsibilities of federal agencies when preparing environmental documentation. In general, federal agencies contemplating implementation of a major federal action must produce an environmental impact statement (EIS) if the action is expected to have significant impacts on the quality of the human environment. When it is uncertain whether the proposed action is likely to have significant impacts, federal agencies are required to prepare an environmental assessment (EA) to evaluate whether an EIS is required. If the EA demonstrates that a preferred action will not significantly impact the quality of the human environment, the agency issues a Finding of No Significant Impact (FONSI), which satisfies the requirements of NEPA, and no EIS is required. Relative to the restoration plan (RP), the Trustees may issue a Final RP describing the preferred and selected restoration action(s), if a FONSI determination is made. For this Draft RP/EA, NOAA and DOI are acting as co-lead federal agencies for the proposed restoration.

In accordance with NEPA and its implementing regulations, this RP/EA summarizes the current environmental setting; describes the purpose and need for restoration actions; identifies alternative actions; assesses their applicability and potential impact on the quality of the physical, biological and cultural environment; and summarizes the opportunity for public participation in the decision-making process.

1.6 PUBLIC INVOLVEMENT

The Trustees have prepared this Draft RP/EA for public review and comment. The Draft RP/EA provides information on the natural resource injuries and service losses assessed in connection with the Sites, the resource restoration objectives that guided the Trustees in developing this plan, the restoration alternatives that were considered, the process used by the Trustees to identify the Preferred Alternative, and the rationale for its selection. Public review of this Draft RP/EA is the means by which the Trustees seek comment on the restoration action proposed for use to compensate for natural resource injuries and losses. As such, it is an integral and important part of the Natural Resource Damage Assessment (NRDA) process and is consistent with all applicable state and federal laws and regulations, including NEPA and its implementing

regulations, and the regulations guiding assessment and restoration planning in accordance with CERCLA at 43 CFR Part 11.

This Draft RP/EA is being made available for public review and comment for a period of 30 calendar days. The time period and deadline for submitting written comments on the Draft RP/EA will be specified in one or more public notices issued by the Trustees to announce its availability for public review and comment. The electronic version of this document will be posted to: https://www.darrp.noaa.gov/. Comments should be submitted in writing via mail, email, or fax with indication of the subject Lordship Pt and Raymark Industries RP/EA to:

Mr. James Turek
NOAA Restoration Center
28 Tarzwell Drive
Narragansett, RI 02882
Phone: 401-782-3200
Fax: 401-782-3201
Email: James.G.Turek@noaa.gov

Additionally, a public meeting will be held in Stratford, Connecticut, to present and discuss the Draft RP/EA to seek public input. The Trustees will consider all written comments received within the comment period and comments provided at the public meeting in developing and releasing the Final RP/EA. Written comments received, and the Trustees' responses to those comments, whether in the form of conceptual plan revisions or written explanations, will be summarized in the Final RP/EA.

2. NATURAL RESOURCES INJURY ASSESSMENT

This section describes how the Trustees assessed the injury to natural resources at the Lordship Point and Raymark Sites. The injury assessments included determining pathways of contamination, identifying contaminants of concern, and calculating the natural resource injuries.

2.1 BACKGROUND OF CONTAMINANT RELEASES AND RESPONSE ACTIONS

2.1.1 Lordship Point Injury Site

The Lordship Point Gun Club Site is situated on a peninsula located at the mouth of the Housatonic River on the Connecticut shore of Long Island Sound (Figure 2). The land to the north and west is mostly residential. The sub-tidal area surrounding the Lordship Point peninsula is predominantly gently sloping, sandy and gravelly benthic substrate with isolated rocky areas along the shoreline. At mean low water, water depths ranging from 2 to 20 feet (ft) are found within 1,000 ft of the shore.

2.1.2 History of Contaminant Releases and Pathway to Trust Resources

Lead is the principal contaminant of concern at the Lordship Point Site. Battelle Ocean Sciences (Battelle 1987) documented acute lead poisoning in 15 of 28 American black ducks (*Anas rubripes*) captured in the area. Elevated lead levels were also found in blue mussels (*Mytilus edulis*) collected at the Site. Lead shot was found in the sediment sampled from the shoreline out to the limits of the shot trajectory (approximately 275 yards from shore). In response to concerns expressed by the Connecticut Coastal Fishermen's Association, Battelle (1990) assessed the potential effects of polynuclear aromatic hydrocarbons (PAHs) present in target fragments. They found that PAH residues in sediment and biota around Lordship Point were no higher than what can be expected for the area, in general, and concluded that clay targets were not a major source of PAHs in biota. As a result of the 1993 sale of the Remington Arms Company by the DuPont Company, responsibility for the Site was transferred to Sporting Goods Properties, Inc., which is a wholly owned subsidiary of the DuPont Company.

Following the range closure in 1986, remedial activities were performed in 1993 and 2000 through 2001. NOAA and USFWS provided technical assistance to the U.S. Environmental Protection Agency (EPA) for the site remedial action. As a result of the final remedial action, approximately 71,000 cubic yards of contaminated soil and sediment were removed from onsite tidal wetlands and shallow water areas. Fringing salt marsh excavated during cleanup activities was revegetated with native plantings.

The Trustees determined that sediment and surface water were the pathways from the Site to wetlands, intertidal, and sub-tidal habitats and aquatic biota including fish, shellfish and migratory birds. A pathway is defined in CERCLA as the route or medium (for example, water or soil) through which hazardous substances are transported from the source of contamination to the natural resource of concern (43 CFR § 11.14). Contaminated habitats of greatest concern are estuarine wetlands (salt marsh) and intertidal and sub-tidal benthic habitats. The shoreline and nearshore areas of concern provide suitable habitat for a number of migratory and resident bird species including American black duck, mallard (*Anas platyrhynchus*), wood duck (*Aix sponsa*),

great blue heron (*Ardea herodias*), and green-backed heron (*Butorides virescens*). The intertidal and sub-tidal contaminated areas provide critical habitat for a number of shellfish species including blue mussel, hard-shelled clam (*Mercenaria mercenaria*), American oyster (*Crassostrea virginica*), razor clam (*Ensis directus*), soft-shell clam (*Mya arenaria*), and bay scallop (*Argopecten irradians irradians*). This area also serves as nursery habitat to benthic and pelagic fishes such as the summer flounder (*Paralichthys dentatus*), as well as use by migratory ("diadromous") fishes such as the American shad (*Alosa sapidissima*), American eel (*Anguilla rostrata*), alewife (*Alosa pseudoharengus*), blueback herring (*Alosa aestivalis*), striped bass (*Morone saxatilis*), and semi-anadromous white perch (*Morone americana*).

2.1.3 Raymark Industries Injury Site

The former Raymark Industries facility footprint is bordered to the northwest by railroad track, to the northeast by Route 110, and to the south by Interstate 95. Surface runoff from the former facility flowed through an underground culvert to Ferry Creek, approximately 0.9 miles from its confluence with the Housatonic River. The freshwater Creek originates from Brewster's Pond via Long Brook (Figures 4 and 5).

2.1.3.1 History of Contaminant Release and Pathway to Trust Resources

The contaminants of primary concern to natural resource injuries include lead, copper, zinc, polychlorinated biphenyls (PCBs), and dioxins. The contamination has primarily resulted from both the disposal of the facility's wastewater and through the filling of tidal marshes along the Housatonic River. It has been estimated that during peak production in the 1970s, approximately 750,000 gallons per day of wastewater were discharged via the settling lagoons to Ferry Creek (Weston 1993). Ferry Creek, its area of confluence with the Housatonic River, and all wetlands adjacent to these two areas, have been highly contaminated (Figure 4). Wetland sediments adjacent to the creek contain copper, lead, nickel, zinc and PCBs above the NOAA Effects Range-Median (ER-M) criteria (Weston 1993). In addition to the contamination derived from wastewater associated with the facility, numerous spills of both above- and below-ground storage tanks also contributed to contamination within the facility footprint (Weston 1993). Most importantly, the EPA has drafted sediment remedial goals that will result in the need for sediment removal due to existing toxic conditions adversely affecting local natural resources.

Much of the contamination located in freshwater ponds outside of the facility footprint is from dredged waste spoils from the facility settling lagoons. The dewatered asbestos and lead solids, which amounted to approximately 10,000 cubic yards (cy) per year, were annually dredged and disposed outside of the facility footprint in various locations throughout Stratford, predominately in Wooster, Brewster's and Frash Ponds (Figures 3, 4, and 5). Many of the disposal locations were lowland areas, and the dredged material was often used as fill to support further land development. Sediment and water samples from numerous wetland and open water habitats on and immediately adjacent to the former facility, downstream, and from the disposal locations outside of the facility footprint are contaminated with asbestos, heavy metals, PCBs, and dioxins. Wetland sediments from locations filled with dredged materials or adjacent to dredged material disposal areas contain contaminants, including lead, zinc, and PCBs that exceed NOAA ER-Ms. The EPA Ecological Risk Assessment shows considerable ecological risk in the estuarine portion of Ferry Creek and adjacent freshwater environments.

Figure 5
Estuarine Wetlands and Tidal Ponds - South
NOAA IDIQ Environmental Restoration Services
Lordship Point/Raymark Restoration Project
USFWS SBMNWR GMMU

In 1990, EPA ordered an emergency removal of materials to an offsite disposal location associated with the Site; in 1992, EPA ordered another emergency removal within the Raymark facility footprint. In March 1994, EPA added the Raymark Site to the National Priorities List. The Site was then divided into Operable Units, and remediation actions have been ongoing.

Within the Raymark Industries Site (which includes the former facility footprint and disposal areas within Stratford), the Trustees determined that effluent and surface runoff were the pathways from the Site to freshwater and estuarine wetlands and ponds. There are three primary contaminated habitats of concern injured by the Raymark Site: (1) freshwater wetlands, (2) freshwater ponds and (3) estuarine wetlands and tidal ponds. Habitat characteristics and potential types of receptors at each are described below.

Freshwater Wetlands

The majority of the freshwater wetland habitat consists of scrub/shrub swamp and emergent marsh. The wetlands are moderately disturbed due to the surrounding industrialized area and much of the vegetation is comprised of non-native, invasive common reed (*Phragmites australis*). Despite the level of disturbance in and surrounding these wetlands, they provide critical habitat for resident or transient wildlife which frequent this coastal marsh habitat. In particular, these wetlands provide suitable habitat for a number of migratory and resident bird species, including Canada geese (*Branta canadensis*), American black duck, mallard, wood duck, great blue heron, green-backed heron, red-shouldered hawk (*Buteo lineatus*), blue jay (*Cyanocitta cristata*), belted kingfisher (*Megaceryle alcyon*), American robin (*Turdus migratorius*), tree swallow (*Tachycineta bicolor*), marsh wren (*Cistothorus palustris*), yellow throat (*Geothlypis trichas*), red-winged blackbird (*Agelaius phoeniceus*), eastern kingbird (*Tyrannus tyrannus*), song sparrow (*Melospiza melodia*), swamp sparrow (*Melospiza georgiana*), eastern phoebe (*Sayornis phoebe*), ovenbird (*Seiurus aurocapillus*), and yellow warbler (*Dendroica petechia*).

Freshwater Ponds

Freshwater ponds impacted by contamination (from use as disposal areas) from the Raymark Site include Wooster Pond and Brewster's Pond (Figure 4). The ponds are located in residential, highly disturbed areas; however, these waterbodies provide habitat for a number of species including fish such as brown bullhead (*Ameiurus nebulosus*), bluegill (*Lepomis macrochirus*), and largemouth bass (*Micropterus salmoides*), and migratory and resident birds similar to those species which inhabit the freshwater wetlands.

Estuarine Wetlands/Tidal Ponds

Estuarine wetlands and tidal ponds affected by contamination from the Raymark Site include Ferry Creek (stream and wetland below the tidal gate), Selby Pond, Frash Pond, tidal waters encompassing the Housatonic Boat Club, waters around Beacon Point, and Great Meadows (Figures 4 and 5). Wetland habitats consist of tidal marshes dominated by native smooth cordgrass (*Spartina alterniflora*) and salt meadow cordgrass (*S. patens*) and non-native, invasive common reed. Numerous migratory bird species, including those which frequent the freshwater

wetlands, are found also in these habitats. Sub-tidal waters of the Housatonic River and the outlet of Ferry Creek are particularly important as they provide habitat for migratory and seasonal resident fish species including American shad, American eel, winter flounder (*Pleuronectes americanus*), sea run brown trout (*Salmo trutta*), alewife, blueback herring, striped bass, and white perch.

2.2 INJURIES TO NATURAL RESOURCES

The Trustees chose a Habitat Equivalency Analysis (HEA) (NOAA 2000) approach to quantify the injuries, as described above, to aquatic and terrestrial organisms resulting from releases from the Sites. The HEA is a natural resource injury accounting procedure that allows parties to identify "debits" (estimating habitat injuries or other resource service losses) due to exposure to hazardous substances, and to identify the scale of restoration required to compensate for assessed injuries or losses. It also allows the debit to be balanced against the ecological services to be gained (credited as "compensation") from proposed habitat restoration projects. The type, scale, or size of a restoration project should be such that the project(s) provides adequate ecological service gains to offset the total of the natural resource injuries and losses.

For both Sites, the HEA model determined potential habitat area for each of the impacted habitats that would need to be restored to compensate for the calculated injury, and to compensate for varying magnitudes of future lost natural resource services. Unfortunately, circumstances at each site precluded the Trustees from attaining the acreage goals as prescribed by the HEA models. For the Lordship Point Site, the statute of limitations for impacts to the Site resulted in the Trustees settling for far less restoration than the HEA models prescribed. Similarly, at Raymark, the bankruptcy agreement (see Section 1.4.2) also resulted in the Trustees receiving substantially less funds than were necessary to complete the restoration prescribed by the HEA model.

3. RESTORATION PLANNING

3.1 RESTORATION GOALS AND OBJECTIVES

The goal of the restoration planning process is to identify potential restoration alternatives to restore, rehabilitate, replace, or acquire natural resources and their services equivalent to natural resources injured or lost as a result of the release of hazardous substances. The restoration planning process may involve two components: primary restoration and compensatory restoration. Primary restoration actions are actions designed to assist or accelerate the return of resources and services to their pre-injury or baseline levels. Primary restoration is often completed soon after a spill or in association with remedial contaminant cleanup actions. In comparison, compensatory restoration includes actions to address interim losses of and injuries to natural resources and their ecological services, until these services recover to baseline levels, which are the environmental conditions that existed, had the contaminant release not occurred.

For the Lordship Point Site, onsite primary restoration was performed as a component of the initial remedial action by placement of clean sands once contaminated intertidal and sub-tidal sediments were removed. Additionally, grassland habitat was created as a component of the primary restoration of Site uplands. The Trustees have developed the restoration actions proposed in this Draft RP/EA as compensatory restoration. The restoration actions undertaken through this Draft RP/EA will address both Sites with an aim to protect injured natural resources near the Sites from future harm while allowing the areas' natural resources to return to pre-injury conditions within a reasonable time period.

3.2 RESTORATION SELECTION CRITERIA

Consistent with the NRDA regulations (43 CFR 11.82), the following criteria were used to evaluate restoration project alternatives and identify the project preferred for implementation under this plan:

- technical feasibility;
- relationship of expected costs of the proposed actions to the expected benefits from the restoration, rehabilitation, replacement, and/or acquisition of equivalent resources;
- cost-effectiveness;
- results of any actual or planned response actions;
- potential for additional injury resulting from the proposed actions, including long-term and indirect impacts, to the injured resources or other resources;
- the natural recovery period of the injury;
- ability of the resources to recover with or without alternative actions;

- potential effects of the action on human health and safety;
- consistency with relevant federal, state, and tribal policies; and
- compliance with applicable federal, state, and tribal laws.

The NRDA regulations give the Trustees discretion to prioritize these criteria and to use additional criteria as appropriate. In developing this Draft RP/EA, the first two criteria listed have been a primary consideration, because they are paramount to ensuring that the restoration action will compensate the public for the resource injuries resulting from Site releases, consistent with the proposed assessment of compensation requirements for the Site.

Additional criteria considered to evaluate the restoration project alternatives included the criteria from the Oil Pollution Act regulations (15 CFR 990.54). These criteria are similar to the criteria listed above in the NRDAR regulations, and include the following:

- extent to which each alternative is expected to meet the Trustees' restoration goals and objectives;
- cost to carry out the alternative;
- likelihood of success of each project alternative;
- extent to which each alternative will avoid collateral injury to natural resources as a result of implementing the alternative;
- extent to which each alternative benefits more than one natural resource or service; and
- effects of each alternative on public health and safety.

3.3 SCREENING FOR POTENTIAL ALTERNATIVES

The Trustees used the criteria listed above, and considered spatial nexus to the injury, technical feasibility, a cost-to-benefits comparison, and achieving the goals and objectives of the restoration as the highest priorities for the compensatory restoration actions. The Trustees' goals and objectives for compensating for the injured natural resources and services include restoring coastal wetlands to benefit estuarine fishes and migratory birds. Therefore, restoration alternatives that focused on the restoration of salt marsh habitat were given the highest priority. Site identification was conducted in the lower Housatonic River watershed or in close proximity but outside of the watershed to identify potential restoration projects at or near the same geographic location of the injury.

4. PROPOSED ACTION AND ALTERNATIVES

To identify potential restoration sites and evaluate restoration alternatives, the Trustees conducted a site identification screening and selection process using the best available information from local, state, and federal governmental and non-governmental sources. The Trustees searched for and considered projects that would benefit coastal wetlands, estuarine and diadromous fishes, and migratory and resident birds that were injured by the contaminant releases.

4.1 ALTERNATIVES NOT FURTHER EVALUATED

The Trustees initially conducted reconnaissance surveys to multiple sites in Stratford and neighboring municipalities to consider potential natural resource restoration projects. At least eighteen sites were visited and approximately ten projects were initially considered as potential restoration alternatives. This effort resulted in evaluation of a group of alternatives that covered a broad geographic coverage (i.e., further upstream of the Housatonic River and further along Long Island Sound shoreline) and involved restoration actions with varying habitat types. However, many of the sites were ineligible as restoration, were of inadequate size, would not result in the type of habitat restoration sought, or were not cost-effective in achieving the requisite restoration. The Trustees concluded that these restoration projects did not meet one or more of the project eligibility or evaluation criteria, and were ultimately eliminated from further evaluation.

4.2 ALTERNATIVES CONSIDERED IN DETAIL

The alternatives retained for detailed analysis include the Preferred Alternative, two Non-Preferred Alternatives, and a No Action Alternative. The Preferred Alternative, Marsh Restoration at the Stewart B. McKinney National Wildlife Refuge (NWR), is comprised of a set of six potential projects (Figure 6). Each of the six potential projects is physically sited within the Great Meadows Marsh Unit (GMMU) of the Stewart B. McKinney NWR in Stratford, and each has been conceptually developed to address the specific restoration objective for the two contaminant releases. Another component of the preferred alternative is to use clean fill excavated and removed from the GMMU to potentially place in an existing area of nearby salt marsh restoration that was constructed in 2006 (originally constructed by the Stratford Development Corporation as mitigation for industrial development), but appears to be adversely affected by low marsh platform elevations (Figure 6). A description of the GMMU restoration areas and rationale for the proposed selection for restoration project siting are presented in Section 4.2.1.1.

The two Non-Preferred alternatives addressed in this Draft RP/EA, including the Long Beach groin removal/shortening and the Shore Beach living shoreline, are also located within coastal areas in the Town of Stratford (Figure 7) and are evaluated here, plus a No Action Alternative is also presented for impact comparison purposes. The rationale for retaining an alternative for detailed evaluation is presented in Table 1, which is located at the end of this chapter.

The projects retained for detailed analysis generally meet the criteria presented in Chapter 3. Specifically, each of these projects meets the priority criteria of geographic nexus and proximity

to the injury, technical feasibility, and cost-effectiveness for the benefits that the project area is expected to receive from restoration or rehabilitation. These projects would also be unlikely to result in additional injury (including long-term adverse impacts) to injured resources and would be designed to complement the natural recovery processes that are anticipated to occur in each area. The retained projects would also be unlikely to negatively impact human health or safety (both during and upon completion of construction) and implementation would be required to comply with federal, state, local and any applicable tribal laws and regulations.

Figure 6
Stewart B. McKinney NWR GMMU
Restoration Area NOAA IDIQ Environmental Restoration Services Lordship Point/Raymark Restoration Project USFWS SBMNWR GMMU

Figure 7
Non-Preferred Alternatives
NOAA IDIQ Environmental Restoration Services
Lordship Point/Raymark Restoration Project
USFWS SBMNWR GMMU

4.2.1 Preferred Alternative: Salt Marsh Restoration at the Stewart B. McKinney National Wildlife Refuge

The goal of the Preferred Alternative is to restore specific salt marsh and intertidal mudflat habitats to benefit fish and wildlife species, improve ecological services, and enhance the resiliency of coastal wetlands. The Preferred Alternative represents a comprehensive approach that would restore the range of injured natural resources and services that occurred at the Lordship Point and Raymark Sites. With this alternative, the Trustees would implement one or more marsh restoration projects that individually benefit targeted species, habitats, water quality, and human uses, as well as collectively achieving the broader goals of compensatory restoration. Projects 1 through 4 involve fill removal, soil fill placement (also often called "thin-layer placement" (TLP)), and/or restoration of tidal hydrology through channel construction and/or berm breaching/removal. Collectively, these actions result in tidal reconnection of marsh and influencing tidal exchange. Project 5 involves removal of a defunct flap gate and culvert replacement to restore hydrologic reconnection of marsh with normal tidal exchange. Project 6 involves invasive plant species management that would be implemented throughout a broad area, including the areas of Projects 1 through 5. The TLP activity at the existing marsh restoration site would be implemented along with one or more projects sited in the six described areas. This activity would involve the use and placement of clean excavated soils from upland fill that is undertaken to construct the marsh restoration at the GMMU sites. Excavated soils would then be placed on an area of the existing saltmarsh that is undergoing marsh vegetation loss due to low marsh platform elevations, relative to the tidal hydrology and prolonged flooding.

4.2.1.1 Description of the GMMU and General Evaluation of Marsh Restoration Projects

The six proposed marsh restoration projects that comprise the Preferred Alternative are situated in the GMMU of the NWR. The natural resources present in this area are representative of the resources injured within the geographic nexus of the Lordship Point and Raymark Sites. Additionally, projects focused within the GMMU can be implemented without additional land acquisition costs because the restoration sites are owned by USFWS. Siting restoration within the NWR will result in a larger area of protected, heterogeneous habitat than would be possible at other locations that are privately owned or not presently under active conservation. Further, as a designated NWR, the area is managed by USFWS for the long-term preservation and conservation of natural resources, including estuarine habitats.

The GMMU area is predominately saltmarsh habitat that has been previously disturbed by the historic placement of dredged soils and filling of wetlands in the 1950s. As a result, many areas of high elevation exist that no longer function as wetland habitat, while many existing areas of low-lying marsh have poor to very poor drainage which negatively impacts the functioning of the low marsh habitat, and which creates secondary problems such as high mosquito production and potential human health issues. The Trustees aim to restore the area with both low, well-flushed, regularly flooded marsh and irregularly flooded conditions which support native a native high marsh plant community. In an effort to help ensure restoration success in these areas, the projects will be designed such that the final elevations of both low and high marsh communities are targeted on the higher end of the acceptable elevation range for these habitats; this design measure will allow for greater resiliency and response to sea level rise.

To maximize the restoration of injured resources at the Lordship Point and Raymark Sites, the Trustees seek to implement the full suite of projects; the ability of the Trustees to execute each project will be dependent upon the cost of the final design, construction, and future maintenance and monitoring efforts that may be implemented for each project. Each of the projects would enhance or restore similar natural resources that were injured by the contaminants released at the impacted Sites. Though occurring outside the Housatonic River watershed, the GMMU falls within the town of Stratford and restoration actions implemented here will benefit many of the same species that utilize the general Housatonic River watershed area. Projects included in the Preferred Alternative also are expected to have a low to moderate cost per unit of restored habitat, and would enhance existing ecological services at the GMMU and provide measurable benefits for fish and wildlife species.

These projects would involve soil removal and removal of invasive shrubs (little to no tree removal would occur), and projects would also involve improvement to hydrologic connectivity. Material excavated to create improved marsh habitat would be placed in other areas within the Site boundaries (as opposed to being hauled offsite), so long as acceptable disposal locations are available and placement of material would have minimal impacts on the disposal site. The conceptual restoration design developed by the Trustees and the analytical results of the soil sampling locations within the GMMU area are included in Appendix A. Placement of the excavated soils is considered a TLP project for which the Trustees seek to implement at the time of execution of one or more of the six marsh restoration projects. During the design phase for the projects, additional soil sampling would be completed for contaminant analyses, and a determination would be made if areas targeted for TLP would also require plug plantings or seeding to expedite recolonization of native salt marsh species, or whether the area(s) would naturally recolonize without seeding or plantings. The amount of plantings and seeding that may occur with project execution will depend on funds available for purchasing and installing native marsh plants and/or seed.

Each of the proposed marsh restoration projects including fill removal and/or TLP, are described in detail below.

4.2.1.2 Preferred Alternative: Marsh Restoration Project 1

Marsh Restoration Project 1 would be implemented at a small pond located on the western side of the GMMU, adjacent to the walking trail and documented terrapin nesting habitat (Figure 8). The 0.5-acre pond and existing wetlands dominated by common reed totaling approximately 0.7 acre would be connected to an existing intertidal creek channel to provide regular tidal exchange. The proposed work activities would involve breaching of an existing berm and construction of an intertidal creek channel to connect the pond area with a nearby existing salt marsh creek. The freshwater pond would be converted to intertidal marsh habitat dominated by smooth cordgrass (*Spartina alterniflora*). This alternative would leave the majority of the existing sandy, man-made berm intact, as it is beneficial to diamondback terrapin (*Malaclemys terrapin terrapin*) as nesting habitat, and this area would be enhanced through the removal of invasive plant species such as autumn olive (*Elaeagnus angustifolia*). Public foot-access along the berm could be maintained, but restricted to a narrow pathway by the planting of native shrub-scrub species, to avoid secondary impacts to terrapin nesting habitat. Marsh elevations and the tidal hydrology affecting the habitat between and/or along the pond could be restored to provide

marsh pink (*Sabatia stellaris*) habitat in the restored high marsh area between the two ponds. This alternative may also include marsh pink propagation and a marsh pink planting program with oversight by botanical experts supporting the Trustees.

During development of Project 1, the Trustees originally considered restoring flow to a larger 3-acre pond to the east of the small pond. Upon review and input from CT DEEP technical staff, the Trustees agreed to providing a tidal connection and tidal exchange to only the smaller 0.5-acre pond, and maintaining the existing 3-acre pond and berm as a coastal freshwater habitat.

Construction access for Project 1 would occur from the GMMU dirt parking lot and extend the length of an existing access path comprised of stone and gravel fill. Construction equipment access would then continue in a westerly direction along the upland edge bordering the saltmarsh boundary. The existing access path is of adequate width for construction equipment access; therefore, tree removal will be avoided, especially larger trees deemed suitable as potential nesting habitat for the federally-protected northern long-eared bat (*Myotis septentrionalis*). However, if tree removal is required, these actions would need to adhere to time-of-year restrictions, as recommended by USFWS in its January 2017 project consultation.

4.2.1.3 Preferred Alternative: Marsh Restoration Project 2

Targeted fill removal and channel construction would occur in a tidally restricted and filled area southeast of the GMMU parking lot and east of Project 1 (Figure 8). Channel construction is needed in the poorly drained, common reed-dominated southern portion of this area to provide regular tidal exchange, which would allow for access and use by fish and other free-swimming aquatic organisms. By improving tidal exchange and the introduction of nekton, this will help reduce the production of nuisance mosquitoes that pose a human health risk through the distribution of diseases. The berm currently restricts tidal exchange, making the site favorable to breeding salt marsh mosquitoes. Fill removal would occur in the northern portion of this area along with perimeter berm removal to restore both high and low marsh elevations. Final grades for each of the marsh restoration areas will be determined after the release of the Final RP/EA and during the design phase.

Existing marsh with documented marsh pink populations would be protected and enhanced by the proposed restoration activities such as removing invasive plants and regrading targeted areas to create suitable habitat for this species. This alternative may also include marsh pink propagation and planting.

This alternative would restore a modestly large area of tidal wetland (approximately 6.5 acres) through the excavation and disposal of approximately 8,285 to 14,190 cubic yards of soils. Excavated soils could be placed in targeted areas as TLP, or to minimize wetland impacts and protect existing forested and/or scrub-shrub transitional habitat used by songbirds along the western border of this area. It is also possible that the excavated sediment could be used to expand/reinforce the existing berm to protect these uplands from more frequent and stronger storm events and saltwater intrusion.

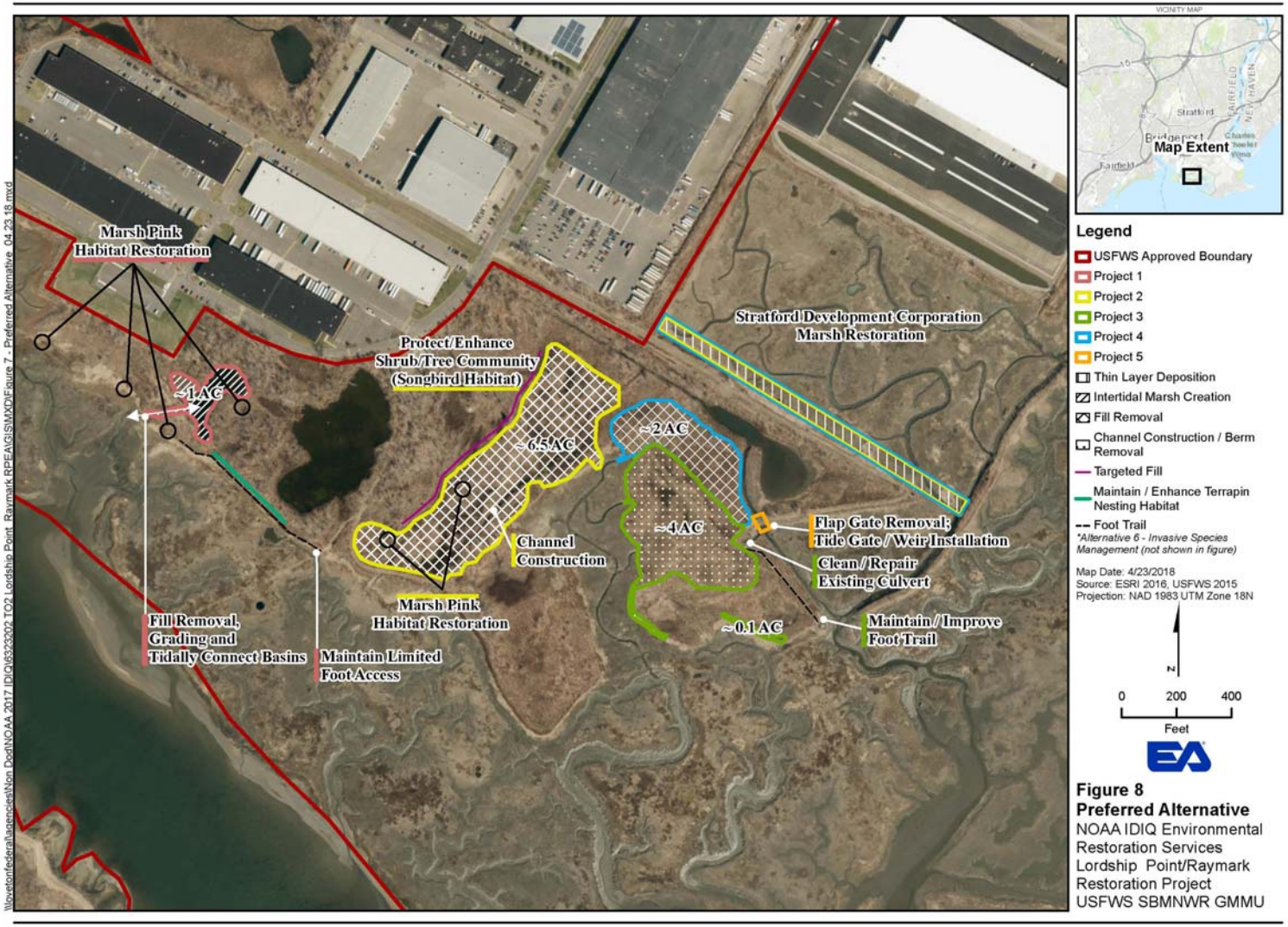


Figure 8
Preferred Alternative
NOAA IDIQ Environmental Restoration Services
Lordship Point/Raymark Restoration Project
USFWS SBMNWR GMMU

A second option for disposal of the excavated sediment is to utilize it to increase the elevation of a portion of the southwest edge of the existing salt marsh bordering the Stratford Development Corporation Industrial salt marsh restoration site and bordering the GMMU (along the north side of the access way to GMMU) where salt marsh vegetation die-back and marsh loss is apparent (Figure 8). The area along the southwest edge of the Stratford Development Corporation marsh mitigation site appears to be too low in elevation, relative to the normal daily tidal flooding and drying (ebbing) of the marsh, and as such could benefit from TLP to provide increased elevations resulting in a healthier, more resilient marsh plant community.

Construction access for Project 2 would occur as described for Project 1. Any impacts from this construction access will need to be addressed as outlined under Project 1.

4.2.1.4 Preferred Alternative: Marsh Restoration Project 3

Marsh Restoration Project 3 would be implemented within an approximately 3.8-acre common reed-dominated area located on the southeast side of the GMMU, adjacent to the walking trail (Figure 8). Currently, tidal flooding occurs primarily via two locations along the marsh border through a 2-ft-diameter unrestricted culvert (approximately 25 ft in length) under the walking trail to the east. The culvert, undersized and in disrepair, has a downstream invert elevation of 4.6 ft and an upstream invert elevation of 3.4 ft, suggesting that only higher tidal flows are transported through the culvert. An existing small rock weir in the channel downstream of the culvert has a crest elevation of ~3.3 ft, which is the highest point in the channel. While much of the northwest portion of the marsh is dominated by stunted, non-native common reed, a remnant, native saltmarsh rush (*Juncus gerardii*) patch is located on the west side of the marsh and exists at an elevation of approximately 5.7 ft National Geodetic Vertical Datum 1929 (NGVD29). A tidal pond located on the west side of this area receives tidal flow inputs from two constructed tidal channels.

The focus of Project 3 would be soil excavation and channel construction to improve regular tidal exchange within the existing poorly drained low marsh (and to eliminate mosquito production, which is a human health hazard as described in Section 5.3.2); removal of perimeter berm to provide the marsh platform with tidal sheet flow; and cleaning and/or repair or replacement of the existing culvert under the GMMU public walking trail to enhance tidal exchange via the culvert.

Similar to Project 2, this target elevation range considers sea-level rise and final proposed grades would be determined during the design phase. By lowering existing marsh elevations, more frequent diurnal tidal flooding would result, supporting a low marsh, smooth cordgrass-dominated plant community, while higher elevations may support native high marsh species such as salt hay (*Spartina patens*). This alternative would convert some high marsh to primarily low marsh to create conditions minimizing potential for common reed re-colonization. Tidal flooding would be increased by excavating one or more channels traversing the area. Channel dimensions would be developed during the final design of the project. The existing culvert under the walking trail would be replaced with a larger (e.g., 4-ft-high by 6-ft-wide box, but to be modeled for size), prefabricated concrete box culvert set at an appropriate elevation to effectively convey tidal flows. The walking trail in the vicinity of the culvert crossing would be raised using excavated soils to inhibit tidal overwash by all but anomalous storm event flood conditions. The

actual dimensions of a replacement culvert would be determined during the project design phase. This project would result in the excavation and disposal of approximately 6,575 to 10,530 cubic yards of soils.

Construction access for Project 3 would occur largely as proposed for the previous projects. One additional consideration is that Project 3 is sited parallel to an abandoned CSX Corporation railroad tracks and a gravel road currently used for refuge visitor access and under private ownership. A temporary access easement may be required if construction equipment would need to pass through this property. The construction access would need to be cleared of trees and underbrush and could be used into the future as a permanent visitor access (as an alternative to the fill road under private ownership). Any impacts resulting from the construction access will need to be addressed as outlined under Project 1.

4.2.1.5 Preferred Alternative: Marsh Restoration Project 4

Project 4 includes soil fill removal (up to an approximate 5-ft excavation depth) to restore approximately 2 acres of low and high marsh immediately north of Project 3 and west of the man-made pond (Figure 8). Similar to Projects 2 and 3, this elevation range takes into account sea-level rise, and final proposed grades would be determined during the design phase.

Channels would also be excavated as a component of this alternative with connection into previously excavated channels to the west of this Site. This alternative could also include habitat enhancement for marsh pink, plant propagation and planting. Excavated fill soils would be strategically placed in onsite uplands or disposed of offsite.

This alternative would result in the excavation and disposal of approximately 2,447 to 5,158 cubic yards of soils. Similar to Projects 2 and 3, excavated sediment could be used either for TLP or to expand/reinforce existing forested and/or scrub-shrub transitional habitat.

The same construction access proposed for Marsh Restoration Project 3 would be utilized for implementation of Marsh Restoration Project 4. Any impacts from construction access will need to be addressed as outlined under Project 1.

4.2.1.6 Preferred Alternative: Marsh Restoration Project 5

This project would modify or replace the existing defunct culvert and flap gate that currently discharges flows from the landward man-made pond that connects a stormwater basin to the saltmarsh (Figure 8). This culvert underlies a recreational trail that leads to the larger of two McKinney NWR observation decks. The existing culvert is undersized and severely undercut, and the existing flap gate has a corroded hole in the structure. A toppling chain-link fence, originally installed to protect pedestrians from a steep drop-off to the channel but no longer serving this purpose, is located on the landward side of the trail overlying the defunct culvert. The flap gate would be removed, and tidal flow would be established provided impacts to upgradient infrastructure would not be adversely affected. Alternatively, a tide gate or managed weir (AgriDrain water control structure or equivalent) would be installed to allow increased, regular tidal exchange with the pond, but limit tidal flooding to prevent flooding of upgradient industrial warehouses and infrastructure (to be further assessed). The USFWS would be

responsible for managing and maintaining the structure, following an operation and maintenance plan that would be developed as part of this restoration alternative.

This project would increase tidal exchange and flushing, enhance tidal habitat conditions within the approximately 1.75-acre shallow water pond upstream of the culvert, and potentially affect additional surrounding marsh area bordering the pond through an increased tidal range and subsequent shift in plant life and wildlife usage. Another option would be to replace the existing defunct culvert and flap gate with an open channel and approximate 35-ft long pedestrian bridge spanning the channel. A bridge rather than a culvert would allow a greater volume of tidal exchange between the landward man-made pond and the seaward salt marsh. Handrails on the short foot-bridge span would add to the safety of recreational trail users. If the culvert were removed and not modified or replaced with a similar culvert or pedestrian bridge, access to the existing observation deck would be unavailable. The engineering phase for this alternative would include assessment to determine if upstream flooding would potentially occur if no flap gate was installed.

As there is no requirement to accommodate emergency vehicle access past the point of the existing undersized culvert, the replacement of this culvert with a pedestrian bridge would not need to accommodate a vehicular load requirement.

The same construction access proposed for Marsh Restoration Projects 3 and 4 would be utilized for implementation of Marsh Restoration Project 5. Any impacts resulting from construction access will need to be addressed as outlined under Project 1.

4.2.1.7 Preferred Alternative: Marsh Restoration Project 6

Project 6 addresses the control of common reed, autumn olive, and other non-native, invasive plant species within the GMMU. Invasive plant control would be accomplished by one or more cuttings of common reed, cutting of autumn olive, and one or more herbicide applications to control these non-native plants. Work would be completed by experienced and licensed pesticide applicators and restoration specialists from or contracted through CT DEEP or USFWS. A total of up to 10 acres of the GMMU would be addressed by this alternative, and be carried out over a 5-year period, pending restoration fund availability. Components of this alternative would likely be carried out, regardless of which of the other alternatives are selected for implementation (if the entire suite of restoration site alternatives is not selected).

Large areas of GMMU are currently invaded with thick growth of common reed, autumn olive, and other non-native, invasive plants. Although these plant species may provide some shelter and a limited food source for wildlife, they typically support a lower diversity and biomass of macro-invertebrates, and they may also render habitat unsuitable for foraging or nesting by birds and mammals. One prime example of this at GMMU is the colonization of terrapin nesting areas by autumn olive, which establishes and thrives on loose, poor, sandy soils. If work is conducted within areas known to host marsh pink, all activities would be first coordinated with and approved by CT DEEP and USFWS. Seasonal time restrictions may be implemented to protect other coastal resources or state-listed species documented in the vicinity.

Construction access for Project 6 is expected to utilize the same roads as construction access for Projects 1 through 5. Any impacts from construction access will need to be addressed as outlined under Project 1.

4.2.2 Non-Preferred Alternative: Long Beach Groin Modification

Long Beach is a coastal barrier beach and back marsh system located immediately south of the Stewart B. McKinney NWR and southeast of Pleasure Beach Park (Figure 7). Seven stone groins are present along the south shore of this barrier beach, affecting natural sediment longshore transport and beach habitat on Long Beach; there is currently a lack of sediment transport from the east to replenish the beach. This alternative would potentially restore sub-tidal shellfish habitat by removing outer portions of existing stone groins originally constructed in 1965. Removal of a portion of the groin length would open up important benthic habitat (bottom substrate) for fauna including macroinvertebrates and shellfish. Removal of a minimum of one-half to more than one-half of the groin length will likely not have an adverse effect on Long Beach, but a physical processes study would be needed to confirm this.

This alternative would also address a goal of the Habitat Management Plan for Long Beach (Metzler and Rosza 2013), which recommends that the town of Stratford evaluate the benefit and liability of the groins on Long Beach including the role that these structures may contribute in dune erosion and inlet formation.

Through this alternative, natural resources that were injured at the impacted sites would be potentially enhanced or restored; however, the project would have significant cost considerations. Barging the large removed stones to disposal sites (or to a location that could reuse the groin stones) would likely drive the cost of this project higher than others being considered. Additionally, this alternative would require the development of a coastal sediment-transport model to predict the effect of groin removal. The development of this modeling and higher material transportation costs would likely not justify the cost of construction given the smaller footprint of the habitat restoration (under 2 acres).

4.2.3 Non-Preferred Alternative: Short Beach Living Shoreline

The Short Beach living shoreline alternative would serve to restore a shoreline reach along Lordship Point (Figure 7) by installing large reef balls (i.e., concrete, spherical structures with various sized openings to allow fauna to colonize) approximately 100 ft seaward of the high tide line, establishing marsh vegetation on clean fill placed behind the reef balls, and constructing coastal sand dunes. This alternative would create potential finfish and oyster habitat similar to the Dupont Stratford Point living shoreline project completed in 2014, to the east of the proposed town-owned Short Beach site.

Although this project has a direct nexus with impacted species and habitat, the construction of a living shoreline would be costly relative to the benefits, and would not likely be offset by the habitat types created. The Trustees however reviewed the monitoring reports for the nearby existing Dupont living shoreline site, which indicate recruitment of oyster spat has been observed, and the artificial reef is providing refuge habitat for a number of macro-invertebrate

and macroalgal species. This site is subject to high tidal energies and storm events, and is thus a location of greater risk of disturbance and failure.

4.2.4 No Action Alternative

The No Action (i.e., natural recovery) alternative is considered in this Draft RP/EA as required by NEPA and the CERCLA NRDA regulations. Under the No Action Alternative, no restoration, rehabilitation, replacement, or acquisition actions would occur. This alternative costs the least because no action would be taken. If selected, there would be no restoration or replacement of the lost resources, and their services and the public would not be made whole for past injuries from the Sites. The No Action Alternative would consist of maintenance work in the affected area that may be carried out by state or federal agencies, to maintain or protect existing resources; no actual restoration actions would be implemented to restore, replace, or enhance resources.

While technically a feasible alternative when screened under the restoration criteria, the No Action Alternative would not meet the goals of the Trustees for the Sites, nor would it provide the compensatory restoration required by the Consent Decree. Therefore, the No Action Alternative is retained for comparative purposes only.

Table 1. Screening Summary of Potential Restoration Alternatives

Restoration Alternative	Project Meets Trustees Goals and Objectives	Strong Spatial Nexus Between Injured and Restored Habitats[(a)]	Technical Feasibility and Reasonable Cost to Implement Alternative	Retain for Detailed Analysis
Suite of six marsh restoration and tidal hydro reconnection alternatives and invasive plant management situated in the McKinney NWR GMMU	Yes	3	Yes—A suite of alternatives also provides the option for Trustees to pick one or more actions from a solid framework of restoration types	Yes
Long Beach Groin Modification/Shortening	Yes	2	Maybe—Detailed modeling required may not justify cost of construction and limited acreage of habitat construction	Yes—Selected as a Non-Preferred Alternative
Short Beach Living Shoreline	Yes	2	No—Costly for the habitat area enhanced and type of habitat provided	Yes—Selected as a Non-Preferred Alternative
No Action	No	0	Not applicable—Action would not incur a cost	Yes—For comparison purposes only

(a) Scale of 0 to 3, with 3 being strongest connection to injured habitats.

Note: Not applicable = Cost not evaluated; projects determined not to meet the goals of the injury restoration.

5. AFFECTED ENVIRONMENT

This chapter presents a brief description of the physical, biological, and cultural environment for the waterways and ecosystems adjacent to the Lordship Point and Raymark Industries Sites as required by NEPA (42 U.S.C. § 4321, *et seq.*). Natural resource injuries occurred within the lower Housatonic watershed and Long Island Sound. Restoration activities will occur within this same area. For most resource categories, descriptions are provided for the larger Housatonic watershed as well as the specific project locations (within the GMMU).

5.1 PHYSICAL ENVIRONMENT

The Housatonic River begins its 149-mile journey at Muddy Pond in Washington, Massachusetts, and falls 959 ft to Long Island Sound. The river flows south through western Massachusetts and Connecticut, becoming tidal 13 miles upriver, just below the Derby/Shelton Dam, and becomes an estuary 8 miles upriver, at approximately the Far Mill River in southern Connecticut. The tides drive the seawater from the Atlantic Ocean into Long Island Sound through the Race, the opening at the eastern end, and push the seawater westward and up into the Housatonic, Connecticut, and Thames rivers, where it mixes with the freshwater flowing downriver into the Sound. Six hydroelectric dams are located along the Housatonic River. The entire Housatonic River watershed is 1,950 square miles. Long Island Sound covers 1,300 square miles.

5.1.1 Air Quality and Noise

CT DEEP and its predecessor departments have monitored some aspects of air quality since the 1950s. The CT DEEP ambient air monitoring network consists of 20 monitoring stations that monitor for six criteria pollutants. These pollutants are considered harmful to public health and welfare, and detrimental to sustaining healthy ecosystems. Although no air quality monitoring stations are located within the NWR boundaries, 8 stations are situated within 20 miles of NWR management units. Sources of air pollution in Connecticut include both mobile sources (primarily motor vehicles) and stationary sources (such as power plants and industrial facilities). The greatest concentration of air pollution sources in the Stewart B. McKinney NWR vicinity is New York City, located approximately 25 miles southwest from the NWR's Calf Island Unit in Greenwich (CT DEEP 2013).

Noise is affected by natural sounds as well as human effects. More focused are the human-induced noises for the area, such as road traffic associated with Lordship Boulevard, the nearby airport with incoming and outgoing planes and jets, and the vehicular and laborer noise associated with the nearby industrial buildings immediately north of the project area. These various noises affect the wildlife that use the McKinney NWR and other nearby coastal habitats, plus have an effect on recreational uses of these areas.

5.1.2 Water Quality

Surface- and ground-water quality classifications are established and adopted by the CT DEEP Bureau of Water Protection and Land Reuse. A wide variety of surface water classifications apply to streams within the Housatonic River watershed. There are approximately 530 named

stream segments within the Housatonic River watershed. Of the 530 named stream segments, approximately 481 are classified as Class AA or Class A surface waters (meaning they are known to support existing or potential public water supply, fish and wildlife habitat, and other important uses).

Within the Stewart B. McKinney NWR, Marsh and Lewis Gut are located within the GMMU drainage sub-basin, within the Southwest Coast Basin, and west of the Housatonic River Basin. Erosion of the main headland to the east of GMMU formed the Long Beach peninsula. The protection of Long Beach by the back-barrier lagoon, Lewis Gut, encouraged the formation of the GMMU salt marsh complex (USFWS 2017). The integrity of the hydrological regime and water quality of the Great Meadows system have been affected over time by land use changes and urban development, such as the construction of the nearby Bridgeport Sikorsky Airport, Lordship Boulevard, landfills, and the disposal of dredged material for industrial, commercial, and residential areas (USFWS 2001).

5.1.3 Soils and Sediments

The soils/dredged sediments within the GMMU area of the McKinney NWR were last placed by the U.S. Army Corps of Engineers at the project site in the 1950s. Procedures for project implementation at that time revealed no facts or evidence indicating that the sediments being moved were contaminated, and no activities have occurred at the McKinney NWR since that time to result in releases of contaminants in the vicinity of the project site. Beginning in the late 1990s, numerous reports were produced as a result of pre-acquisition surveys, and sediment sampling to support restoration activities, which documented the existing conditions of the sediment and soils within the GMMU. The reports are provided in Appendix A.

5.1.4 Geology and Soils

Metamorphic rock from the Precambrian era underlies most of the Housatonic River valley. The dominant soil order in the Housatonic region is Inceptisol soils. Inceptisols are soils that exhibit minimal horizon development. They are widely distributed and occur under a wide range of ecological settings. They are common along fairly steep slopes of the Appalachian topography in this region and in young geomorphic surfaces like the glacial-formed terrain of southern New England land use varies with this soil order, with a sizable percentage used for forestry, recreation, and watersheds. Most of the soils currently support or formerly supported deciduous forest vegetation, but some support shrub or grass vegetation. Most are used as forest or have been cleared and are used as cropland or pasture.

5.1.5 Climate

The Connecticut Coast lies in the humid zone of the temperate climate range and experiences warm summers and cold winters. The climate is influenced year-round by the moderating effects of the Atlantic Ocean and Long Island Sound. According to NOAA's 100-year averages (1901-2001), the average daily summer temperature is 68.5^{o} Fahrenheit and the average daily winter temperature is 27.5^{o} Fahrenheit (NOAA State Annual and Seasonal Time Series website). Annual precipitation averages 47 inches, with approximately 39 inches of snowfall each year. Thunderstorms occur on an average of 22 days each year, primarily during the summer months

(USFWS 1989a). These conditions may be changing with a changing climate and varying weather patterns such as increased peak precipitation events and increased winds.

5.2 BIOLOGICAL ENVIRONMENT

5.2.1 Habitat Types and Vegetation

The Housatonic estuary includes four types of habitat: uplands (well-drained soils with elevations up to 500 ft), tidal wetlands and mud flats, sand spits and barrier beaches, and Long Island Sound. The tidal wetlands and mud flats, low-lying areas that flood at high tide and are exposed at low tide, are one of the most important habitats in the estuary. Marsh plants slow and soak up flood waters, filter out chemicals and partially break down and take in pollutants, and also prevent land erosion by absorbing the force of wind and waves. Microscopic organisms and bacteria in tidal marshes break down dead plant and animal matter, cleaning the water and recycling nutrients into the estuary. Estuaries are crucial breeding grounds for many marine animals, support a wide variety of plant and animal life, and produce four times more organic matter than a fertilized cornfield.

Vegetative habitats along the estuary and along the Housatonic River corridor include transition hardwoods (older stands including northern red oak [*Quercus rubra*], hemlock [*Tsuga canadensis*], and American beech [*Fagus grandifolia*]), central hardwoods (northern red oak, black oak [*Quercus velutina*], and hickories [*Carya* spp.]), southwest hills (dominated by oaks, ashes, and poplars) including forested wetland systems, and coastal hardwood forests.

The GMMU, which includes properties owned and managed by USFWS, the City of Bridgeport, and the Town of Stratford, is comprised of tidal salt marsh, filled wetlands and upland, barrier beach, and the Lewis Gut embayment. The GMMU contains the largest block (~225 acres) of unditched salt marsh remaining in the state of Connecticut. This 600-acre marsh-upland complex is a remnant of what was once an extensive tidal marsh system covering 5+ square miles extending from Johnsons Creek in the west to the Housatonic River in the east (King's Mark Environmental Review Team 1987).

Salt marsh vegetation is organized along a gradient depending on species tolerance for saline and anoxic conditions (Mitsch and Gosselink 2000). Most of the GMMU is low marsh, which receives tidal exchange twice daily and is generally dominated by smooth cordgrass. The high marsh, which receives less regular tidal influence, is comprised of a variety of species including salt marsh hay (*Spartina patens*), saltmarsh rush, and spike grass (*Distichlis spicata*) (Nixon 1982).

5.2.2 Wildlife and Aquatic Biota

The lower Housatonic River and its watershed provide important habitat for a wide variety of aquatic and terrestrial biota. The central portion of the watershed provides the most unique habitats including marble ridges and ledges, caves, and calcareous wetlands supporting species such as bald eagle that roost on the cliffs and ledges, and various bat species that dwell in the limestone caves; and the endangered amphibians and reptiles that rely on the calcium-rich swamps and bogs. The Housatonic River and its associated watershed provide important

stopover and nesting habitat for multiple species of breeding and migratory waterfowl. The lower reaches of the Housatonic River are characterized by estuarine and open water environments and are frequented during the spring and fall migrations by numerous migratory bird species.

The Housatonic River and its associated tributaries provide an important fishery resource in Connecticut. Both coldwater and warmwater fish species are found within the Housatonic River watershed. Above Derby Dam, the fish are primarily freshwater species, while fish species below the dam consist of freshwater, estuarine, and diadromous fishes. The mouth of the Housatonic River contains important natural shellfish beds, particularly for American oyster and hard-shelled clam.

In Long Island Sound and at the mouth of the Housatonic River, plants and animals living in the open water are either bottom-dwelling or water column species, which supports a wide variety of life including estuarine and migratory or diadromous fishes.

Located along the Atlantic Flyway, the GMMU is an important site for migratory birds including waterfowl, shorebirds, wading birds, raptors, and passerines. The GMMU serves as an important feeding and staging area for many waterfowl species. More than 5,000 individual shorebirds roost on backdune sandflat communities of Pleasure and Long beaches during migration (USFWS 1991). Nesting and migrating shorebirds, gulls, and terns utilize the GMMU as a feeding and loafing area.

At least 24 species of mammals have been observed on the NWR, including six species of bat, five of which are state-listed species (two endangered and three species of concern). The northern diamondback terrapin, a state-listed species, is known to occupy areas of the NWR (USFWS 2017) (see Section 5.2.3 for a description of this species).

Although formal macro-invertebrate surveys of the GMMU have not been conducted, typical saltmarsh species likely characterize the GMMU such as American oyster, ribbed mussel, hard and soft-shell clam, green crab, fiddler crab, and horseshoe crab.

5.2.3 Threatened and Endangered Species

The Endangered Species Act (ESA) of 1973 (16 U.S.C. §§1531, *et seq*.) requires federal agencies to conserve endangered and threatened species and to conserve the ecosystems upon which these species depend. CT DEEP also identifies species that are of special concern to the State. Table 2 lists those federally protected species and state species of concern that potentially reside within the area of the Preferred Alternative (see Section 4.2).

The Trustees queried the USFWS Environmental Conservation Online System, Information for Planning and Conservation database in December 2016 to obtain a list of federal and state-listed threatened and endangered species that may be present in the project area (Table 2). In addition to the federally listed species protected under the ESA, Connecticut state-listed species of concern, as designated by CT DEEP are also listed. These species include migratory birds as well as breeding or wintering habitat for mammals, and reptiles, fish, invertebrates, and plants. This table includes both species that are known to occur (through observation) within the Stewart

B. McKinney NWR, and state-listed species that have the potential to be present in the area. These species also have the potential to be present in multiple areas within the geographical nexus between the two injured Sites.

The Trustees requested concurrence from USFWS in January 2017 that implementation of the Preferred Alternative "may affect, not likely to adversely affect" piping plover (*Charadrius melodus*), roseate tern (*Sterna dougallii*), or the northern long-eared bat, and that the project would have "no effect" on red knot (*Calidris canutus*) or any other species listed as threatened or endangered, their habitats, or proposed or designated critical habitats. USFWS provided their concurrence with these findings in May 2017 and no further consultation under Section 7 of the ESA is required. USFWS recommended that surveys for the northern long-eared bat should be performed if tree removal activities occur and that, preferably, activities should avoid clearing suitable staging and swarming habitat during the spring and fall. This correspondence is included in Appendix B.

Table 2. Federal and State-Listed Species that Occur or Have the Potential to Occur on the Stewart B. McKinney NWR, Stratford, Connecticut

Common Name	Refuge Occurrence[(a)]	Federal T&E[(b)]	State T&E[(c)]
LANDBIRDS			
American Kestrel	X		SC
Bald Eagle	X		T
Barn Owl			E
Broad-winged Hawk	X		SC
Brown Thrasher	X		SC
Cerulean Warbler	X		SC
Common Nighthawk	X		E
Horned Lark	X		E
Ipswich Savannah Sparrow	X		SC
Long-eared Owl	X		SC
Northern Harrier	X		E
Northern Parula	X		SC
Northern Saw-whet Owl	X		SC
Peregrine Falcon	X		T
Purple Martin	X		SC
Red-headed Woodpecker	X		E
Saltmarsh Sparrow	X		SC
Seaside Sparrow	X		T
Sedge Wren	X		E
Sharp-shinned Hawk	X		E
Short-eared Owl	X		T
Whip-poor-will			SC
WATERBIRDS			
American Bittern	X		E
Common Loon	X		SC
Common Tern	X		SC
Glossy Ibis	X		SC
Great Egret	X		T
Least Bittern	X		T
Least Tern	X		T
Little Blue Heron	X		SC

Common Name	Refuge Occurrence[(a)]	Federal T&E[(b)]	State T&E[(c)]
Pied-billed Grebe	X		E
Snowy Egret	X		T
Yellow-crowned Night Heron	X		SC
SHORE AND SEA BIRDS			
American Oystercatcher	X		T
Upland Sandpiper			E
Piping Plover	X	T	T
Red Knot	X	T	
Roseate tern	X	E	E
MAMMALS			
Eastern Red Bat	X		SC
Eastern Small-footed Bat	X		E
Harbor Porpoise			SC
Harbor Seal	X		
Hoary Bat			SC
Least Shrew			E
Little Brown Bat	X		E
Northern Long-eared bat		T	E
Silver-haired Bat			SC
Southern Bog Lemming			SC
Tri-colored Bat			E
REPTILES AND AMPHIBIANS			
Eastern Box Turtle	X		SC
Eastern Ribbon Snake			SC
Green Sea Turtle		T	T
Kemp's Ridley Turtle		E	E
Leatherback		E	E
Loggerhead Sea Turtle		E	T
Northern Diamondback Terrapin	X		SC
Smooth Green Snake	X		SC
Wood Turtle			SC
FISH			
Atlantic Sturgeon		E	E
Blueback Herring	X		SC
Sea Lamprey	X		
Shortnose Sturgeon		E	E
Spiny Dogfish	X		
Striped Bass	X		
INVERTEBRATES			
American Burying Beetle		E	SC EX
Atlantis Fritillary	X		E
Northeastern Beach Tiger Beetle		T	SC EX
Puritan Tiger Beetle		T	E
Saltmarsh Tiger Beetle			SC
PLANTS			
Bayonet Grass	X		SC
Beach Needle Grass	X		E
Blazing-star			SC
Dillenius' Tick-trefoil			SC
Dioecious Sedge			SC
Eastern Prickly-pear	X		SC

Common Name	Refuge Occurrence[(a)]	Federal T&E[(b)]	State T&E[(c)]
Featherfoil			SC
Fragrant Sumac			SC
Golden Alexanders			E
Hairy Forked Chickweed			SC EX
Lilaeopsis			SC
Marsh Pink	X		E
Mudwort			SC
Panic Grass	X		T
Parker's Pipewort			E
Red Goosefoot			SC EX
Seabeach Sandwort	X		SC
Sickle-leaf Golden-aster	X		E
Small Skullcap			E
Smooth Black-haw	X		T
Starry Campion			T
Stiff Goldenrod			E
Swamp Cottonwood			T
Tall Cinquefoil			SC
Yellow Pimpernel			E
Yellow Thistle			E

(a) X = Species is known to occur on the NWR, as provided by several physical surveys, observations, and inventories.
(b) Federal Endangered Species List. E = Endangered; T = Threatened (https://www.fws.gov/endangered/).
(c) Connecticut's Endangered, Threatened, and Special Concern Species-2015. E = Endangered; T = Threatened; SC = Special Concern; EX = Believed Extirpated (CT DEEP 2015).

Source: Draft Mosquito Management Plan and EA for the GMMU at the Stewart B. McKinney NWR

The population of marsh pink at GMMU is the last known natural population of this plant in the state. It is a state-designated endangered annual plant that grows on open, sandy soils at the upper edges of salt and brackish marshes. Although marsh pink is abundant along much of the Atlantic and Gulf coast, it is rare in New England and only exists at one site in Connecticut, which is on the NWR. One of the greatest threats to this species in New England and on the McKinney NWR is the spread of non-native invasive common reed. Marsh pink requires open space and cannot compete with this tall invasive grass. Management for this species would require opening up sandy space adjacent to present populations at the site by controlling common reed using mechanical and chemical methods, as well as minimizing human disturbance and the development of wrack in these areas (USFWS 2017).

The federal- and state-listed piping plover, roseate tern, and red knot are all known to occur within the McKinney NWR. Piping plover is a small shorebird that inhabits coastal beaches and associated tidal areas that provide suitable foraging and nesting habitat. The roseate tern is exclusively marine, breeding on small islands and on sand dunes of barrier beaches. During the breeding season of April to July, they forage over shallow bays, tidal inlets and channels, and sandbars. Red knot is a highly migratory shorebird that may be present in Connecticut during spring and fall migration. They are restricted to coastal and rocky shores and forage on mudflats. The other primary species of concern known to occur at the McKinney NWR are the northern

harrier and northern diamondback terrapin. Northern diamondback terrapin nest at GMMU, and are found in greater concentrations in the tidal creeks of the refuge. There are also sandy soil areas adjacent to the marshes where female terrapins have been documented using as egg laying sites.

5.2.4 Essential Fish Habitat

Essential Fish Habitat (EFH) designations were produced by the New England Fishery Management Council, Mid-Atlantic Fishery Management Council, South Atlantic Fishery Management Council, and the National Marine Fisheries Service (NMFS) in the Northeastern United States pursuant to the Magnuson-Stevens Fishery Conservation and Management Act. Table 3 provides the coordinates for the selected 10-ft x 10-ft squares of latitude and longitude to evaluate EFH utilization along the coast.[1] Table 4 lists the EFH species documented in this selected area.

The Trustees requested concurrence from NOAA Fisheries, Office of Habitat Conservation (OHC) in July 2016 that implementation of the Preferred Alternative "may affect, not likely to adversely affect" EFH in the project area such as salt marsh and intertidal mud flat habitats. Implementation of the alternative could produce adverse effects that are either no more than minimal, temporary, or can be alleviated with minor project modifications or conservation recommendations. This determination was followed by a request for an abbreviated EFH consultation. OHC provided concurrence in October 2016 that the preferred alternative would not likely cause any substantial EFH concerns. Follow-up consultation will be completed once final project specific details and plans are submitted for consideration.

Table 3. Coordinates Geo-Referencing the Area Encompassing Essential Fish Habitat (EFH) Assessment

Boundary	North	East	South	West
Coordinates	41° 10.0' N	73° 00.0' W	41° 00.0' N	73° 10.0' W

Table 4. Species Determined to Utilize EFH within the Proposed Project Area

Species	Eggs	Larvae	Juveniles	Adults
Atlantic salmon (*Salmo salar*)			X	X
pollock (*Pollachius virens*)			X	X
whiting (*Merluccius bilinearis*)				X
red hake (*Urophycis chuss*)	X	X	X	X
redfish (*Sebastes fasciatus*)	n/a			
winter flounder (*Pleuronectes americanus*)	X	X	X	X
windowpane flounder (*Scopthalmus aquosus*)	X	X	X	X
American plaice (*Hippoglossoides platessoides*)			X	X
Atlantic sea herring (*Clupea harengus*)			X	X
bluefish (*Pomatomus saltatrix*)			X	X
Atlantic mackerel (*Scomber scombrus*)	X	X	X	X
summer flounder (*Paralicthys dentatus*)			X	
scup (*Stenotomus chrysops*)	X	X	X	X
black sea bass (*Centropristus striata*)	n/a		X	

[1] The information can be found at: http://www.nero.noaa.gov/hcd/STATES4/conn_li_ny/41007300.html.

Species	Eggs	Larvae	Juveniles	Adults
king mackerel (*Scomberomorus cavalla*)	X	X	X	X
Spanish mackerel (*Scomberomorus maculatus*)	X	X	X	X
cobia (*Rachycentron canadum*)	X	X	X	X
sand tiger shark (*Odontaspis taurus*)		X		

Additionally, the Draft Habitat Restoration Planning, GMMU, Stewart B. McKinney NWR (USFWS 2001) lists the following species residing within or in close proximity of the project area of the selected restoration alternative: Atlantic mackerel (*Scomber scombrus)*, bluefish (*Pomatomus saltatrix)*, summer flounder, scup (*Stenotomus chrysops*), winter flounder, and windowpane flounder (*Scopthalmus aquosus*).

Horseshoe crab (*Limulus polyphemus*) also have the potential to occur within the GMMU area. This species has a wide geographic range and frequents sub-tidal estuarine habitat. While not a federal- or state-listed species, the IUCN Red List (http://www.iucnredlist.org/) has listed this species in the vulnerable risk category across its entire geographic range and in the endangered risk category for the sub-region of New England. Declines are largely due to over-harvest. Habitat requirements change throughout the horseshoe crab life cycle, extending from intertidal beach fronts and tidal flats for eggs and larvae, to the edge of the continental shelf for adults. In the Long Island Sound, horseshoe crab spawning occurs in shallow waters in early May, peaking at the end of May (Smith et al. 2016). Nests can be found on beaches ranging from coarse-grained, cobble-dominated substrates to fine-grained and poorly-drained muddy substrates (Beekey and Mattei 2009).

5.2.5 Coastal Resiliency

From 2011 through 2016, The Nature Conservancy worked with Connecticut's coastal communities to assess local vulnerability to sea level rise and storm surge impacts, as well as identify unprotected parcels of land that would accommodate the predicted salt marsh advancement, using the Coastal Resilience Tool. Coastal resiliency is an important consideration in marsh restoration. Wetlands are vulnerable to sea- level rise and strong storm events. Preparing for future sea-level impacts by restoring these wetlands to a mix of high and low marsh elevations can help to protect and preserve these critical habitats and provide protection of inland habitats.

5.2.6 Mosquito Problems and Control Measures

An important consideration for evaluating sea-level rise issues relative to the GMMU of the Stewart B. McKinney NWR is the impact to mosquito populations and mosquito management. The changes in the rise of the water may alter the hydrology of our coastal marshes and lands adjacent to the NWR's salt marshes. The sites that are now mosquito breeding areas could change due to inundation of salt water or other factors associated with sea-level rise.
The management of mosquitoes in Connecticut is a collaborative effort involving CT DEEP, the Connecticut Agricultural Experiment Station, and the Department of Public Health, together with the Department of Agriculture and the Department of Pathobiology at the University of Connecticut. These agencies are responsible for monitoring and managing the state's mosquito population levels to reduce the potential public health threat of mosquito-borne diseases.

Records of mosquito-transmitted diseases in Connecticut date back to 1743. In the early 1900s many saltmarsh areas were drained to reduce the mosquito population. Starting in 1936, federal funding for mosquito control came from the Works Progress Administration, which continued in the State until 1940 when it was severely reduced. During this time, the area that would eventually become the GMMU was ditched to help reduce mosquitoes and disease.

As part of the statewide Mosquito Management Plan, CT DEEP has previously been allowed to monitor and control larval mosquito populations on the NWR, at both the Salt Meadow Unit in Westbrook and the GMMU in Stratford. In the early 1990s, CT DEEP performed Open Marsh Water Management in the mosquito-producing areas of the Salt Meadow Unit, essentially eliminating salt marsh mosquito-producing sites there. CT DEEP began monitoring at GMMU and the Salt Marsh Unit in 1998.

5.3 HUMAN ENVIRONMENT

5.3.1 Socioeconomics

Fifty-one towns, three cities, and one borough are located wholly or partially in the Housatonic River watershed. As of 1 July 2007, the estimated total population within the Connecticut portion of the Housatonic River watershed is approximately 1 million people (U.S. Census Bureau 2008). The City of Waterbury has the largest population (107,174), and the Town of Canaan has the smallest (1,094). Population trends between the 2000 census and 2007 population estimates vary among the 55 municipalities. Population decreases are primarily attributed to economic change, as many industrial and manufacturing facilities have closed or left the area. The northern third of the watershed in Connecticut is predominately rural. The central third includes a mix of rural, industrial, commercial, and residential land uses. The southern third is predominantly urbanized and include the municipalities of Naugatuck, Seymour, Derby, Stratford, and Milford.

The GMMU consists largely of salt marsh with a limited amount of upland. The land did not historically or currently serve as housing or locations of business for the local population. However, there are large industrial and warehouse buildings employing many workers located directly adjacent to the McKinney NWR, and many commercial businesses are nearby, along Lordship Boulevard.

5.3.2 Environmental Justice

Within the state, population density is highest in Fairfield County, which is where the GMMU within the McKinney NWR is located. CT DEEP classifies Stratford and Bridgeport, the two towns where the GMMU is found, as “Urban Core” communities. The combined population of the two towns is approximately 200,000. Minority or low-income populations inhabit housing in areas within 1 to 2 miles of the McKinney NWR. The GMMU of the NWR provides the local populace and local workers with many benefits, including an accessible green space, walking trails for exercise, wildlife viewing areas, and a place to hunt waterfowl. These are some of the activities identified in the Connecticut Statewide Comprehensive Outdoor Recreation Plan as in high demand and likely to increase. Therefore, the NWR is a part of a larger patchwork of

publicly owned lands that can help to achieve equal access to natural areas across socioeconomic groups. Mosquito management and control associated with the proposed marsh restoration projects would be especially beneficial to the local populace and local workers surrounding GMMU, as they are the most likely to be negatively affected by a large mosquito population and potential disease near their homes and places of employment (USFWS 2017).

5.3.3 Land Use and Recreation

Connecticut is the fourth most densely populated state in the United States predominantly due to the coastal population. About 200,000 people live in the towns and cities surrounding the Great Meadow Unit (Town of Stratford and the City of Bridgeport). Most of the land use around the GMMU is industrial and commercial with some residential zones bordering the eastern side of the marsh.

Public use of the NWR is limited to wildlife-dependent recreational activities including hunting, fishing, wildlife photography, wildlife observation, interpretation, and environmental education. Approximately 27,000 people visit the NWR annually for these wildlife-dependent activities. The GMMU has a small trail system, as well as a designated waterfowl hunting zone. There is no fishing on the NWR as of this date.

In the larger Housatonic watershed area, harvesting of American oysters from Long Island Sound and the Housatonic River estuary between Milford and Stratford began in the mid-1700s. Until the mid-1970s, pollution, overfishing, predators, and hurricane damage caused the decline of oyster populations. The Connecticut oyster industry has been rebuilt through pollution control, erosion reduction to reduce sedimentation, and using sound management and aquacultural practices.

5.3.4 Cultural Resources

The original settlers in the Housatonic River valley were the Paugussett Indians. Eventually, the Indian name *Ousatonic*, meaning *place beyond the mountains*, was given to the Housatonic River. The tribes settled along the riverbanks, farmed the fertile floodplains, and harvested fish and shellfish. Inland groups of Indians also traveled to Long Island Sound for salt and fish.

English colonists from the Quinnipiac (New Haven) colony bought land surrounding the Wepawaug River from the Paugussett Indians and founded the Wepawaug Colony, which later became Milford. The settlers depended on the river to survive and to move goods and people (the steep hills rising from the river shore made road building difficult). The river also provided an abundant supply of fish, clams, and oysters, and many migratory birds.

The GMMU within the McKinney NWR was used by both Native Americans and early European settlers. Decades before the arrival of the first settlers in 1639, Native Americans inhabited the Johnsons Creek area each summer and actively used the marsh for fishing, oystering, clamming, and hunting game birds. Although the GMMU has a significant human history, the 2011 Archaeological Overview Assessment for the NWR makes it clear that the "low-lying, waterlogged terrain and the poorly drained soils do not lend themselves to human habitation." Therefore, the prospect of archaeological or post-contact cultural resources being

found in the wetland areas, which were used by humans for hunting, fishing and recreation, but not for settlement, has a low to moderate probability (Douchette and Elam 2011).

6. ENVIRONMENTAL CONSEQUENCES

Federal agencies preparing an EA must consider the direct effects of all components of a proposed action as well as indirect and cumulative effects. In this chapter, the Trustees evaluate the reasonably foreseeable consequences of implementing the alternatives proposed in Chapter 4 on the physical, biological, and human environment described in Chapter 5. The following sections discuss the potential environmental impacts from the compensatory restoration projects anticipated under the Preferred Alternative, the Non-Preferred alternatives, and the No Action Alternative. Alternatives considered but found not to be reasonable (described in Section 4.1) are not evaluated in detail in this chapter. To warrant detailed evaluation by the Trustees, an alternative must be reasonable and meet the project's purpose and need (see Section 1.3).

6.1 SCOPE OF THE NEPA ANALYSIS

This Draft RP/EA describes and compares the potential impacts of the proposed preferred and non-preferred site-specific alternatives for the Lordship Point and Raymark restoration, as well as the Non-Preferred alternatives and the No Action alternative. This Draft RP/EA analyzes the potential direct, indirect, and cumulative ecological, physical, and socioeconomic impacts associated with the alternatives.

The following definitions were generally used to characterize the nature of the various impacts evaluated in this RP/EA:

- ***Short-term or long-term impacts***: These characteristics are determined on a case-by-case basis and do not refer to a specific timeframe. In general, *short-term impacts* are those that would occur only with respect to a particular activity or for a finite period. *Long-term impacts* are those that are more likely to be persistent and chronic.

- ***Direct or indirect impacts***: A *direct impact* may be caused by a proposed action and occurs contemporaneously at or near the location of the action. An *indirect impact* is caused by a proposed action and may occur later in time or be farther removed in distance but still be a reasonably foreseeable outcome of the action. For example, a direct impact of erosion on a stream might include sediment-laden waters in the vicinity of the action, whereas an indirect impact of the same erosion might lead to lack of fish spawning habitat and result in reduced reproduction rates of native fish spawning downstream where the sediment settles.

- ***Minor, moderate, or major impacts***: These relative terms are used to characterize the magnitude of an impact. *Minor impacts* are generally those that may be perceptible but, in their context, are not amenable to measurement because of their relatively minor character. *Moderate impacts* are those that are more perceptible and, typically, more likely to be quantified or measured. *Major impacts* are those that, in their context and due to their intensity or severity, have the potential to meet the thresholds for significance set forth in Council on Environmental Quality (CEQ) regulations (40 CFR 1508.27) and, thus, warrant heightened attention and examination for potential means for mitigation to fulfill the requirements of NEPA.

- ***Adverse or beneficial impacts***: An *adverse impact* is one having unfavorable or undesirable outcomes on the manmade or natural environment. A *beneficial impact* is one having positive outcomes on the man-made or natural environment. A single action may result in adverse impacts on one environmental resource and beneficial impacts on another resource.

- ***Cumulative impacts***: The CEQ regulations implementing NEPA define *cumulative impacts* as the "impacts on the environment which result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions." (40 CFR 1508.7). Cumulative impacts may result from individually minor but collectively significant actions taking place over a period of time within a specific geographic area.

6.2 RESTORATION ALTERNATIVES INCLUDING NO ACTION

The Trustees evaluated the potential for restoration actions associated with the Preferred Alternative, two Non-Preferred alternatives, and the No Action Alternative to impact the following: the physical environment (air quality and noise, water quality, geology and soils, and climate), the biological environment (habitat types and vegetation, wildlife and aquatic biota, threatened and endangered species, EFH, coastal resiliency and mosquito population,), the human environment (socioeconomics, environmental justice, land use and recreation, and cultural resources), and the potential for cumulative impacts.

6.2.1 Physical Environment

6.2.1.1 Air Quality and Noise

Preferred Alternative: The proposed activities are expected to result in minor, temporary adverse, direct impacts on air quality as a result of the proposed construction activities. Exhaust emissions from earth-moving equipment and/or supply boats contain air pollutants, but these emissions would only occur during the construction phase of the project, likely over the late fall and winter months; the amounts would be minimal for all criteria pollutants, and should be quickly dissipated by prevailing winds. There would be no long-term negative impacts to air quality.

Noise associated with earth-moving equipment represents a short-term, adverse impact during the construction phase. It may periodically and temporarily disturb wildlife in the immediate vicinity of the site, or cause movement of wildlife away from the site to other ecologically suitable areas of the NWR. Similarly, recreating persons may avoid this area due to noise during construction, but as with wildlife, such disruption will be limited to the construction phase, and there are other comparable substitute recreation sites readily available within the NWR. Construction activities would occur during normal work day periods and adhere to local ordinance requirements. Since the work is expected to occur during the fall and winter, nearby residences would be less affected if home doors and windows are closed. No long-term effects would occur as a result of noise during construction.

Non-Preferred Alternatives: Minor, temporary, adverse direct impacts on both air quality and noise would result from removal of groins at Long Beach and installation of a living shoreline at Short Beach. Installation of the shoreline would involve the use of heavy equipment (e.g., cranes, barges) with heavy exhaust and work would likely continue onsite for weeks to months. Similar to the Preferred Alternative, these impacts would be short-lived and would not cause any long-term impacts. Additionally, this project would likely be completed during fall and winter months, and therefore, fewer people would be in the area to be affected by construction noise.

No Action: There would be no impacts to air quality or noise with the No Action alternative. Air quality and noise conditions would remain the same as current conditions at and in close proximity to the sites.

6.2.1.2 Water Quality

Preferred Alternative: In the short term, direct impacts to water quality from the Preferred Alternative would be localized, minor, and adverse. During the construction period, earth-moving activities (either the mining or placement of sediments) will increase turbidity in the immediate vicinity and the adjacent marshes to some degree; implementation of best management practices and mitigation measures (such as use of silt fences, or other sediment and erosion controls) during construction will minimize this effect. After construction is completed, the sediments are expected to be stabilized with development of a plant community cover.

In the long-term, indirect, moderate beneficial impacts are expected. Beneficial impacts would include the enhancement and increase in estuarine marsh habitat at the site, aiding in future retention of sediments, and improvement of local water quality via filtration of larger volumes of water as a result of more frequent exchange.

The proposed project involves the re-distribution of sediments dredged and placed by the U.S. Army Corps of Engineers at the project site in the 1950s. Procedures for project implementation at that time revealed no facts or evidence indicating the sediments being moved were contaminated and no activities have occurred at the NWR since that time to result in releases of contaminants near the project site. Beginning in the late 1990s, numerous reports were produced as a result of pre-acquisition surveys, and sediment sampling to support restoration activities, that documented the existing conditions of the sediment and soils within the GMMU. In general, these studies found that contaminant levels in fill, underlying soils, and groundwater is appropriate and most chemicals were present either below the detection limit or below human health and ecological screening levels.

Impacts from thin-layer placement of material excavated from the marsh restoration areas would be dependent upon the location of deposition. For water quality, if material is placed in identified Clean Water Act Section 404 jurisdictional federal wetland areas, there may be direct, long-term, minor adverse impacts to water quality from filling of the area. If material is placed in upland areas, water quality in the area would not likely be affected.

Non-Preferred Alternatives: Groin shortening along Long Beach, and the installation of a living shoreline at Short Beach would have similar indirect, short-term adverse impacts to water quality as the Preferred Alternative; however, these impacts would likely be moderate in nature due to

the work being performed in water. Impacts would result from removal and placement of material that would temporarily increase turbidity at the project site and in adjacent areas. There would be long-term, minor to moderate beneficial impacts on water quality after construction, as groin removal would increase longshore water exchange along the beach and an artificial reef would attract filter-feeding species that would improve water quality over time.

No Action: No restoration actions would occur, so there would be no direct or indirect, beneficial or adverse impacts on water quality. However, water quality under the No Action Alternative would be subject to any changes in development in the area, enforced water quality regulations, or potential municipal maintenance programs that may be implemented.

6.2.1.3 Geology and Soils

Preferred Alternative: Neither of the components of the proposed restoration action includes activities with the potential to directly or indirectly impact the overall geology of the area. In the immediate project area, there is potential for short-term indirect, minor adverse impacts to soils to occur due to soil excavation, compaction and removal from movement of equipment onsite.

Non-Preferred Alternatives: In the immediate project areas, there is potential for short-term indirect, moderate adverse impacts to soils resulting from soil compaction on beach and dune areas from movement of equipment onsite.

No Action: Under the No Action alternative, geology would remain largely the same, as no restoration actions would be occurring. For the Short Beach living shoreline alternative, no action may result in continued or increasing erosion rates along the beach. Geology and soils under the No Action Alternative would be subject to any changes in development in the area, or potential municipal maintenance programs that may be implemented.

6.2.1.4 Climate

Preferred Alternative: No direct impacts on local climate are anticipated; however, projects implemented under the Preferred Alternative could provide additional indirect benefits of resiliency to the McKinney NWR ecosystem. For example, restoration and protection of coastal marshes and wetlands would help to mitigate wetland losses and impacts anticipated as the result of sea-level rise. Restored marsh areas would also increase carbon sequestration, benefiting the overall climate quality in the area.

Non-Preferred Alternative: No direct or indirect impacts on local climate are anticipated.

No Action: Without implementing projects to increase coastal resiliency in the area, there is potential for the No Action alternative to have indirect, long-term moderate to major adverse impacts, as these areas would continue to suffer land loss and negative ecosystem effects due to sea-level rise.

6.2.2 Biological Environment

6.2.2.1 Habitat Types and Vegetation

Preferred Alternative: During the construction phase of this project, direct short-term and localized adverse impacts would occur due to construction activities and temporary alterations in hydrology. Movement of construction vehicles onsite may injure some vegetation, and changes in water flow may temporarily impact the amount of water reaching certain vegetated areas. In the long-term, indirect, moderate beneficial impacts would be anticipated from the removal of substantial portions of dominant species to allow for growth of more favorable low-marsh species that provide quality habitat. Implementation of this alternative would alter the type of marsh present at the project areas, by creating more beneficial habitats; filled marsh areas would be converted back to low and high marsh elevations and would support vegetation specific to these habitats. Drowning, low marsh areas would be improved by increasing drainage and adding elevation in some areas. Additionally, for Project 5, where improvement to the tidal flap gate and existing culvert is performed, tidal marsh vegetation would benefit further development surrounding the pond. If sufficient salinities within the pond are reached through increased tidal exchange, a reduction in the density of common reed might also be achieved.

For the TLP activity, deposition of excavated material from the marsh restoration areas in other areas near the project sites would likely have short-term, minor to moderate adverse impacts on mudflat habitat and sparse salt marsh vegetation in the placement area, depending on what vegetation, if any remains. If material is placed in Section 404 jurisdictional federal wetlands, impacts would be longer-term beneficial with the restoration of a more robust native marsh plant community.

Non-Preferred Alternatives: Because the majority of work under the Non-Preferred alternatives would take place in-water and would affect sub-tidal and water column habitat; and be less likely to impact vegetation. Aside from limited dune habitat, it is unlikely that implementation of the Long Beach alternative would produce indirect or direct adverse or beneficial impacts on vegetation. For the Short Beach alternative, this project could potentially include creation of a small fringe marsh that would support appropriate low and high marsh vegetation. Best management practices would minimize any short-term, temporary impacts to dune vegetation, should construction activities occur in these areas.

No Action: With this alternative, no restoration would occur. Therefore, vegetation would remain the same. Minor, long-term adverse impacts to vegetation would occur as the salt marsh habitat would continue to degrade from impaired hydrology and the increase in invasive species coverage. The same level of impacts may occur at Short Beach, as refuge habitat for fish and invertebrates would not be created.

6.2.2.2 Wildlife and Aquatic Biota

Preferred Alternative: During the construction phase of this project, direct, short-term and localized adverse impacts would occur to biota that normally use the disturbed upland and marsh. Impacts would include potential for smothering of low-mobility organisms via increased turbidity in the water, and displacement of highly mobile organisms from construction

operations. Following construction, there would be indirect, moderate, long-term beneficial impacts to aquatic organisms. The restored marsh habitat and tidal connectivity would provide improved areas for feeding and shelter for fish and other aquatic biota, as well as nutrient cycling and carbon sequestration and storage capacity.

Direct, short-term adverse impacts would also occur to wildlife that utilizes the project area. These impacts would be minimal as most species could move to utilize other nearby suitable habitats until construction is complete. Behavior of species that use wetlands impacted by this restoration activity may be temporarily modified. Following construction, wildlife would experience indirect, long-term and moderate beneficial impacts from improved foraging and nesting habitat along with a restored prey base. Beneficial impacts to wildlife would also occur from the removal of invasive species.

For the TLP activity, deposition of soils excavated for the marsh restoration in other areas near the project sites would likely have short-term, minor to moderate adverse impacts on biota directly in the placement area, and on other organisms that utilize the area for foraging. Long-term, beneficial impacts would occur as a robust low and high marsh would re-establish to provide healthy habitat for fish and wildlife.

Non-Preferred Alternatives: Direct, short-term adverse impacts to wildlife and aquatic organisms would be similar to those described for the Preferred Alternative. Because these projects would be implemented in beach habitats, there is potential for negative impacts to piping plover (*Charadrius melodus*); however, impacts would be largely avoided by adhering to time-of-year restrictions (completing construction during seasons when piping plover are not utilizing the beach habitat). Impacts on wildlife and aquatic organisms would generally be on a smaller scale compared to the GMMU projects, as the Long Beach and Short Beach alternatives do not encompass as large of a restoration area.

No Action: With this alternative, no restoration would occur. Therefore, wildlife and aquatic organisms would continue to progress with the status of the habitat. Minor, long-term adverse impacts to benthic organisms, fish, and wildlife would occur as the salt marsh habitat would continue to degrade from impaired hydrology and increased invasive species coverage (at GMMU).

6.2.2.3 Threatened and Endangered Species

Preferred Alternative: Federal- and state-listed species would experience the same direct, short-term adverse impacts during construction as described above for other wildlife and aquatic organisms and vegetation present at the site. All projects conducted under the Preferred Alternative will require a review for potential impacts to those species of concern outlined in Section 5.2.3 Seasonal time restrictions may be implemented to protect other coastal resources or state-listed species documented in the vicinity. During threatened and endangered species consultation, USFWS concurred with the Trustees, finding that the preferred alternative "may affect, not likely to adversely affect" any federally listed species or species' habitat at the site. Elevating the walking trail may result in minor salt marsh impacts including minor and localized changes in hydrology and a temporary decrease in salt marsh vegetation in newly placed soil

material. In the long-term, moderate beneficial impacts would also be the same as described above.

The activities as currently proposed have the potential to result in direct, beneficial impacts to the state-endangered marsh pink. This species has been documented within the area of Project 3 in the past, but was not observed during multiple site visits in recent years; however, this does not preclude its potential persistence at the site, and a CT DEEP consultation would be necessary during the engineering phase of the project. Overall, beneficial impacts to the threatened marsh pink population would occur, as the population at the GMMU is the only known remaining population in Connecticut, and this population would be protected through activities performed under the Preferred Alternative.

If diamondback terrapin habitat is enhanced through the removal of autumn olive or other vegetation, allowing foot traffic along the berm in Project 1 may increase mortality rates by creating easier access for both collectors and natural predators. Best management practices for vegetation management and public access would be implemented to minimize risks to terrapin nesting sites.

Non-Preferred Alternatives: As it is possible that many of the threatened or endangered organisms described for the GMMU area are also present in the Long Beach and Short Beach areas (aside from the marsh pink population), it is anticipated that the impacts of these non-preferred alternatives would follow the impacts described above for the Preferred Alternative. One species that may be impacted by implementation of the non-preferred alternatives (that may be less impacted at GMMU) is piping plover. These impacts would be largely avoided by adhering to time-of-year restrictions during construction operations.

No Action: Under this alternative, there would be no restoration occurring, and the status of the threatened and endangered species utilizing the area would continue to decline with increasing habitat quality decline and threat from invasive species. Therefore, impacts to threatened and endangered species would be long-term, minor, and adverse.

6.2.2.4 Essential Fish Habitat

Preferred Alternative: The EFH including salt marsh and intertidal mud flat habitats would experience direct, short-term, minor adverse impacts as described above related to soil excavation, filling, and grading construction activities. Long-term, local moderate beneficial impacts would occur. Beneficial impacts would result from the reestablishment, enhancement, and restoration of salt marsh through the proposed restoration action. This would include healthier and more resilient salt marshes to serve as EFH for species such as winter flounder. The areas of marsh would serve as habitat for prey species (e.g., mummichog, Atlantic silverside) of managed fishes, as well as provide a nursery for the larvae and juvenile stages of managed species such as winter flounder.

Non-Preferred Alternatives: For the Long Beach groin shortening, minor, temporary negative impacts to EFH would occur due to increased water column turbidity. Long-term, there would be minor to moderate beneficial impacts to EFH since large stone will be removed to restore sub-tidal habitat including water column and benthic habitats for fish, shellfish and aquatic wildlife.

For the Short Beach living shoreline, temporary, minor adverse impacts would occur as a result of placement of reef ball structures or soils in the intertidal zone. Long-term, there would be minor to moderate beneficial impacts to EFH since reef balls would be expected to increase localized oyster populations and other benthic macro-invertebrates, plus fish using these sub-tidal structures. The changes in sub-tidal habitat including water column and benthic habitats will also provide long-term, minor to moderate benefits to waterfowl and other aquatic wildlife.

No Action: With this alternative, no restoration activities would occur, and therefore there would be a long-term minor adverse impact on species that could benefit from increased nursery access during larval and juvenile stages.

6.2.2.5 Coastal Resiliency

Preferred Alternative: Projects implemented under the Preferred Alternative could provide additional indirect benefits of resiliency to the McKinney NWR ecosystem. For example, restoration and protection of coastal marshes and wetlands would help to mitigate wetland losses and impacts anticipated as the result of sea-level rise. Restored marsh areas would also increase carbon sequestration, benefiting the overall climate quality in the area.

Non-Preferred Alternative: Both the Long Beach groin shortening and the Short Beach living shoreline projects would be expected to provide minor to moderate, localized beneficial coastal resiliency impacts. Groin shortening would allow more natural long-shore transport of coastal sediments, allowing the barrier beach system to potentially expand in width and/or height. These conditions would be expected to provide greater protection of the GMMU marshes on the landward side of the barrier beach.

For the Short Beach living shoreline, the reef ball installation, combined with oyster establishment, and restoration of a salt marsh fringe and back dune would collectively provide increased resiliency to the Lordship Point grassland, the Audubon visitor center, and to a limited extent, the residences west of this project area. The proposed project would be expected to increase sediment accretion and potentially reduce incoming wave energies to minimize shore erosion.

No Action: Without implementing projects to increase coastal resiliency in the area, there is potential for the No Action alternative to have indirect, long-term moderate to major adverse impacts, as these areas would continue to suffer land loss and negative ecosystem effects due to sea-level rise.

6.2.2.6 Mosquito Problems and Control Measures

Preferred Alternative: Following completion of restoration, there would be indirect, long-term moderate beneficial impacts due to reduction of many of the salt marsh mosquito-producing areas in the McKinney NWR project areas. Restoring tidal exchange and connectivity with an improved hydrology will reduce shallow standing water areas to aid in reducing mosquito breeding habitat.

Non-Preferred Alternatives: It is not anticipated that restoration actions implemented in these areas would have any impact, either adverse or beneficial, on the mosquito populations within the NWR.

No Action: With this alternative, no restoration activities would occur, other than existing CT DEEP mosquito control activities. At the GMMU, this may produce long-term, indirect and adverse impacts to the area, as mosquito populations would continue to flourish, presenting risk to refuge visitors, plus nearby residences in the area.

6.2.3 Human Environment

6.2.3.1 Socioeconomics

Preferred Alternative: Short-term, minor beneficial impacts to socioeconomics would occur during the construction period due to the increase in jobs in the local economy. Following completion of restoration, there would be long-term, moderate beneficial impacts due to an increase in tourism and fishing opportunities which would result from an improved resource within the McKinney NWR.

Non-Preferred Alternatives: Short-term, minor beneficial impacts to socioeconomics would occur during the construction period due to the increase in jobs in the local economy. For these alternatives, it is not anticipated that restoration would necessarily significantly increase tourism to these areas, aside from potential increase for increased use of the walking trail near Short Beach, nor have any impact on populous in the area. These project alternatives are anticipated to have limited, minor long-term impacts to potential tourism in these areas.

No Action: With this alternative, no restoration activities would occur. At GMMU, this may produce long-term, indirect and adverse impacts to the local community through decreased public access and tourism in the NWR due to continued salt marsh degradation and nuisance mosquito populations.

6.2.3.2 Environmental Justice

Preferred Alternative: The anticipated effects of each of the alternatives of this plan would occur only within the boundaries of the NWR and do not involve loss or acquisition of businesses, residential homes, or community facilities. This alternative does not have the potential to negatively or disproportionately affect minority or low-income populations in the area, including economically, socially, or in terms of conditions affecting their health. There would be long-term, indirect beneficial impacts because proposed activities are expected to restore an environment that is of equal benefit to all Stratford area residents.

Non-Preferred Alternatives: For the Long Beach groin shortening and Short Beach living shoreline alternatives, the anticipated impacts on environmental justice would be the same as those described for the Preferred Alternative.

No Action: With this alternative, no restoration activities would occur. This condition is not anticipated to have any measurable effect, either adverse or beneficial on environmental justice.

6.2.3.3 Land Use and Recreation

Preferred Alternative: The noise and increased turbidity of surface waters arising from earth-moving activities during project construction are expected to discourage and decrease recreational activities near the site during construction. Any such effect will be limited to the period of construction and should be short-term, direct, and minor. There are many comparable substitute recreation sites readily available within the NWR. Over the longer term, the proposed restoration action will increase the quality, productivity, and quantity of marsh habitat in this area, resulting in indirect, long-term, moderate beneficial impacts. The marsh habitat in the McKinney NWR is a foundation for many recreational activities (e.g., fishing, hunting, bird watching), and the improvement in site conditions is expected to enhance opportunities for, and quality of, a variety of recreational uses.

Traffic would occur or increase at the site during the period of construction. The area and constituents most affected by the traffic will be the owners and employees of the warehouse and industrial district adjacent to the McKinney NWR. Because of the commercial uses in this area, increased traffic associated with the restoration efforts would likely be unnoticed and would not affect nearby commercial activities. This alternative would not result in any land use changes.

Non-Preferred Alternatives: Beach usage at Short Beach and Long Beach during construction activities would likely be directly adversely impacted, though impacts would be short-term, localized and minor. During construction, access to the beaches may be limited, thus disrupting normal usage. Once construction is completed, usage of the beaches would return to normal. These alternatives would not result in any land use changes. Long-term, minor, beneficial recreational impacts would result due to more stable beach conditions, greater site aesthetics, and potentially increased recreational fishing and bird watching opportunities.

No Action: For this alternative, no restoration activities would take place. This would limit the opportunity to improve marsh areas at GMMU, and likely preclude any increase in recreation in the beach or shallow water areas. With shoreline conditions not deliberately modified, these sites would continue to be adversely affected by storm events and sediment transport and impacts would be adverse, indirect, long-term, and minor to moderate in magnitude.

6.2.3.4 Cultural Resources

Preferred Alternative: Impacts from the Preferred Alternative on cultural resources would only occur if earthwork impacted a previously unidentified item of cultural or historical significance. The GMMU is in a low-lying waterlogged environment, which, while suitable for recreational activities, is not and was not historically suitable for development or settlement. It is therefore unlikely that implementation of this alternative would produce any impacts, adverse or beneficial, on cultural or historical resources. However, if any resources are discovered during construction that could be of cultural or historical importance, construction will cease and the Connecticut State Historic Preservation Office would be contacted.

The selected restoration actions will not adversely impact properties listed in or eligible for listing in the National Register of Historic Places. NOAA found the restoration actions identified

in this RP/EA would not adversely impact properties listed in or eligible for listing in the National Register of Historic Places, and submitted that determination to the Connecticut State Historic Preservation Office, and has sought a formal response.

Non-Preferred Alternatives: It is not anticipated that implementation of either the Long Beach or Short Beach alternatives would produce any impact, adverse or beneficial, on cultural resources. Short Beach is in a heavy-use area and thus the likelihood of resources of a cultural or historical significance being impacted by restoration is low to non-existent.

No Action: With this alternative, no restoration activities would occur. It is not anticipated that the No Action Alternative would have any impact, adverse or beneficial, on cultural resources.

6.3 CUMULATIVE IMPACTS OF THE RESTORATION ALTERNATIVES

Preferred Alternative:

Wetland restoration and creation projects are regularly implemented along the North Atlantic coast to address erosion, subsidence, and sea-level rise, and have been used as a means of compensating the public for other natural resource damage claims arising in New England and the Northern Atlantic. Wetland restoration projects recently completed in this area include:

- Over 140 acres of tidal wetlands were restored in this area during the late 1980s and early 1990s
- Over 40 acres of tidal wetlands were restored within the Stratford Development Corporation area of the GMMU in the early 2000s
- Numerous non-tidal flow projects were implemented in nearby municipalities with restoration actions including invasive species control and ditch plugging; and
- Dune restoration projects were completed at Long Beach in 2011 and 2014.

As a primary goal of CT DEEP is to improve the resiliency of coastal marshes, it is anticipated that numerous similar types of projects will be implemented in Stratford and in the GMMU in the foreseeable future.

The proposed project does not in and of itself represent or create a precedent for future settings of a type that would significantly affect the quality of the human environment. The proposed project is not expected to have a significant cumulative effect on the human environment since it alone, or in combination with other wetland restoration projects in the vicinity, should not change the larger current pattern of hydrologic discharge, boat traffic, economic activity, or land use in the NWR or the watershed. The proposed action would only restore habitat that originally existed and occurred naturally at this location within the NWR. Further, the actions proposed are intended to compensate the public, i.e., make the public and the environment whole, for resource injuries caused by releases of hazardous substances into the watershed. The preferred restoration action is not part of any systematic or comprehensive plan for the restoration of coastal wetlands in Connecticut, or the broader Long Island Sound coast.

The project actions would not result in any change to the economic activity in the area, and the restoration would contribute to the overall ecological health of the area. There is the direct potential to improve water quality through reduced sedimentation. The creation and enhancement of wildlife habitat supplements existing habitat in the region. A net cumulative beneficial impact may result from the synergy with future restoration activities.

Non-Preferred Alternatives: The cumulative impacts of the Long Beach and Short Beach alternatives are anticipated to be similar to those described above for the Preferred Alternative; these actions are not anticipated to have any significant cumulative effect on the natural or human environment, as these activities will only restore habitats that occurred at these locations or, in the case of Long Beach, work to restore longshore transport and sedimentation similar to, but less than, pre-groin construction status.

No Action: The No Action alternative is expected to result in cumulative adverse impacts and would not provide the conditions necessary for recovery of the injured resources. With No Action, natural resources and their services would not return to baseline, and interim service losses would not be compensated.

6.4 COMPARISON OF ALTERNATIVES

A comparison of the environmental consequences associated with the Preferred Alternative, the Non-Preferred Alternatives, and the No Action Alternative is summarized in Table 5.

Table 5. Summary of Environmental Consequences of the Restoration Alternatives

Resource	Preferred Alternative				Non-Preferred Alternatives				No Action Alternative			
	Type	**Duration**	**Magnitude**	**Quality**	**Type**	**Duration**	**Magnitude**	**Quality**	**Type**	**Duration**	**Magnitude**	**Quality**
Air Quality and Noise	Direct	Short-term	Minor	Adverse	Direct	Short-term	Minor	Adverse	No impact	No impact	No impact	No impact
Water Quality	Direct	Short-term	Minor	Adverse	Direct	Short-term	Moderate	Adverse	No impact	No impact	No impact	No impact
	Indirect	Long-term	Moderate	Beneficial	Indirect	Long-term	Minor to Moderate	Beneficial				
Geology	Indirect	Short-term	Minor	Adverse	Indirect	Short-term	Moderate	Adverse	No impact	No impact	No impact	No impact
Climate	Indirect	Long-term	Minor to moderate	Beneficial	No impact	No Impact	No impact	No Impact	No Impact	No Impact	No Impact	No Impact
Habitat and Vegetation	Direct	Short-term	Minor	Adverse	Indirect	Long-term	Moderate	Beneficial	Indirect	Long-term	Minor	Adverse
	Indirect	Long-term	Moderate	Beneficial								
Wildlife and Aquatic Organisms	Direct	Short-term	Minor	Adverse	Direct	Short-term	Minor	Adverse	Indirect	Long-term	Minor	Adverse
	Indirect	Long-term	Moderate	Beneficial	Indirect	Long-term	Minor	Beneficial				
Threatened and Endangered Species	Direct	Short-term	Minor	Adverse	Direct	Short-term	Minor	Adverse	Indirect	Long-term	Minor	Adverse
	Indirect	Long-term	Moderate	Beneficial	Indirect	Long-term	Moderate	Beneficial				
Essential Fish Habitat	Direct	Short-term	Minor	Adverse	No impact	No Impact	No impact	No impact	Indirect	Long-term	Minor	Adverse
	Indirect	Long-term	Moderate to Major	Beneficial								
Coastal Resiliency	Indirect	Lon-term	Minor to moderate	Beneficial	No impact	No Impact	No impact	No Impact	Indirect	Long-term	Moderate	Adverse
Socioeconomics	Direct	Short-term	Minor	Beneficial	Direct	Short-term	Minor	Beneficial	Indirect	Long-term	Minor	Adverse
	Indirect	Long-term	Moderate	Beneficial	Indirect	Long-term	Minor	Beneficial				
Mosquito Population	Indirect	Long-term	Moderate to Major	Beneficial	No impact	No impact	No impact	No impact	Indirect	Long-term	Minor	Adverse
Environmental Justice	Indirect	Long-term	Minor	Beneficial	Indirect	Long-term	Minor	Beneficial	No impact	No impact	No impact	No impact
Land Use and Recreation	Direct	Short-term	Minor	Adverse	Direct	Short-term	Minor	Adverse	Indirect	Long-term	Minor to Moderate	Adverse
	Indirect	Long-term	Moderate	Beneficial								
Cultural Resources	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact

7. CONCLUSIONS

In accordance with NEPA and its implementing regulations, this Draft RP/EA summarizes the current environmental setting; assesses the injury to or loss of natural resources or ecological services associated with the two Sites; describes the purpose and need for restoration actions; identifies alternative actions; assesses their applicability and potential impact on the quality of the physical, biological, and cultural environment; and summarizes the opportunity the Trustees provided for public participation in the decision-making process.

The Trustees considered multiple restoration alternatives to compensate the public for injuries to natural resources resulting from contamination from the two Sites. After evaluating the initial set of alternatives, the Trustees identified a suite of six marsh restoration projects sited in the Stewart B. McKinney NWR GMMU as the Preferred Alternative, based on the anticipated ecological benefits to marsh habitat, including fish and shellfish habitat, as well as project cost effectiveness and overall need for restoration within the Lower Housatonic River watershed. The Trustees also identified two Non-Preferred Alternatives and evaluated a No Action Alternative for comparison purposes.

Overall, implementation of the Preferred Alternative would result in the most long-term beneficial impacts to natural, physical, and human resources within the project area. The Non-Preferred Alternatives, while potentially resulting in suitable habitat to compensate for lost resources, would not provide the range of compensation across habitat types and ecosystem services that the Preferred Alternative is expected to provide. Additionally, the Non-Preferred Alternatives would be expected to have limited benefits to many resources in the human environment, including socioeconomics and recreation.

This information has been used to make a threshold determination as to whether preparation of an EIS is required prior to selection of the final restoration action. Based on the EA integrated into this document, the Trustees – NOAA, USFWS, and the State of Connecticut – conclude that the proposed restoration action does not meet the threshold requiring the preparation of an EIS, and pending consideration of public comments on this Draft RP/EA, propose to issue a FONSI.

8. APPLICABLE ENVIRONMENTAL LAWS AND REGULATIONS

Anadromous Fish Conservation Act
The Anadromous Fish Conservation Act (16 U.S.C. § 757a, *et seq.*) provides authority to conserve, develop, and enhance anadromous fishery resources.

Compliance: The preferred alternative would directly conserve, develop, and enhance anadromous fishery resources.

Clean Air Act
The Clean Air Act (42 U.S.C. § 7401, *et seq.*) directs EPA to set limits on air emissions to ensure basic protection of health and the environment. The fundamental goal is the nationwide attainment and maintenance of the National Ambient Air Quality Standards (NAAQS). Primary NAAQS are designed to protect human health. Secondary NAAQS are designed to protect the public welfare (for example, to prevent damage to soils, crops, vegetation, water, visibility, and property).

Compliance*:* All construction activities would be completed with conventional equipment in compliance with all local ordinances.

Clean Water Act
The Clean Water Act (33 U.S.C. § 1251, *et seq.*) is the principal law governing pollution control and water quality of the Nation's waterways. Section 404 of the law authorizes a permit program for the beneficial uses of dredged or fill material in navigable waters. The U.S. Army Corps of Engineers administers the program.

Compliance*:* Coordination with the U.S. Army Corps of Engineers would be completed pursuant to Section 404 of this Act. All joint federal/state permits would be obtained prior to the start of construction activities. All construction activity would be completed in compliance with Section 404 of the law.

Coastal Zone Management Act
The goal of the federal Coastal Zone Management Act (CZMA) (16 U.S.C. § 1451, *et seq.*, 15 CFR Part 923) is to preserve, protect, develop, and, where possible, restore and enhance the Nation's coastal resources. The federal government provides grants to states with federally approved coastal management programs. Section 1456 of the CZMA requires any federal action inside or outside of the coastal zone that affects any land or water use or natural resources of the coastal zone to be consistent, to the maximum extent practicable, with the enforceable policies of approved state management programs. It states that no federal license or permit may be granted without giving the State the opportunity to concur that the project is consistent with the State's coastal policies. The regulations outline the consistency procedures.

Compliance*:* The Trustees believe the project selected for implementation is consistent with Connecticut CZMA programs. The permit applicant would apply for consistency concurrence.

Endangered Species Act
The federal Endangered Species Act (16 U.S.C. § 1531, *et seq.*, 50 CFR Parts 17, 222, and

224) directs all federal agencies to conserve endangered and threatened species and their habitats and encourages such agencies to utilize their authority to further these purposes. Under the Act, NOAA/NMFS and USFWS publish lists of endangered and threatened species. Section 7 of the Act requires that federal agencies consult with these two agencies to minimize the effects of federal actions on endangered and threatened species.

Compliance: The Trustees would conduct the necessary follow-up Section 7 consultations with NMFS and USFWS staff during the design phase of this project prior to implementation.

Estuaries Protection Act
The Estuary Protection Act (16 U.S.C. § 1221-1226) highlights the values of estuaries and the need to conserve natural resources. It authorizes the Secretary of the Interior, in cooperation with other federal agencies and the states, to study and inventory estuaries of the United States, to determine whether such areas should be acquired by the federal government for protection, to assess impacts of commercial and industrial developments on estuaries, to enter into cost-sharing agreements with states and subdivisions for permanent management of estuarine areas in their possession, and to encourage state and local governments to consider the importance of estuaries in their planning activities related to federal natural resource grants.

Compliance: The restoration activities would enhance anadromous fish populations and thus benefit estuarine resources.

Fish and Wildlife Conservation Act
The Fish and Wildlife Conservation Act of 1980 (16 U.S.C. § 2901 and 50 CFR § 83) provides for the consideration of impacts on wetlands, protected habitats, and fisheries.

Compliance: The Trustees expect the restoration project would enhance habitats and species populations, thereby benefiting natural resources. Coordination with USFWS, NMFS, and CT DEEP signifies compliance with this Act.

Fish and Wildlife Coordination Act
The Fish and Wildlife Coordination Act (16 U.S.C. § 661, *et seq*.) states that wildlife conservation shall receive equal consideration with other features of water-resource development. The Act requires federal permitting and licensing agencies to consult with NOAA/NMFS, USFWS, and state wildlife agencies before permitting any activity that in any way modifies any body of water to minimize the adverse impacts of such actions on fish and wildlife resources and habitat.

Compliance: NOAA and USFWS are joint federal natural resource trustees who have worked cooperatively on evaluating various restoration projects and in selecting the preferred alternative. The Trustees would be consulting with agency regulatory staff during the 404 permitting process to minimize any potential adverse impacts to fish and wildlife resources and habitats.

Magnuson-Stevens Fishery Conservation and Management Act
The Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. § 1801, *et seq*.) as amended and reauthorized by the Sustainable Fisheries Act (Public Law 104297), established

a program to promote the protection of EFH in the review of projects conducted under federal permits, licenses, or other authorities that affect or have the potential to affect such habitat. After EFH has been described and identified in fishery management plans by the regional fishery management councils, federal agencies are obligated to consult with the Secretary of the U.S. Department of Commerce with respect to any action authorized, funded, or undertaken or proposed to be authorized, funded, or undertaken, by such agency that may adversely affect any EFH.

Compliance: The Trustees would evaluate and coordinate restoration designs with the NMFS Northeast Region OHC staff during the design and permitting phase to comply with the EFH provisions of the Act.

Marine Mammal Protection Act

The Marine Mammal Protection Act (16 U.S.C. § 1361, *et seq*.) establishes a moratorium on the taking and importation of marine mammals and marine mammal products, with exceptions for scientific research, allowable incidental taking, subsistence activities by Alaskan natives, and hardship. The Act provides authority to manage and protect marine mammals, including maintenance of the ecosystem.

Compliance: No or minimal interaction with seals or other marine mammals in the area of the proposed restoration is expected. The proposed restoration project would have no adverse effects on marine mammals.

Migratory Bird Treaty Act

The Migratory Bird Treaty Act (16 U.S.C. § 715, *et seq*.) provides for the protection of migratory birds. The Act does not specifically protect the habitat of these birds but may be used to consider time of year restrictions for remedial activities on sites where it is likely migratory birds may be nesting and/or to stipulate maintenance schedules that would avoid the nesting seasons of migratory birds.

Compliance: Consultation with USFWS constitutes compliance with this Act. If restoration construction activities are deemed to adversely impact migratory birds, time-of-year restrictions would be issued for these activities.

National Environmental Policy Act

Congress enacted the National Environmental Policy Act (NEPA; 42 U.S.C. Section 4321 *et seq*.) in 1969 to establish a national policy for the protection of the environment. NEPA applies to federal agency actions that affect the human environment. Federal agencies are obligated to comply with NEPA regulations adopted by CEQ. NEPA requires that an EA be prepared in order to determine whether the proposed restoration actions will have a significant effect on the quality of the human environment. If an impact is considered significant, then an EIS is prepared. If the impact is considered not significant, then a FONSI is issued.

Compliance: The Trustees have integrated this Restoration Plan with the NEPA and CEQ processes to comply, in part, with those requirements. This integrated process allows the

Trustees to meet the public involvement requirements of NEPA and CEQ concurrently. Full compliance is expected at the time a FONSI is issued.

National Historic Preservation Act
Congress enacted the National Historic Preservation Act in 1966 (16 U.S.C. § 470 *et seq.*) to establish a program for the preservation of historic properties throughout the nation. Section 106 of the National Historic Preservation Act mandates federal agencies undergo a review process for all federally funded and permitted projects that will impact sites listed on, or eligible for listing on, the National Register of Historic Places. It requires the federal agency to evaluate the effect a project may have on historic properties. It allows interested parties an opportunity to comment on the potential impact projects may have on significant archaeological or historic sites. The main purpose for the establishment of the Section 106 review process is to minimize potential harm and damage to historic properties.

Compliance: The selected restoration alternative would not adversely impact properties listed in or eligible for listing in the National Register of Historic Places. NOAA, as the Lead Federal Agency for the restoration, expects the restoration actions identified in this RP/EA will not adversely impact properties listed in or eligible for listing in the National Register of Historic Places, and submitted that determination to the Connecticut State Historic Preservation Office via letter dated 4 January 2017. The Connecticut State Historic Preservation Office (SHPO) and Tribal Historic Preservation Offices (THPOs) have been contacted regarding the project, and NOAA and USFWS are awaiting formal responses.

Preservation of Historic and Archeological Data Act
The purpose of the Preservation of Historic and Archeological Data Act of 1974, as amended, (16 U.S.C. § 469, *et seq.*) is to provide for the preservation of historic American sites, buildings, objects, and antiquities of national significance, and for other purposes by specifically providing for the preservation of historical or archaeological data which might otherwise be lost or destroyed.

Compliance*:* No interaction with historic sites, buildings, objects, and antiques of national significance is expected in the area of the proposed restoration. The proposed restoration project would have no adverse effects on historic and archaeological data.

Rivers and Harbors Act
The federal Rivers and Harbors Act (33 U.S.C. § 401, *et seq.*) regulates development and use of the Nation's navigable waterways. Section 10 of the Act prohibits unauthorized obstruction or alteration of navigable waters, and vests the U.S. Army Corps of Engineers with authority to regulate discharges of fill and other materials into such waters.

Compliance*:* Restoration actions that require Section 404 Clean Water Act permits may require permits under Section 10 of the Rivers and Harbors Act. A single joint federal/state permit usually serves for both. Therefore, the Trustees can ensure compliance with the Act through the same mechanism. The restoration activities would be addressed under the joint federal/state permit.

Watershed Protection and Flood Prevention Act
The Watershed Protection and Flood Prevention Act as amended (16 U.S.C. § 1001, *et seq*.) authorizes the Secretary of Agriculture to provide technical and financial assistance to entities of state and local governments and tribes (project sponsors) for planning and installing watershed projects. The U.S. Department of Agriculture agency responsible for program management is the Natural Resources Conservation Service.

Compliance: Floodplain impacts will be considered prior to selection of final project plans. The Trustees do not anticipate floodplain impacts with the preferred alternative.

Information Quality Guidelines issued pursuant to Public Law 106-554
Information disseminated by federal agencies to the public after 1 October 2002 is subject to information quality guidelines developed by each agency pursuant to Section 515 of Public Law 106-554 that are intended to ensure and maximize the quality of such information (i.e., the objectivity, utility, and integrity of such information).

Compliance: This restoration plan is an information product covered by information quality guidelines established by NOAA and the Department of the Interior for this purpose. The quality of the information contained herein is consistent with the applicable guidelines.

Executive Order 11514, Protection and Enhancement of Environmental Quality, as amended by Executive Order 11911, Relating to Protection and Enhancement of Environmental Quality
Executive Orders 11514 and 11991 require that federal agencies monitor, evaluate, and control their activities to protect and enhance the quality of the Nation's environment to sustain and enrich human life; inform the public about these activities; share data gathered on existing or potential environmental problems or control methods; and cooperate with other governmental agencies.

Compliance: Releasing the Draft RP/EA for public comment fully addresses the intent of this Executive Order.

Executive Order 11990, Protection of Wetlands
Executive Order 11990 (40 CFR § 6392 (a) and Appendix A) requires federal agencies to avoid the adverse impacts associated with the destruction or loss of wetlands, to avoid new construction in wetlands if alternatives exist, and to develop mitigative measures if adverse impacts are unavoidable.

Compliance: The preferred alternative avoids impacts to high-quality wetlands upstream of the project site by eliminating any construction activities in this area. The invasive plant common reed would be removed from the project site and earth-moving activities would be limited to areas dominated by the invasive plant. Wetland enhancement activities would occur including the removal of the invasive plant, regrading a 2-acre emergent marsh, and creation of a forested buffer wetland. These restoration activities would result in the restoration of high-quality wetlands once dominated by the invasive plant common reed. The preferred restoration actions are in compliance with, and fully address, the intent of the Executive Order.

Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, and Executive Order 12948, Amendment to Executive Order No. 12898

Executive Orders 12898 and 12948 require each federal agency to identify and address, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority and low-income populations.

Compliance: The Trustees have concluded that no low-income or ethnic-minority communities would be adversely affected by the proposed restoration activities.

Executive Order 12962, Recreational Fisheries

Executive Order 12962 requires that federal agencies, to the extent permitted by law and where practicable, and in cooperation with states and tribes, improve the quantity, function, sustainable productivity, and distribution of the Nation's aquatic resources for increased recreational fishing opportunities.

Compliance*:* The compensatory restoration activities undertaken would improve estuarine and diadromous fish populations including managed fisheries and forage fish species, and thus improve recreational fisheries.

Executive Order 13112, Invasive Species

The purpose of Executive Order 13112 is to prevent the introduction of invasive species and provide for their control, and to minimize the economic, ecological, and human health impacts that invasive species cause.

Compliance: The preferred restoration project includes the removal of the invasive common reed. Construction activities would not cause or promote the introduction or spread of invasive species. Annual surveys for invasive species and actions to control them, should they be present in the created marsh, have been budgeted into costs for this project.

9. LIST OF PREPARERS

The core team for this analysis consists of technical staff from NOAA, USFWS, and CT DEEP. Roles, contributions, and expertise are summarized for the team below. This team provided the majority of the drafting of analysis, and technical review. However, the team greatly appreciates the input provided by other individuals, who participated in the review and development of this document.

Name	Role	Agency and Location
James Turek	NOAA Trustee Representative and Project Manager	NOAA National Marine Fisheries Service; Narragansett, Rhode Island
John Fiorentino	NOAA Office of Habitat Conservation, NEPA Coordinator	NOAA Office of Habitat Conservation; Silver Spring, Maryland
Andrew Major	USFWS Trustee Representative	USFWS; Concord, New Hampshire
Molly Sperduto	NRDA/EC Program Supervisor	USFWS; Concord, New Hampshire
Rick Jacobson	State of Connecticut Trustee Representative	CT DEEP; Hartford, Connecticut

10. PERSONS/AGENCIES CONSULTED

Jennifer Mattei, Sacred Heart University, Fairfield, Connecticut
Roger Wolfe, CT DEEP, Madison, Connecticut
Harry Yamalis, CT DEEP, Hartford, Connecticut
Alison Verkade, NMFS, Gloucester, Massachusetts
Susan Jacobson, CT DEEP, Hartford, Connecticut
Nelson Debarros, CT DEEP, Hartford, Connecticut
Kevin O'Brien, CT DEEP, Hartford, Connecticut
Dave Cary, CT DEEP, Hartford, Connecticut
Ron Rosza, CT DEEP, retired
Paul Capotosto, CT DEEP, retired
Brian Thompson, CT DEEP, Hartford, Connecticut
Tina Batoh, Town of Stratford, Stratford, Connecticut
Cynthia Cosair, USFWS, Charlestown, Rhode Island
Robert Bell, CT DEEP, Hartford, Connecticut
Patrick Bowe, CT DEEP, Hartford, Connecticut
Patrick Comins, CT Audubon, Stratford, Connecticut
Michael Liberati, Dupont, Stratford, Connecticut
Richard Potvin, USFWS, Stewart B McKinney NWR, Westbrook, Connecticut
Suzanne Paton, USFWS, Charlestown, Rhode Island
Susan Adamowicz, USFWS, Wells, Maine
Min Huang, CT DEEP, Hartford, Connecticut

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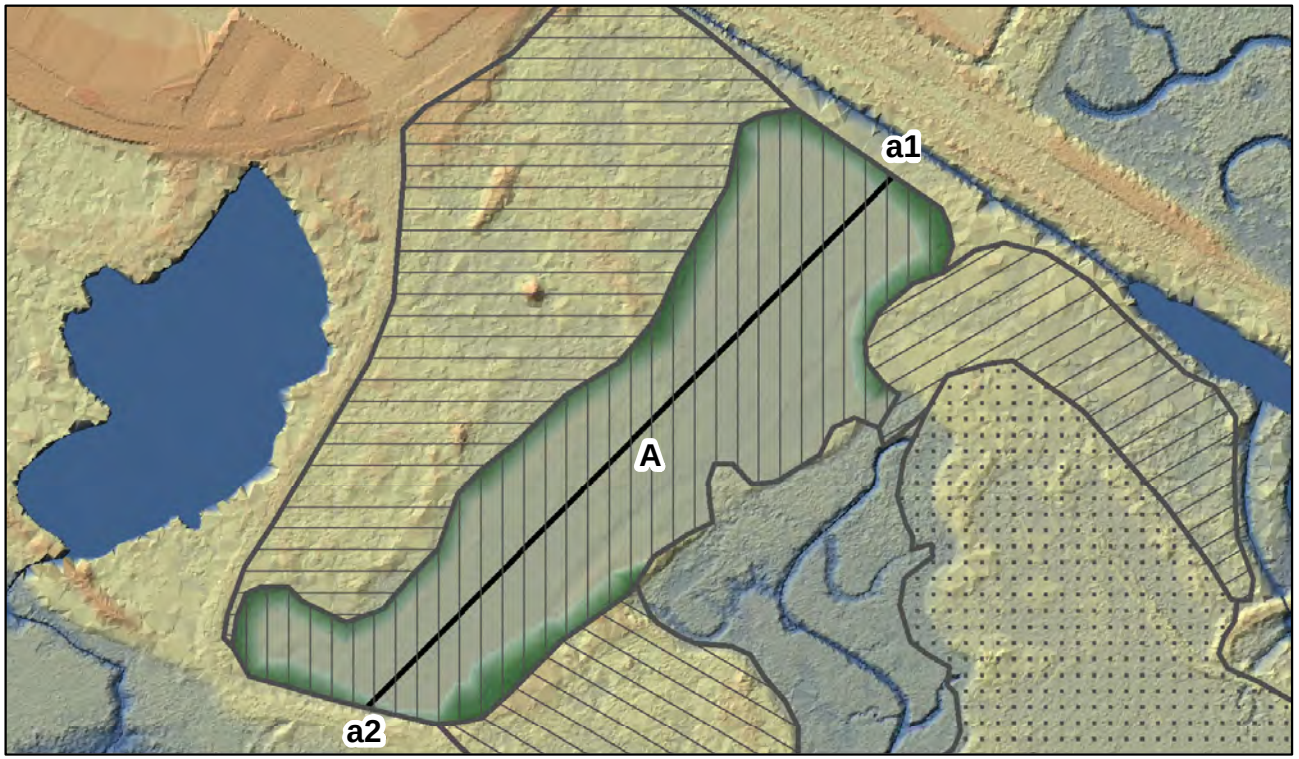
APPENDIX A

Supporting Documentation



0 210 420 840 1,260 1,680 Feet

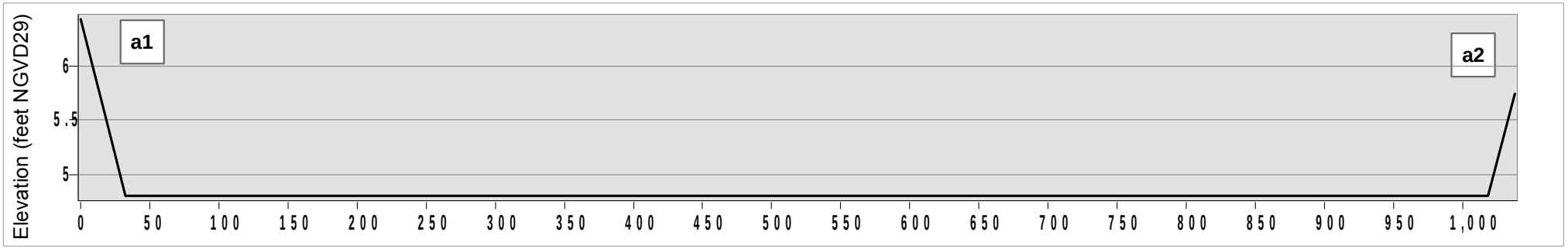
Restoration Alternatives

- Alternative 2
- Alternative 3
- Alternative 4
- Supplemental Work Area A
- Supplemental Work Area B

Alternative 2 - Excavation with slope

Elevation

- 7.009 - 8.069
- 6.473 - 7.009
- 6.145 - 6.473
- 5.911 - 6.145
- 5.698 - 5.911
- 5.485 - 5.698
- 5.288 - 5.485
- 5.076 - 5.288
- 4.886 - 5.076
- 4.8 - 4.886



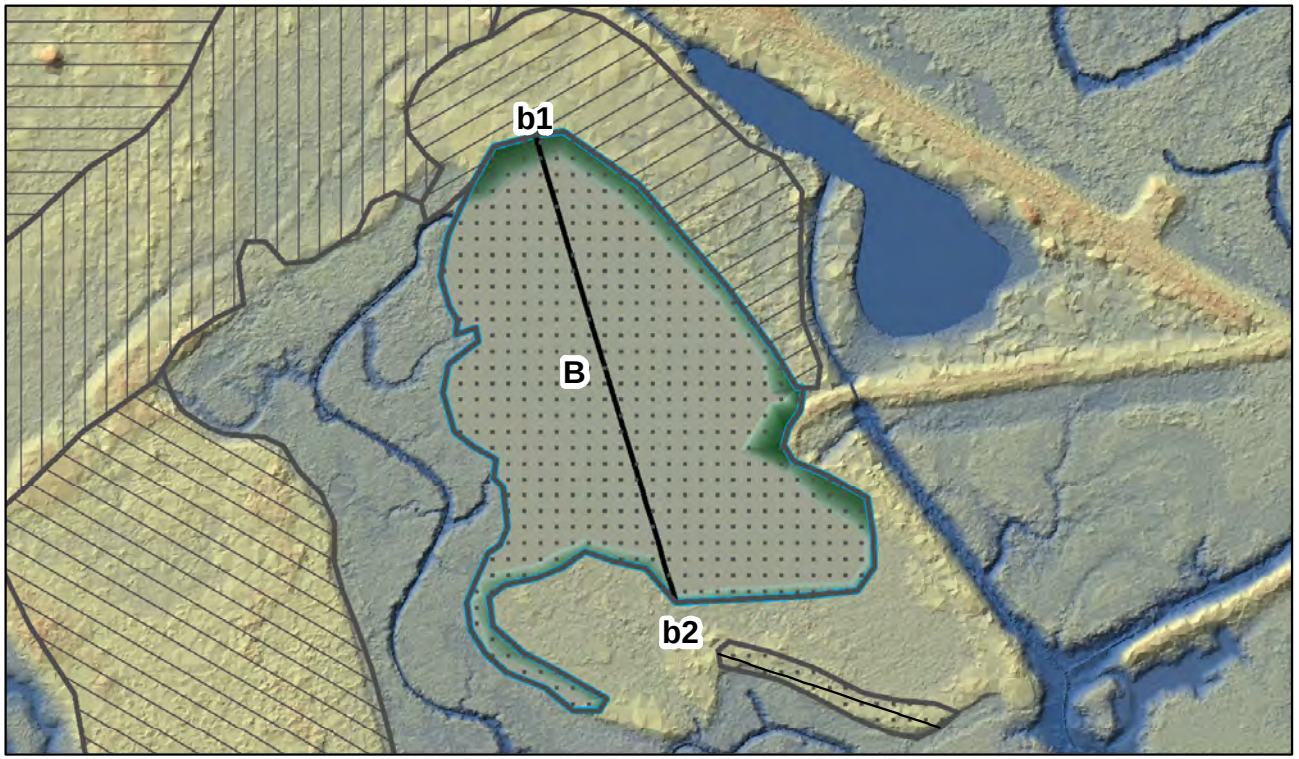
Great Meadows Restoration Alternatives: Alternative 2: Transect Profile A

Elevations derived from USACOE 2012 Post-Sandy LiDAR
NAVD88 = NGVD29 - 1.08' (NOAA VDatum v3.2)
Map printed on April 9 2014

N W E S

	High (cu yds)	Low (cu yds)
Basic Volume (excavate to 4.8', no side-slope)	14,190	11, 025
Advanced Volume (excavate to 4.8' with 1:20 side-slope)	11,450	8,285

High/Low differential for Basic Volume accounts for a likely overestimation of the marsh surface in the LiDAR data by ~ 0.3'. This amounts to ~ 3,165 cu yds. High/Low differential for Advanced Volume accounts for side-slopes of ~ 1:20 remaining in the area to tie into existing permieter grades. This amounts to ~2,740 cu yds.



Feet

0 200 400 800 1,200 1,600

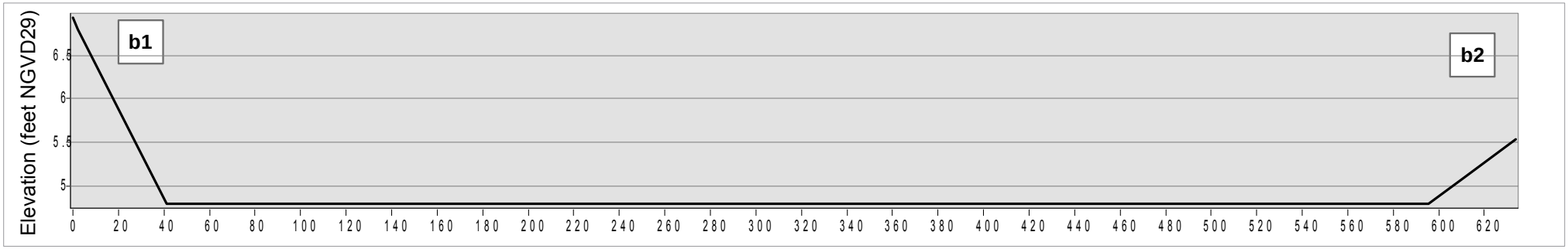
Restoration Alternatives

- Alternative 2
- Alternative 3
- Alternative 4
- Supplemental Work Area A
- Supplemental Work Area B

Alternative 3 - Excavation with slope

Elevation

- 7.127 - 8.32
- 6.58 - 7.127
- 6.194 - 6.58
- 5.875 - 6.194
- 5.621 - 5.875
- 5.413 - 5.621
- 5.229 - 5.413
- 5.065 - 5.229
- 4.891 - 5.065
- 4.31 - 4.891



Transect Length (feet)

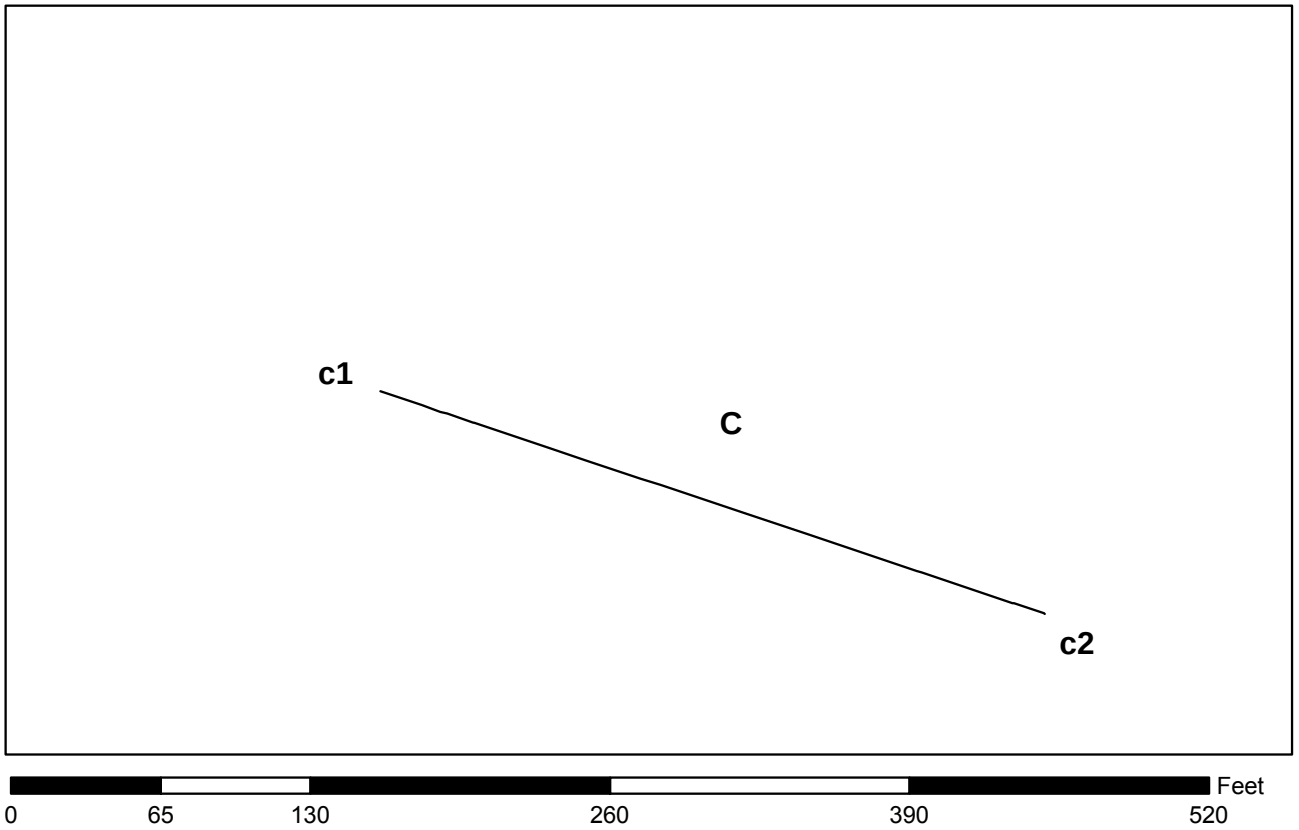
Great Meadows Restoration Alternatives: Alternative 3: Transect Profile B

Elevations derived from USACOE 2012 Post-Sandy LiDAR
NAVD88 = NGVD29 - 1.08' (NOAA VDatum v3.2)
Map printed on April 9 2014

N W E S

Alternative 3	High (cu yds)	Low (cu yds)
Basic Volume (excavate to 4.8', no side-slope)	9,236	6,710
Advanced Volume (excavate to 4.8' with 1:20 side-slope)	8,067	5,541

High/Low differential for Basic Volume accounts for a likely overestimation of the marsh surface in the LiDAR data by ~ 0.3'. This amounts to ~ 2,526 cu yds. High/Low differential for Advanced Volume accounts for side-slopes of ~ 1:20 remaining in the area to tie into existing permieter grades. This amounts to ~1,169 cu yds.



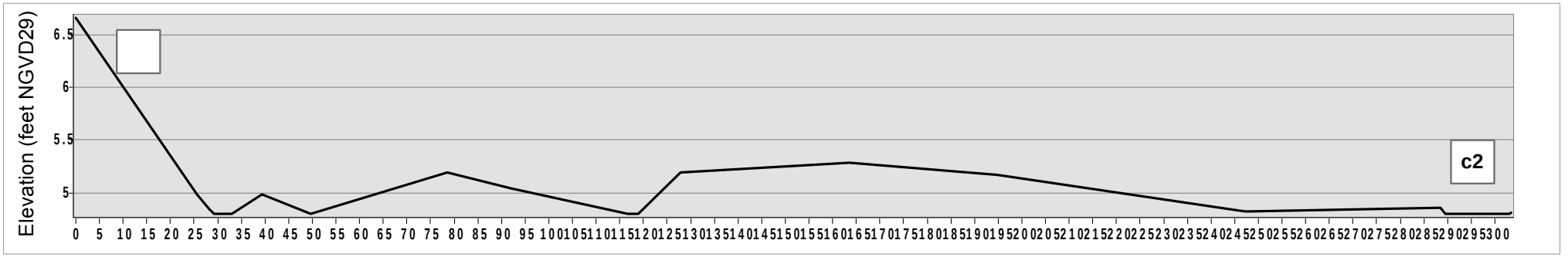
Restoration Alternatives

- Alternative 2
- Alternative 3
- Alternative 4
- Supplemental Work Area A
- Supplemental Work Area B

Alternative 3 - Excavation (Berm) with slope

Elevation

- 6.319 - 6.738
- 6.06 - 6.319
- 5.841 - 6.06
- 5.657 - 5.841
- 5.492 - 5.657
- 5.332 - 5.492
- 5.178 - 5.332
- 5.029 - 5.178
- 4.879 - 5.029
- 4.8 - 4.879

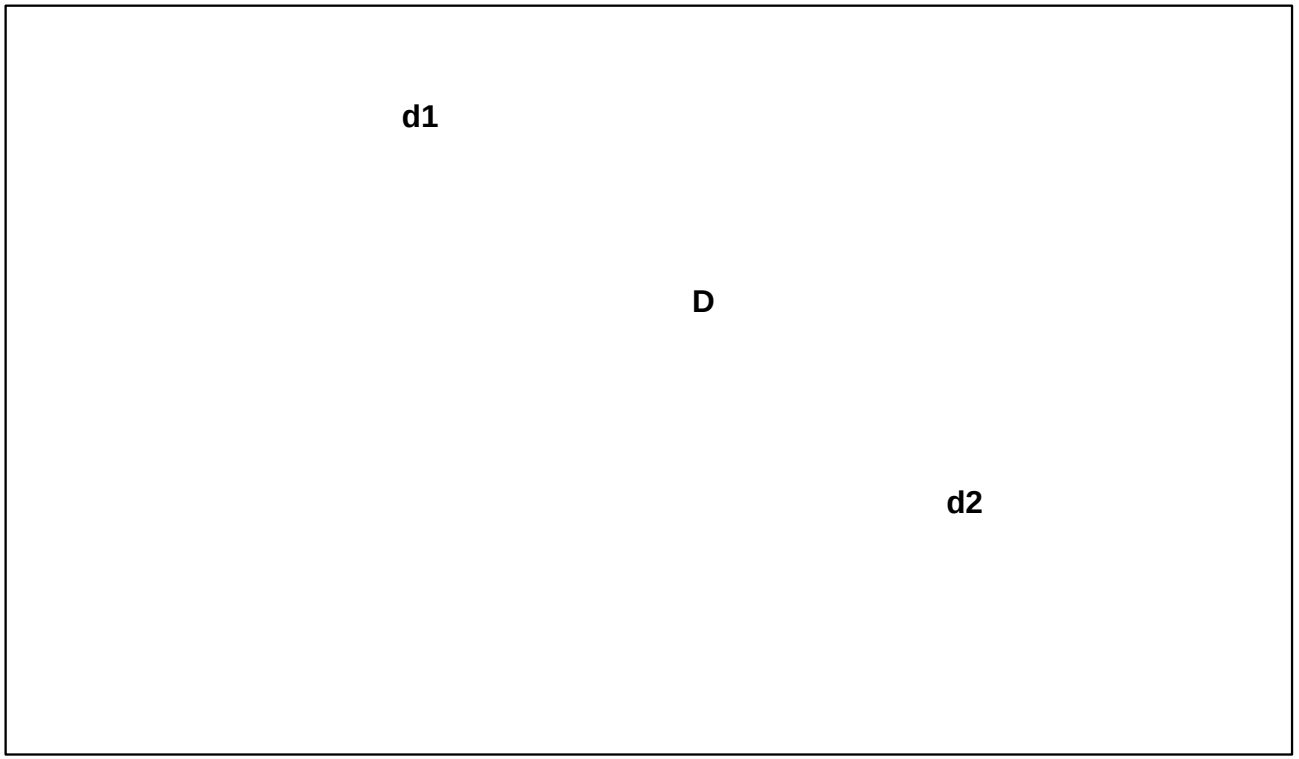


Great Meadows Restoration Alternatives: Alternative 3 (Berm): Transect Profile C

Elevations derived from USACOE 2012 Post-Sandy LiDAR
NAVD88 = NGVD29 - 1.08' (NOAA VDatum v3.2)
Map printed on April 9 2014

Alternative 3 (Berm)	High (cu yds)	Low (cu yds)
Basic Volume (excavate to 4.8', no side-slope)	510	387
Advanced Volume (excavate to 4.8' with 1:20 side-slope)	313	190

High/Low differential for Basic Volume accounts for a likely overestimation of the marsh surface in the LiDAR data by ~ 0.3'. This amounts to ~ 123 cu yds. High/Low differential for Advanced Volume accounts for side-slopes of ~ 1:20 remaining in the area to tie into existing permieter grades. This amounts to ~197 cu yds.



Restoration Alternatives

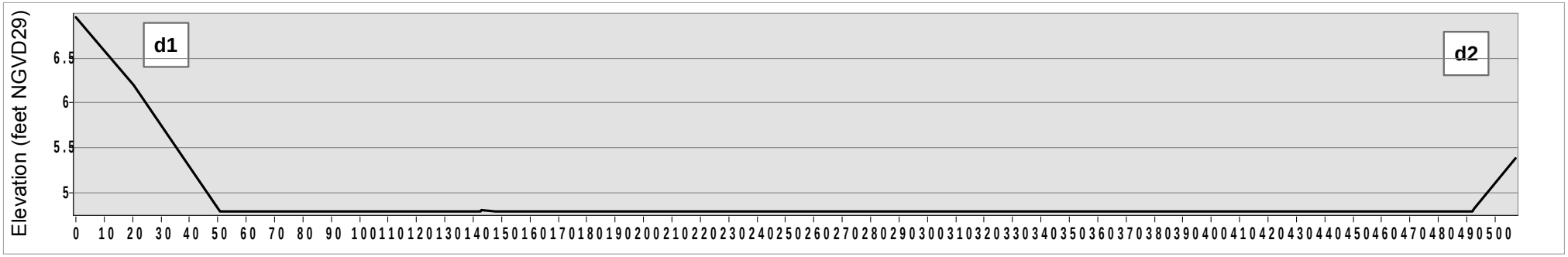
- Alternative 2
- Alternative 3
- Alternative 4
- Supplemental Work Area A
- Supplemental Work Area B

Alternative 4 - Excavation with slope

Elevation

- 7.093 - 7.852
- 6.655 - 7.093
- 6.306 - 6.655
- 6.02 - 6.306
- 5.77 - 6.02
- 5.547 - 5.77
- 5.334 - 5.547
- 5.131 - 5.334
- 4.915 - 5.131
- 4.8 - 4.915

0 135 270 540 810 1,080 Feet



Great Meadows Restoration Alternatives: Alternative 4: Transect Profile D

Elevations derived from USACOE 2012 Post-Sandy LiDAR
NAVD88 = NGVD29 - 1.08' (NOAA VDatum v3.2)
Map printed on April 9 2014

Alternative 4	High (cu yds)	Low (cu yds)
Basic Volume (excavate to 4.8', no side-slope)	5,158	4,086
Advanced Volume (excavate to 4.8' with 1:20 side-slope)	3,519	2,447

High/Low differential for Basic Volume accounts for a likely overestimation of the marsh surface in the LiDAR data by ~ 0.3'. This amounts to ~ 1,072 cu yds. High/Low differential for Advanced Volume accounts for side-slopes of ~ 1:20 remaining in the area to tie into existing permieter grades. This amounts to ~1,639 cu yds.

Fuss & O'Neill Inc. *Consulting Engineers*

56 Quarry Road, Trumbull, CT 06611
TEL 203 374-3748 FAX 203 374-4391
INTERNET: www.fussandoneill.com

Other Offices:
Manchester, Connecticut
West Springfield, Massachusetts
Providence, Rhode Island

May 2, 2002

Mr. William J. Kolodnicki
Refuge Manager
U.S. Fish and Wildlife
P.O. Box 1030
Westbrook, CT 06498

RE: Soil Quality Assessment
Long Beach Boulevard
Wetland Restoration Area 4
Stratford, Connecticut

Dear Mr. Kolodnicki:

At the request of James Caissy of the Stratford Land Development Corporation, we are submitting the enclosed report summarizing the activities and results of the soil sampling conducted at the above-referenced site. This report is the same as the one that was sent to Ken Feathers at the CT DEP for his review, except that in your copy, Tables 3 and 4 have been updated to include synthetic precipitation leaching procedure (SPLP) data for selected samples. SPLP data can be compared directly to pollutant mobility criteria from the Connecticut Remediation Standard Regulations.

Please contact the undersigned at (203) 374-3748 x 506 or Mark LeMoine ext. 503 if we can be of further assistance.

Sincerely,

Elizabeth P. Troop, P.E.
Senior Environmental Engineer

Enclosure

F:\2000\139\S10\200

WETLAND RESTORATION AREA
SOIL SAMPLING RESULTS
THE STRATFORD LAND DEVELOPMENT COMPANY, LP
STRATFORD, CONNECTICUT

TABLE OF CONTENTS

1.0 INTRODUCTION

Fuss & O'Neill, Inc. (F&O) was retained by Stratford Land Development Company, LP (SLDCLP) to conduct a soil quality assessment of a parcel of land known as Restoration Area #4, located at the end of Long Beach Boulevard in Stratford, Connecticut (subject site). A site location map is provided in Figure 1. The objective of this study was to identify the quality of soils associated with this proposed tidal wetland restoration area.

2.0 BACKGROUND

The Stratford Land Development Company, LP (SLDCLP) currently owns 76 acres on the coast in Stratford, Connecticut. During the 1950's, the Army Corp of Engineers requested and received permission to create a dike and deposit dredging spoils on these properties. It is believed that the dredging spoils originated from Long Island Sound and Bridgeport Harbor.

As shown in Figure 2, the SLDCLP now plans to develop a portion of Parcel 3 for industrial and commercial use including a building and parking lot. This area is hereinafter called "the Development Area." As part of this planned development, SLDCLP is planning to initiate the wetland restoration of an approximately 10 acre adjacent parcel (Restoration Area #4), hereinafter known as the "Wetland Restoration Area." As part of this restoration, approximately two feet of sediment (i.e., dredging spoils) will be removed from an area of existing inland wetlands and adjacent uplands, and a breach created in the existing dike to allow for tidal influence on this area. In addition, several channels and tidal ponds have been proposed as part of this restoration project. The removal of sediment will produce a tidally influenced aquatic environment. SLDCLP plans to use the material removed from the Wetland Restoration Area as fill on portions of the Development Area.

On May 17, 2001, a meeting was held with representatives of the Connecticut Department of Environmental Protection (DEP) to discuss this project. In that meeting, it was agreed that criteria found in the Connecticut Remediation Standard Regulations (RSR) would be used as guidance in interpreting the soil analysis results. However, it must be understood that since this is a wetland restoration project, not a site remediation, the RSR are used as guidance rather than regulatory compliance criteria.

Some RSR provisions will be used to manage the soil that is removed from the Wetland Restoration Area. For example, the RSR describe the options that may be used for polluted soils to remain in-place or can be re-used in other areas. For this project, the DEP has suggested that if polluted soils are encountered within the area to be excavated, these soils may be deposited as fill in the Development Area provided they are environmentally isolated (i.e. covered with either 4 feet of clean soils or 2 feet of clean soil covered by asphalt). This approach is consistent with the RSR.

Following the May 2001 meeting, a Sampling and Analysis Plan was submitted to the DEP. This Plan was approved by DEP by letter dated 1 October 2001. Sampling was conducted in January 2002 to meet the requirements of that plan.

3.0 PROJECT OBJECTIVES AND SCOPE OF WORK

The proposed area to be excavated contains approximately 10 acres. The material to be analyzed is homogeneous and is not known to have been impacted by industrial or commercial activities since it was deposited in the 1950's. Therefore, one sample station per acre was used to collect samples for analysis.

The project was divided into three portions. Phase A consisted of the soils currently in the Development Area. Phase B consisted of the soils which will be excavated from the Wetland Restoration Area and used as fill in the Development Area. Phase C consisted of the soils which will remain in the Wetland Restoration Area following restoration.

Under the plans developed by the SLDCLP, the soil will be removed from the Wetland Restoration Area and used as fill in the Development Area. The development will include buildings and a paved parking area. The sampling was conducted to assess the soils from both the restoration and development areas.

3.1 Phase A - Development Area

Phase A consisted of sampling the upper two feet of soil at two locations in the Development Area to determine the quality of the existing surface soils. The purpose of this sampling was to determine if background concentrations of constituents listed in Table 1 were similar to those of the material that will be removed from the Wetland Restoration Area and used as fill in the Development Area. Laboratory analytical results will be compared to the State of Connecticut Industrial/Commercial Direct Exposure Criteria (I/C DEC) from the RSR.

3.2 Phase B -Wetland Restoration Area - Shallow Soil

Phase B consisted of sampling the upper two feet of soils that will be removed from the Wetland Restoration Area. Ten soil locations were selected to represent the soil quality of the ten-acre Wetland Restoration Area. Laboratory analytical results will be compared to the State of Connecticut Industrial/Commercial Direct Exposure Criteria (I/C DEC) from the RSR.

3.3 Phase C- Wetland Restoration Area - Deeper Soil

Phase C consisted of the sampling of soils below 2' deep to determine the quality of the soils that will remain in place after the wetland restoration is complete. Once the wetland restoration project is completed, these soils will be exposed and will comprise the new aquatic environment. Laboratory analytical results will be compared to the State of Connecticut Pollutant Mobility Criteria for GB areas (PMC GB) from the RSR.

3.4 Constituents of Concern

The parameters to be analyzed for monitoring associated with this project, as identified in

Table 1 of this report, were selected based on previous test results and experience with analyzing fill material.

4.0 SUMMARY OF SITE SAMPLING AND ANALYSES

Soil sampling was conducted using a stainless steel hand auger. Each soil sample was classified in the field and apportioned into appropriate laboratory supplied containers. Once sealed, the containers were placed on ice and delivered to Phoenix Environmental Laboratories, Inc. of Manchester, Connecticut with Chain-of-Custody documentation. Soil samples were analyzed for the constituents listed in Table 1. The sampling device used was field decontaminated between sampling locations by rinsing the sampling equipment with the following reagents: non-phosphate detergent, tap water, 20% methanol solution, deionized water, 10% nitric acid solution and deionized water.

4.1 Soil Sampling and Analysis – Phase A

Samples were collected from two locations within the Development Area, as shown on Figure 2. Samples were collected within the 0-2' interval. Analytical results are summarized in Table 2. All results are below the I/C DEC of the RSRs.

4.2 Soil Sampling and Analysis - Phase B

Samples were collected from ten locations within the Wetland Restoration Area, as shown on Figure 2. All locations were assumed to be equally representative of overall site conditions. Soil samples were collected from the 0-1' interval and 1-2' interval. Analytical results are summarized in Table 3. With the exception of arsenic, all results are below the I/C DEC of the RSRs. Five of the twenty- two samples had arsenic concentrations in excess of the I/C DEC. The arithmetic and geometric means were computed (using one-half the detection limit for non-detects) and both were below that I/C DEC criteria.

4.3 Soil Sampling and Analysis - Phase C

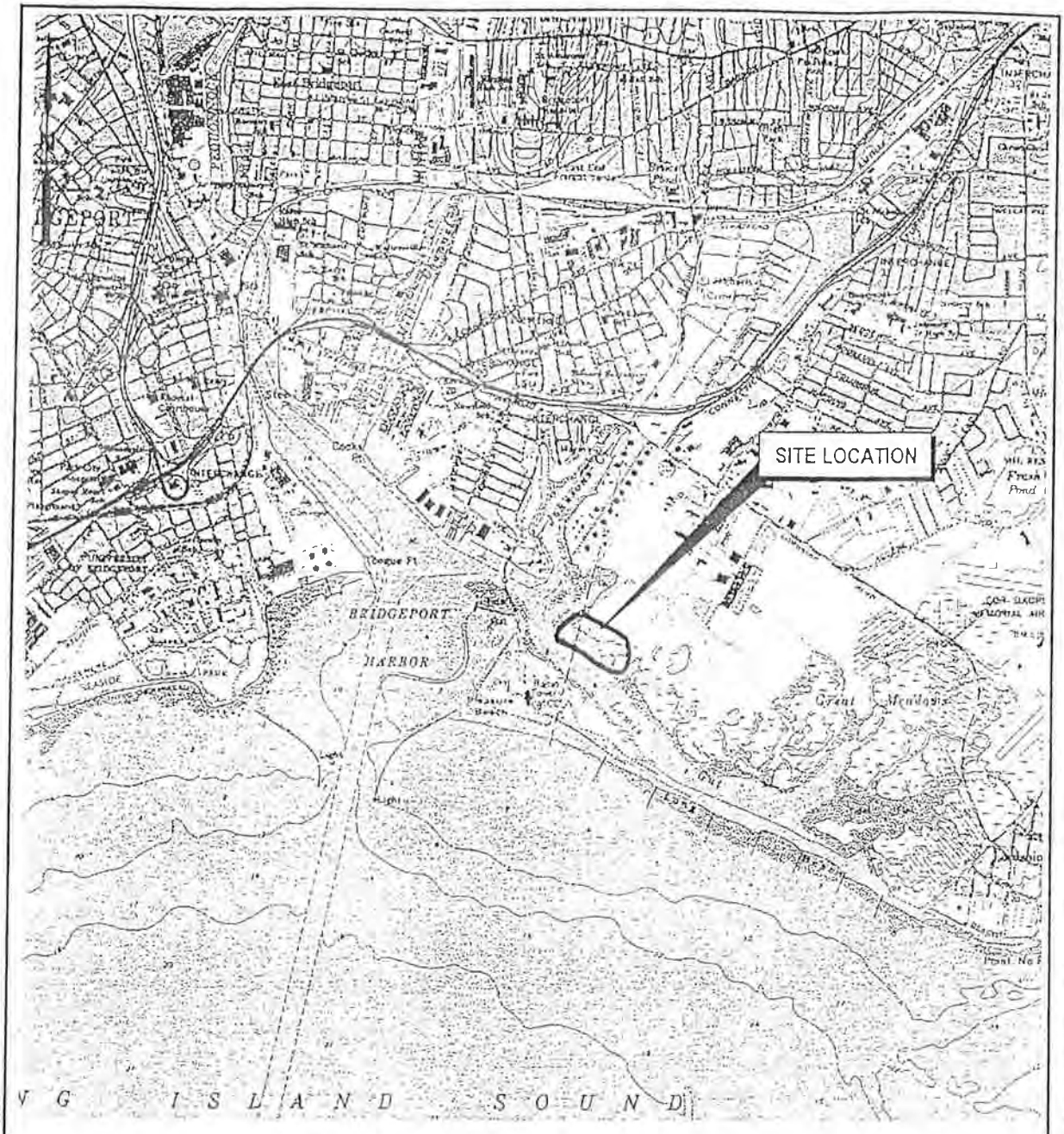
The same ten sample locations were used for Phase C as were used for Phase B, but the Phase C samples were collected at deeper intervals. Soil samples collected for the Phase C portion of this study were collected in one-foot intervals, continuously, from a depth of two feet, at the same sample locations as those in Phase B until native material was encountered. Analytical results are summarized in Table 4. These soil samples represent the material that will remain in the restored wetlands and form the wetland habitat. Therefore, the "bioavailability" of the metals in these sediments is of interest. A relatively new procedure, called acid volatile sulfide and simultaneously extracted metals (AVS/SEM) was used to determine the bioavailability of metals contained in the sediments. Simply stated, if sufficient sulfide is present, metals are in precipitated (metal-sulfide) form and not available for bio-assimilation.

The sample results were compared to the GB PMC. The GB PMC is a measure of constituent concentration in liquid in the units of mg/l. Since these were soil samples which can only be measured on a mass (mg/kg) basis, the GB PMC were multiplied by twenty to

conservatively convert them to mass based units of mg/kg. The factor of twenty results from the fact that if a liquid extraction (such as SPLP) is performed to get a liquid sample from a soil sample, the constituents (typically metals) are diluted by a factor of at least twenty. The dilution would be twenty-fold if ALL of the metals in the sample were extracted from the soil sample. However, since this rarely happens in the laboratory, or in nature, this estimate is usually conservative and a factor higher than 20 could sometimes provide a mote accurate comparison. An extraction technique, such as SPLP, could be used to get a more accurate comparison to the GB PMC.

One of the mass mercury samples and two of the twelve AVS-SEM chromium samples were above 20X the GB PMC for these metals. The arithmetic and geometric means were computed and neither were below 20X the GB PMC for these metals. All of the AVS-SEM lead samples were above 20X the GB PMC.

The Extractable Total Petroleum Hydrocarbon (ETPH) results varied widely between samples. One of the thirteen samples had ETPH concentrations above the GB PMC. The arithmetic and geometric mean were computed and both were below the GB PMC. No Semi-Volatile Organic Compounds (SVOCs) were detected in the sample with the high ETPH. SVOCs did not exceed the GB PMC in any sample.



SCALE = 1: 24000

0 1/2 1 MILE

0 2000 4000

SCALE 1"= 2000'

FIGURE 1

MAP REFERENCE:

THIS MAP WAS PREPARED FROM THE FOLLOWING
7 5 MINUTE SERIES TOPOGRAPHIC MAP
BRIDGEPORT, CONN. 1964 PHOTOREVISED 1984

Quadrangle Location

Fuss & O'Neill Inc. Consulting Engineers
(860)646-2469

SITE LOCATION MAP

STRATFORD LAND DEVELOPEMENT
RESTORATION AREA #4

STRATFORD CONNECTICUT

PROJ NO 20001139.S10 DATED MARCH 2002 SCALE 1"= 2000'

J:\DWG\P2001\139\S10\SITELOC.PRT

TABLE 1
Analytical Parameter List
Wetland Restoration Project
Stratford Development Company
Stratford , Connecticut

Constituents	EPA Method
Metals	
Arsenic	SW-846 Method 6010A
Mercury	SW-846 Method 7471A
Beryllium	SW-846 Method 6010A
Cadmium	SW-846 Method 6010A
Chromium	SW-846 Method 6010A
Copper	SW-846 Method 6010A
Lead	SW-846 Method 6010A
Nickel	SW-846 Method 6010A
Potassium	SW-846 Method 6010A
Selenium	SW-846 Method 6010A
Silver	SW-846 Method 6010A
Thallium	SW-846 Method 6010A
Zinc	SW-846 Method 6010A
Extractable Total Petroleum Hydrocarbons (ETPH)	CT ETPH
PCBs and Pesticides	SW-846 Methods 8081/8082
Volatile Organic Compounds (VOCs)	SW-836 Method 8260
Semi-Volatile Organic Compounds (SVOCs)	SW-846 Method 8270
Acid Volatile Sulfide - Simultaneously Extracted Metals (AVS-SEM)**	
Synthetic Precipitation Leach Procedure (SPLP)*	SW-846 Method 1312

Notes:
* SPLP may be run on select metals for some samples
**AVS-SEM was be run for ICAP metals for select samples in the Phase C portion of this work

TABLE 3
Soil Quality Summary
Phase B - Shallow Soils - Wetland Restoration Area
Stratford, Connecticut
REVISED MAY, 2002

Constituent	I/C DEC	Sample ID	W00001-01	W00001-02	W00002-05	W00002-06	W00003-09	W00003-10	W00004-20	W00004-21
		Sample Depth	0-1'	1-2'	0-1'	1-2'	0-1'	1-2'	0-1'	1-2'
		Date	01/04/02	01/04/02	01/04/02	01/04/02	01/04/02	01/04/02	01/23/02	01/23/02
		Units								
Metals										
Arsenic	10	mg/Kg	**16.4**	4.58	**16.9**	**14.1**	8.96	**22.0**	3.1	8.7
SPLP Arsenic		mg/L						ND<0.01		
Mercury	610	mg/Kg	ND<0.10	0.24	ND<0.10	ND<0.10	ND<0.10	ND<0.10	ND<0.10	ND<0.10
SPLP Mercury		mg/L						ND<0.001		
Beryllium	2	mg/Kg	0.39	0.255	0.401	0.383	0.259	0.468	0.40	0.40
Cadmium	1,000	mg/Kg	ND<0.10	ND<0.10	ND<0.10	ND<0.10	ND<0.10	ND<0.10	ND<0.10	0.20
Chromium	NE	mg/Kg	75.2	69.2	40.0	42.0	24.8	46.3	22.4	27.6
SPLP Chromium		mg/L						ND<0.01		
Copper	76,000	mg/Kg	70.3	102	46.8	49.5	29.0	52.1	32.3	30.3
Lead	1000	mg/Kg	65.3	26.3	36.4	33.1	20.6	35.3	16.6	22.8
SPLP Lead		mg/L						ND<0.015		
Nickel	7500	mg/Kg	13.5	9.55	13.8	13.1	8.54	15.0	11.1	11.9
Potassium	NE	mg/Kg	130	180	168	208	88.1	231	2850	4840
Selenium	10,000	mg/Kg	ND<2.5	ND<2.5	ND<2.5	ND<2.5	ND<2.5	ND<2.5	ND<2.5	ND<5.0
Silver	10,000	mg/Kg	0.102	0.252	ND<0.10	ND<0.10	ND<0.10	ND<0.10	ND<0.10	ND<0.20
Thallium	160	mg/Kg	ND<5.0	ND<5.0	ND<5.0	ND<5.0	ND<5.0	ND<5.0	ND<5.0	ND<10.0
Zinc	610,000	mg/Kg	54.2	39.6	53.9	52.2	34.3	58.5	50.0	50.0
Percent Solid	NA	%	60	59	54	52	90	49	69	55
Ext. Petroleum HC	2500	mg/Kg	ND<10	99	300	190	110	190	ND<10	ND<10
PCB/Pesticide Method 8081*	---	ug/Kg	ND	ND	ND	ND	ND	ND	ND	ND
VOCs Method 8021*	---	ug/Kg	ND	ND	ND	ND	ND	ND	ND	ND
SVOCs Method 8270*	---	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND

Notes
* Only constituents with a positive detection shown
NE - None Established
ND - Not Detected
NA - Not Applicable
--- = Varies depending on constituent

TABLE 3
Soil Quality Summary
Phase B - Shallow Soils - Wetland Restoration Area
Stratford, Connecticut
REVISED MAY, 2002

Constituent	I/C DEC	Sample ID	W00005-25	W00005-26	W00006-28	W00006-29	W00007-31	W00007-32	W00007-33	W00008-37
		Sample Depth	0-1'	1-2'	0-1'	1-2'	0-1'	0-1' Dup	1-2'	0-1'
		Date	01/23/02	01/23/02	01/23/02	01/23/02	01/23/02	01/23/02	01/23/02	01/23/02
		Units								
Metals										
Arsenic	10	mg/Kg	5.5	5.0	3.8	1.9	ND<1.0	ND<1.0	ND<1.0	ND<1.0
SPLP Arsenic		mg/L		ND<0.01						
Mercury	610	mg/Kg	0.19	0.66	0.20	ND<0.10	ND<0.10	ND<0.10	ND<0.10	ND<0.10
SPLP Mercury		mg/L		ND<0.001						
Beryllium	2	mg/Kg	0.30	0.20	0.50	0.20	ND<0.10	ND<0.10	ND<0.10	ND<0.10
Cadmium	1,000	mg/Kg	ND<0.20	ND<0.10	0.20	0.10	ND<0.10	ND<0.10	ND<0.10	ND<0.10
Chromium	NE	mg/Kg	33.8	77.6	37.7	10.8	4.10	3.40	4.10	5.80
SPLP Chromium		mg/L		ND<0.01						
Copper	76,000	mg/Kg	38.8	54.9	95.8	30.1	10.7	8.70	9.20	10.1
Lead	1000	mg/Kg	54.7	67.9	63.6	19.4	7.30	6.70	5.70	22.2
SPLP Lead		mg/L		ND<0.015						
Nickel	7500	mg/Kg	12.6	9.80	12.6	7.10	3.80	3.00	3.0	3.30
Potassium	NE	mg/Kg	3860	3920	1770	1260	513	503	444	568
Selenium	10,000	mg/Kg	ND<5.0	ND<2.5	ND<2.5	ND<2.5	ND<2.5	ND<2.5	ND<2.5	ND<2.5
Silver	10,000	mg/Kg	ND<0.20	0.5	ND<0.10	ND<0.10	ND<0.10	ND<0.20	ND<0.20	ND<0.20
Thallium	160	mg/Kg	ND<10.0	ND<5.0	ND<5.0	ND<5.0	ND<5.0	ND<5.0	ND<5.0	ND<5.0
Zinc	610,000	mg/Kg	48.5	39.0	109	53.9	21.6	14.0	15.9	17.2
Percent Solid	NA	%	58	65	82	86	94	95	95	93
Ext. Petroleum HC	2500	mg/Kg	ND<10	90	ND<10	ND<10	ND<10	ND<10	ND<10	ND<10
PCB/Pesticide method 8081*	---	ug/Kg	ND	ND	ND	ND	ND	ND	ND	ND
VOCs method 8021*	---	ug/Kg	ND	ND	ND		ND	ND	ND	ND
Toluene	500	ug/Kg	ND	ND	ND	6.9	ND	ND	ND	ND
SVOCs method 8270*	---	ug/Kg	ND	ND	ND	ND	ND	ND	ND	ND

Notes
* Only constituents with a positive detection shown
NE - None Established
ND - Not Detected
NA - Not Applicable
--- = Varies depending on constituent

TABLE 3
Soil Quality Summary
Phase B - Shallow Soils - Wetland Restoration Area
Stratford, Connecticut
REVISED MAY, 2002

Constituent	I/C DEC	Sample ID	W00008-38	W00009-40	W00009-41	W00010-43	W00010-44	W00010-45	Arithmetic Mean	Geometric Mean
		Sample Depth	1-2'	0-1'	1-2'	0-1'	1-2'	1-2' Dup		
		Date	01/23/02	01/23/02	01/23/02	01/23/02	01/23/02	01/23/02		
		Units								
Metals										
Arsenic	10	mg/Kg	ND<1.0	3.4	1.2	4.2	6.3	**11.9**	6.4	3.6
SPLP Arsenic		mg/L						ND<0.01		
Mercury	610	mg/Kg	ND<0.10	0.38	BDL<0.10	BDL<0.10	0.65	0.98	0.18	0.1
SPLP Mercury		mg/L						ND<0.001		
Beryllium	2	mg/Kg	0.20	0.20	0.2	0.4	0.30	0.30	0.2	0.2
Cadmium	1,000	mg/Kg	ND<0.10	ND<0.10	BDL<0.10	BDL<0.10	BDL<0.20	BDL<0.20	BDL<0.20	BDL<0.20
Chromium	NE	mg/Kg	10.7	35.0	18.2	31.6	90.3	122	38	26
SPLP Chromium		mg/L						ND<0.01		
Copper	76,000	mg/Kg	23.8	41.3	33.5	52.3	464	135	69	46
Lead	1000	mg/Kg	15.2	47.0	27.5	24.7	67.4	121	37	28
SPLP Lead		mg/L						ND<0.015		
Nickel	7500	mg/Kg	7.20	8.30	8.50	10.3	11.8	12.0	9.9	9.6
Potassium	NE	mg/Kg	2220	2680	2840	3340	3800	4450	1857	1019
Selenium	10,000	mg/Kg	ND<2.5	ND<2.5	BDL<2.5	BDL<2.5	BDL<5.0	BDL<5.0	BDL<5.0	BDL<5.0
Silver	10,000	mg/Kg	ND<0.10	ND<0.10	BDL<0.10	BDL<0.10	0.80	1.2	0.2	0.1
Thallium	160	mg/Kg	ND<5.0	ND<5.0	BDL<5.0	BDL<5.0	BDL<10.0	BDL<10.0	BDL<5.0	BDL<5.0
Zinc	610,000	mg/Kg	37.2	38.4	42.7	41.6	49.1	47.1	45.3	41.3
Percent Solid	NA	%	79	72	70	70	48	52		
Ext. Petroleum HC	2500	mg/Kg	ND<10	ND<10	ND<10	ND<10	280	400	79	18
PCB/Pesticide method 8081*	---	ug/Kg	ND	ND	ND	ND	ND	ND	ND	ND
VOCs method 8021*										
Toluene	1000	ug/Kg	8.6	9.8	ND	ND	ND	ND	ND	ND
SVOCs method 8270*										
Fluoranthene	2500	ug/Kg	490	ND	ND	ND	420	ND		
Phenanthrene	2500	ug/Kg	390	ND	ND	ND	ND	ND		
Pyrene	2500	ug/Kg	400	ND	ND	ND	420	ND		

Notes
* Only constituents with a positive detection shown
NE - None Established

TABLE 4
Soil Quality Summary
Phase C - Deep Soil Sampling - Restoration Area
Stratford, Connecticut
REVISED MAY, 2002

Constituents	GB PMC	20 X GB PMC	Sample ID	W0004-22	W0004-23	W00005-27	W00006-30
			Sample Depth	2-3'	3-4'	2-3'	2-3'
			Date	01/23/02	01/23/02	01/23/02	01/23/02
			Description		Native	Native	Native
			Units				
Metals (method)							
Arsenic (mass)	0.5 mg/L**	10 mg/ Kg	mg/Kg	-	-	-	-
Arsenic (AVS-SEM)	0.5 mg/L**	10 mg/ Kg	mg/Kg	2.2	1.1	1.6	BDL<1.0
Mercury (mass)	0.02 mg/L**	0.4 mg/Kg	mg/Kg	-	-	-	-
Mercury (AVS-SEM)	0.02 mg/L**	0.4 mg/Kg	mg/Kg	0.1	BDL<0.1	0.4	BDL<0.1
Beryllium (mass)	0.04 mg/L**	0.8 mg/Kg	mg/Kg	-	-	-	-
Beryllium (AVS-SEM)	0.04 mg/L**	0.8 mg/Kg	mg/Kg	BDL<0.1	BDL<0.1	BDL<0.1	0.2
Cadmium (mass)	0.05 mg/L**	1 mg/Kg	mg/Kg	-	-	-	-
Cadmium (AVS-SEM)	0.05 mg/L**	1 mg/Kg	mg/Kg	BDL<0.1	0.4	BDL<0.1	0.3
Chromium (mass)	0.5 mg/L**	10 mg/kg	mg/Kg	-	-	-	-
Chromium (AVS-SEM)	0.5 mg/L**	10 mg/Kg	mg/Kg	5.6	3.5	11.5	7.2
SPLP Chromium			mg/L			BDL<0.01	
Copper (mass)	13 mg/L**	260 mg/Kg	mg/Kg	-	-	-	-
Copper (AVS-SEM)	13 mg/L**	260 mg/Kg	mg/Kg	43.6	83.3	82.4	72.8
Lead (mass)	0.15 mg/L**	3 mg/Kg	mg/Kg	-	-	-	-
Lead (AVS-SEM)	0.15 mg/L**	3 mg/Kg	mg/Kg	13.5	18.3	24.3	26.6
SPLP Lead			mg/L			BDL<0.015	
Nickel (mass)	1 mg/L**	20 mg/Kg	mg/Kg	-	-	-	-
Nickel (AVS-SEM)	1 mg/L**	20 mg/Kg	mg/Kg	0.7	2.5	0.8	0.9
Potassium (mass)	NE	NE	mg/Kg	-	-	-	-
Potassium (AVS-SEM)	NE	NE	mg/Kg	227	162	274	498
Selenium (mass)	0.5 mg/L**	10 mg/Kg	mg/Kg	-	-	-	-
Selenium (AVS-SEM)	0.5 mg/L**	10 mg/Kg	mg/Kg	BDL<0.1	BDL<2.5	BDL<2.5	BDL<2.5
Silver (mass)	0.36 mg/L**	7.2 mg/Kg	mg/Kg	-	-	-	-
Silver (AVS-SEM)	0.36 mg/L**	7.2 mg/Kg	mg/Kg	0.1	0.2	0.3	BDL<0.1
Thallium (mass)	0.05 mg/L**	0.1 mg/Kg	mg/Kg	-	-	-	-
Thallium (AVS-SEM)	0.05 mg/L**	0.1 mg/Kg	mg/Kg	BDL<2.5	BDL<2.5	BDL<2.5	BDL<2.5
Zinc (mass)	50 mg/L**	1000 mg/Kg	mg/Kg	-	-	-	-
Zinc (AVS-SEM)	50 mg/L**	1000 mg/Kg	mg/Kg	24.7	104	43.9	87.2
Percent Solid		NA	%	52	46	47	57
Ext. Petroleum HC	2500	NA	mg/Kg	3300	240	1300	300
PCB/Pesticides method 8081*	---	NA	ug/Kg	ND	ND	ND	ND
VOCs method 8021*	---	NA	ug/Kg	ND	ND	ND	ND
SVOCs method 8270*							
Fluoranthene	2500	NA	ug/Kg	ND	1,300	ND	ND
Pyrene	2500	NA	ug/Kg	ND	2,200	ND	ND

Notes:
* Only constituents with a detection shown
NE - None Established
ND - Not Detected
NA - Not Applicable
GB PMC - GB Groundwater Protection Criteria
** - Pollutant Mobility Criteria Units for Inorganics are mg/L. Multiply by 20 for a conservative estimate in mg/Kg
20 X GB PMC - used as a comparison for mg/Kg
AVS-SEM - Acid Volatile Sulfide -Simultaneously Extracted Metals

TABLE 4
Soil Quality Summary
Phase C - Deep Soil Sampling - Restoration Area
Stratford, Connecticut
REVISED MAY, 2002

Constituents	GB PMC	20 X GB PMC	Sample ID	W00007-34	W00007-35	W00008-39	W00009-42
			Sample Depth	2-3'	3-4'	2-3'	2-3'
			Date	01/23/02	01/23/02	01/23/02	01/23/02
			Description	Sands	Sands	Native	Native
			Units				
Metals (method)							
Arsenic (mass)	0.5 mg/L**	10 mg/ Kg	mg/Kg	-	-	-	-
Arsenic (AVS-SEM)	0.5 mg/L**	10 mg/ Kg	mg/Kg	BDL<1.0	BDL<0.1	1.2	BDL<0.1
Mercury (mass)	0.02 mg/L**	0.4 mg/Kg	mg/Kg	-	-	-	-
Mercury (AVS-SEM)	0.02 mg/L**	0.4 mg/Kg	mg/Kg	BDL<0.1	0.1	0.4	BDL<0.1
Beryllium (mass)	0.04 mg/L**	0.8 mg/Kg	mg/Kg	-	-	-	-
Beryllium (AVS-SEM)	0.04 mg/L**	0.8 mg/Kg	mg/Kg	BDL<0.1	BDL<0.1	0.1	0.4
Cadmium (mass)	0.05 mg/L**	1 mg/Kg	mg/Kg	-	-	-	-
Cadmium (AVS-SEM)	0.05 mg/L**	1 mg/Kg	mg/Kg	BDL<0.1	BDL<0.1	0.1	0.5
Chromium (mass)	0.5 mg/L**	10 mg/kg	mg/Kg	-	-	-	-
Chromium (AVS-SEM)	0.5 mg/L**	10 mg/Kg	mg/Kg	1.5	4.9	7.1	9.8
Copper (mass)	13 mg/L**	260 mg/Kg	mg/Kg	-	-	-	-
Copper (AVS-SEM)	13 mg/L**	260 mg/Kg	mg/Kg	4.3	26.0	113	74.4
Lead (mass)	0.15 mg/L**	3 mg/Kg	mg/Kg	-	-	-	-
Lead (AVS-SEM)	0.15 mg/L**	3 mg/Kg	mg/Kg	7.7	15.1	19.2	20.2
Nickel (mass)	1 mg/L**	20 mg/Kg	mg/Kg	-	-	-	-
Nickel (AVS-SEM)	1 mg/L**	20 mg/Kg	mg/Kg	0.6	1.4	1.4	1.6
Potassium (mass)	NE	NE	mg/Kg	-	-	-	-
Potassium (AVS-SEM)	NE	NE	mg/Kg	114	210	384	423
Selenium (mass)	0.5 mg/L**	10 mg/Kg	mg/Kg	-	-	-	-
Selenium (AVS-SEM)	0.5 mg/L**	10 mg/Kg	mg/Kg	BDL<2.5	BDL<2.5	BDL<2.5	BDL<2.5
Silver (mass)	0.36 mg/L**	7.2 mg/Kg	mg/Kg	-	-	-	-
Silver (AVS-SEM)	0.36 mg/L**	7.2 mg/Kg	mg/Kg	BDL<0.1	0.2	0.3	0.1
Thallium (mass)	0.05 mg/L**	0.1 mg/Kg	mg/Kg	-	-	-	-
Thallium (AVS-SEM)	0.05 mg/L**	0.1 mg/Kg	mg/Kg	BDL<2.5	BDL<2.5	BDL<2.5	BDL<2.5
Zinc (mass)	50 mg/L**	1000 mg/Kg	mg/Kg	-	-	-	-
Zinc (AVS-SEM)	50 mg/L**	1000 mg/Kg	mg/Kg	20.2	28.9	51.0	76.3
Percent Solid	NA	NA	%	93	77	53	53
Ext. Petroleum HC	2500	NA	mg/Kg	ND	ND	240	450
PCB/Pesticides method 8081*	---	NA	ug/Kg	ND	ND	ND	ND
VOCs method 8021*	---	NA	ug/Kg	ND	ND	ND	ND
SVOCs method 8270*	---	NA	ug/Kg	ND	ND	ND	ND

Notes:
* Only constituents with a positive detection shown
NE - None Established
ND - Not Detected
NA - Not Applicable
GB PMC - GB Groundwater Protection Criteria
** - Pollutant Mobility Criteria Units for Inorganics are mg/L. Multiply by 20 for a conservative estimate in mg/Kg
20 X GB PMC - used as a comparison for mg/Kg
AVS-SEM - Acid Volatile Sulfide -Simultaneously Extracted Metals
--- = Varies depending on constituent

TABLE 4
Soil Quality Summary
Phase C - Deep Soil Sampling - Restoration Area
Stratford, Connecticut
REVISED MAY, 2002

Constituents	GB PMC	20 X GB PMC	Sample ID	W00010-46	Arithmetic Mean	Geometric Mean
			Sample Depth	2-3'		
			Date	01/23/02		
			Description	Native		
			Units			
Units	mg/L	mg/Kg				
Metals (method)						
Arsenic (mass)	0.5 mg/L**	10 mg/ Kg	mg/Kg	-	5.0	4.7
Arsenic (AVS-SEM)	0.5 mg/L**	10 mg/ Kg	mg/Kg	1.1	1.0	0.6
Mercury (mass)	0.02 mg/L**	0.4 mg/Kg	mg/Kg	-	0.3	0.3
Mercury (AVS-SEM)	0.02 mg/L**	0.4 mg/Kg	mg/Kg	BDL<0.1	0.1	0.1
Beryllium (mass)	0.04 mg/L**	0.8 mg/Kg	mg/Kg	-	0.2	0.2
Beryllium (AVS-SEM)	0.04 mg/L**	0.8 mg/Kg	mg/Kg	0.4	0.1	0.1
Cadmium (mass)	0.05 mg/L**	1 mg/Kg	mg/Kg	-	0.1	0.1
Cadmium (AVS-SEM)	0.05 mg/L**	1 mg/Kg	mg/Kg	0.4	0.2	0.2
Chromium (mass)	0.5 mg/L**	10 mg/kg	mg/Kg	-	41.6	38.1
Chromium (AVS-SEM)	0.5 mg/L**	10 mg/Kg	mg/Kg	8.6	6.8	7.1
Copper (mass)	13 mg/L**	260 mg/Kg	mg/Kg	-	39.3	40.2
Copper (AVS-SEM)	13 mg/L**	260 mg/Kg	mg/Kg	112	62	66
Lead (mass)	0.15 mg/L**	3 mg/Kg	mg/Kg	-	39.0	44.3
Lead (AVS-SEM)	0.15 mg/L**	3 mg/Kg	mg/Kg	**25.3**	18.1	19.5
Nickel (mass)	1 mg/L**	20 mg/Kg	mg/Kg	-	7.7	9.7
Nickel (AVS-SEM)	1 mg/L**	20 mg/Kg	mg/Kg	6.2	1.9	1.7
Potassium (mass)	NE	NE	mg/Kg	-	1011	844
Potassium (AVS-SEM)	NE	NE	mg/Kg	485	289	300
Selenium (mass)	0.5 mg/L**	10 mg/Kg	mg/Kg	-	BDL<2.5	BDL<2.5
Selenium (AVS-SEM)	0.5 mg/L**	10 mg/Kg	mg/Kg	BDL<2.5	BDL<2.5	BDL<2.5
Silver (mass)	0.36 mg/L**	7.2 mg/Kg	mg/Kg	-	0.1	0.1
Silver (AVS-SEM)	0.36 mg/L**	7.2 mg/Kg	mg/Kg	BDL<0.1	0.2	0.2
Thallium (mass)	0.05 mg/L**	0.1 mg/Kg	mg/Kg	-	BDL<5.0	BDL<5.0
Thallium (AVS-SEM)	0.05 mg/L**	0.1 mg/Kg	mg/Kg	BDL<2.5	BDL<5.0	BDL<5.0
Zinc (mass)	50 mg/L**	1000 mg/Kg	mg/Kg	-	30.5	32.0
Zinc (AVS-SEM)	50 mg/L**	1000 mg/Kg	mg/Kg	113	60.7	57.0
Percent Solid		NA	%	42		
Ext. Petroleum HC	2500	NA	mg/Kg	440	514	145
PCB/Pesticides method 8081*	---	NA	ug/Kg	ND		
VOCs method 8021*	---	NA	ug/Kg	ND		
SVOCs method 8270*	---	NA	ug/Kg	ND		

Notes:
* Only constituents with a with a positive detection shown
NE - None Established
ND - Not Detected
NA - Not Applicable
GB PMC - GB Groundwater Protection Criteria
** - Pollutant Mobility Criteria Units for Inorganics are mg/L. Multiply by 20 for a conservative estimate in mg/Kg
20 X GB PMC - used as a comparison for mg/Kg
AVS-SEM - Acid Volatile Sulfide -Simultaneously Extracted Metals
--- = Varies depending on constituent

LEVEL II PRE-ACQUISITION SURVEY OF SPORTING GOODS PROPERTIES, INC. (TRACT 28): STEWART B. MCKINNEY NATIONAL WILDLIFE REFUGE

August, 2005
U.S. Fish and Wildlife Service, New England Field Office
Michael J. Bartlett, Supervisor

SECTION A. PROPERTY DESCRIPTION

The Lordship Point Gun Club Site (former Remington Gun Club) is a 30 acre site located at Stratford Point, at the mouth of the Housatonic River on the Connecticut shore of Long Island Sound. Trap and skeet shooting began in the 1920s. During its operation, an estimated 48 million clay targets and 3 million pounds of lead shot were deposited on or near the site. The trap and skeet fields at the site were positioned so that most of the targets and shot were deposited along the shoreline or into the waters of Long Island Sound (American Marine Contractors, 1997).

SECTION B. ISSUES

Prior to acquisition, the Service conducts contaminant surveys in accordance with Chapter 341 FW 3: Pre-Acquisition Environmental Site Assessments. This process is meant to determine whether there is a reasonable probability that a hazardous substance is located on a property in which the Service may wish to acquire an interest. Under Chapter 341 FW 3, if the answer to any question on a Level I Survey Checklist is anything other than "No", "None", or "Not Applicable" and there is insufficient information documented to conclude that no additional investigation is necessary, a Level II Survey may be required. On April 9, 1999, Realty Specialist Daniel Leahy completed a Level I Pre-acquisition Contaminant Survey of the three tracts (Attachment A). The statements on the checklist which had answers other than "No", "None" or "Not Applicable" are as follows:

Section C. Site Inspection Screen
2. Other debris, 3. fills, 5. above ground storage tanks, 8. vegetation different from surrounding area, 11. stained ground, 12. unusual colors in water.

Section D. Record Searches
1. Past uses which might indicate potential problems, other, dredge materials, 2. Nearby land uses (commercial and industrial), 3. Known hazardous substance sites in vicinity

In talking with individuals familiar with the area, there was no reason to suspect contamination (Attachment B). Because of the possible levels of contaminants that might have been in the dredged materials from Bridgeport Harbor, however, the Service determined that a Level II Survey should be conducted. The Level II Survey would consist of a series of sediment samples.

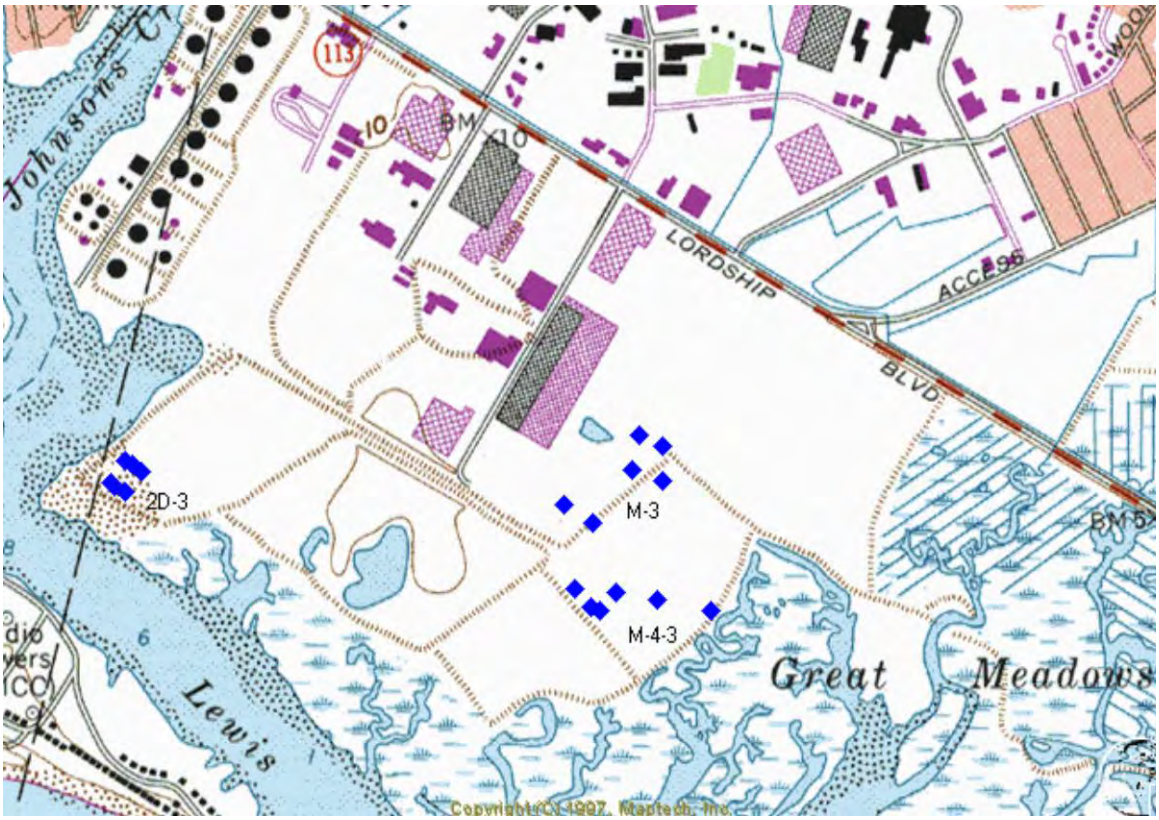
The remainder of this report is the methods, results, and recommendations of the Level II Survey.

SECTION C. INVESTIGATION RESULTS

1. Methods

Six sediment samples were taken in each of the three parcels. Locations were chosen to give the best overall coverage of the parcel (Figure 1), and all collection locations were marked using a Rockwell PLGR GPS receiver (Table 1). Sediments/soils were collected using a stainless steel corer. Because the northern section of Parcel 2D-3 and all of Parcel M-3 are scheduled for habitat enhancement activities (the top 24" of sediment are scheduled to be removed), samples were taken 24" below the surface. All other samples were taken at the surface (Table 1). Prior to each sample, the corer was decontaminated using standard FWS protocols (USFWS 1993). Samples were placed in 1000 ml chemically clean glass jars and placed on ice for transport to Concord, NH. Samples were stored at -20° C prior to shipment to the analytical lab. All samples were analyzed for metals, organochlorines, and grain size using methods as described in Appendix 1.

Figure 1. Locations where samples were collected.



2. Results - Physical Characteristics

Table 1. Physical characteristics of samples collected as part of the Level II Survey - Great Meadows Marsh.

Sample	Type	Depth	Wt (gms)	% Moist.	% Sand	% Silt	% Clay	Latitude*	Longitude*
2D301	Soil	Surf	950	2.96	98	1	1	410947.8	730943.5
2D302	Soil	Surf	1050	5.5	96	1	3	410948.1	730944.4
2D303	Soil	Surf	750	11.7	97	1	2	410948.4	730944.8
2D304	Sed.	24"	880	12	89	5	6	410949.2	730942.0
2D305	Sed.	24"	910	15.5	91	3	6	410949.6	730942.8
2D306	Sed.	24"	1210	28.5	95	1	4	410949.9	730943.5
M301	Sed.	24"	890	19.8	86	1	13	410950.8	730854.4
M302	Sed.	24"	820	33.7	40	23	37	410948.5	730856.2
M303	Sed.	24"	1040	24.8	82	2	16	410945.6	730900.7
M304	Sed.	24"	740	14.1	86	4	10	410951.6	730856.4
M305	Sed.	24"	1010	47.3	19	41	40	410949.3	730857.2
M306	Sed.	24"	680	47.1	10	66	24	410946.9	730903.3
M4301	Sed.	Surf	680	34.8	74	3	23	410939.9	730900.9
M4302	Sed.	Surf	760	55.9	41	14	45	410941.2	730902.3
M4303	Sed.	Surf	840	34.6	77	4	19	410939.7	730900.1
M4304	Sed.	Surf	500	51.5	54	11	35	410939.7	730849.9
M4305	Sed.	Surf	560	35.9	34	31	35	410940.4	730854.8
M4306	Sed.	Surf	620	12.9	82	8	10	410940.9	730858.6

*Locations are expressed in Geographic as DDMMSS.S

3. Results - Metals

Table 2. Heavy metal analytical results expressed as parts per million, dry weight.

	2D3			M3			M43		
Metal	**Min.**	**Max.**	**Mean***	**Min.**	**Max.**	**Mean***	**Min.**	**Max.**	**Mean***
Al	1040.0	8489.0	**2769.2**	4923.0	17805	**9440.0**	2690.0	12796	**6123.8**
As	0.85	3.86	**1.85**	3.38	15.70	**6.46**	2.93	14.30	**5.63**
B	0.50	5.28	**1.47**	0.58	75.50	**5.78**	3.04	22.60	**8.05**
Ba	6.16	50.50	**14.10**	28.90	74.30	**45.22**	30.30	84.40	**45.03**
Be	0.05	0.38	**0.13**	0.30	1.26	**0.54**	0.19	0.51	**0.33**
Cd	0.19	0.98	**0.37**	0.49	3.14	**1.25**	0.57	1.55	**0.93**
Cr	2.94	15.80	**7.37**	10.40	342.0	**36.96**	69.80	343.0	**120.95**
Cu	6.17	29.50	**12.35**	25.80	831.0	**91.56**	57.40	348.0	**148.4**
Fe	2667	16542	**5745.6**	10192	48019	**21307**	9421	34693	**15317**
Hg	0.01	0.14	**0.02**	0.01	0.30	**0.04**	0.06	0.59	**0.20**
Mg	556.0	4496.0	**1412.9**	2286.0	9335.0	**4847.9**	2256.0	6919.0	**3613.8**
Mn	26.9	138.0	**59.82**	75.50	596.0	**222.68**	72.50	201.0	**110.15**
Mo	0.50	1.16	**0.61**	0.57	9.40	**2.05**	1.39	7.72	**3.77**
Ni	2.80	8.37	**5.56**	7.63	33.80	**14.33**	7.12	26.30	**13.76**
Pb	4.42	29.70	**10.54**	5.34	124.0	**27.11**	36.70	188.0	**95.82**
Se	0.04	0.15	**0.05**	0.05	0.34	**0.10**	0.05	0.61	**0.16**
Sr	3.35	49.40	**10.58**	13.20	64.20	**28.64**	18.90	64.70	**36.17**
V	7.45	23.50	**14.10**	14.60	59.00	**31.48**	26.50	60.30	**35.28**
Z	15.20	59.50	**30.58**	41.30	445.0	**100.55**	27.60	125.0	**56.02**

*Means are expressed as geometric rather than arithmetic.

4. Results - Organics

With the exception of total PCBs and DDT and it's metabolites, all other analytes were below detection limits for all samples. Two out of 18 samples (M4302 and M4305) had total PCBs above the detection limits (0.991 and 0.669 ppm respectively). One out of 18 samples (M4305) had p,p'-DDD levels above the detection limit (0.025 ppm). Fourteen out of 18 samples had p,p'-DDE levels above the detection limit. Mean values for the three parcels are as follows: **2D3**-0.082 (n=4), **M3**-0.142 (n=4), **M43**-0.189 (n=6). Seven out of 18 samples had p,p'-DDT levels above the detection limit (range 0.017-0.091). Individual sample results can be found in Appendix 1.

5. Discussion and Recommendations

Long et al. (1995) compiled literature values for biological effects of various chemicals in marine and estuarine sediments. Using percentiles, they came up with sediment quality criteria from which to judge the potential of concentrations of particular contaminants to cause biological effects. The lower 10^{th} percentile of the effects data for each chemical was identified and referred to as the effects range-low (ERL). The 50^{th} percentile is referred to as the effects range-median (ERM). Ingersoll et al. (1996) calculated probable effect Levels (PEL) using procedures as described by MacDonald (1994). Table 3 compares these sediment quality criteria to mean values found during this study.

Table 3. Sediment quality criteria and mean values reported for this study (ppm-dry weight).

Analyte	**ERL**	**ERM**	**PEL**	**2D3**	**M3**	**M43**
Al	-	-	60,000	2,769	9,440	6,123
As	8.2	70	48	1.85	6.46	5.63
B	-	-	-	1.47	5.78	8.05
Ba	-	-	-	14.10	45.22	45.03
Be	-	-	-	0.13	0.54	0.33
Cd	1.2	9.6	3.2	0.37	**1.25**	0.93
Cr	81.0	370	120	7.37	36.96	**120.95**
Cu	34.0	270	100	12.35	**91.56**	**148.40**
Fe	-	-	-	5,746	21,307	15,317
Hg	0.15	0.71	-	0.02	0.04	**0.20**

Table 3 (Continued)						
Analyte	**ERL**	**ERM**	**PEL**	**2D3**	**M3**	**M43**
Mg	-	-	1,200	**1,413**	**4,848**	**3,614**
Mn	-	-	-	59.82	222.7	110.15
Mo	-	-	-	0.61	2.05	3.77
Ni	20.9	51.6	33	5.56	14.33	13.76
Pb	46.7	218	82	10.54	27.11	**95.82**
Se	-	-	-	0.05	0.10	0.16
Sr	-	-	-	10.58	28.64	36.17
V	-	-	-	14.10	31.48	35.28
Z	150	410	540	30.58	100.55	56.02
PCB	0.027	0.180	0.240	-	-	**0.303**
p,p'-DDE	0.002	0.027	-	**0.082**	**0.142**	**0.189**

When sample results are compared with sediment reference values, it is obvious that low levels of metals are present on site. ERL values were exceeded in at least one parcel for Cd, Cr, Cu, Hg, and Pb, although none of these sites exceeded ERMs. Mg exceeded the PEL value in all three parcels. This is not surprising considering the urban nature of the site and the fact that low levels of metals are often associated with dredged materials. Although the total PCB value for Parcel M43 exceeded the ERM value, Long et al. (1995) tends to be a fairly conservative value. Environment Canada uses 1 ppm as a toxic effects threshold, and the US EPA considers 10 ppm as indicative of heavily polluted sediments. The levels of the DDT metabolite DDE in all three parcels are elevated. While there is some risk to aquatic resources, the levels do not approach the chronic marine equilibrium-partitioning threshold of 3.25 ppm of Bolton et al. (1985). When comparing contaminant levels in sediments, it is important to chose appropriate "benchmarks" from the surrounding area. Because this is an urban setting, levels of various constituents will be higher than in more pristine areas.

SECTION D. COST ESTIMATES

There are no projected remediation or other environmental cleanup costs for this site that will be incurred by the Service. The cost to the New England Field Office of sample collection, analysis, and preparation of this Level II Pre-Acquisition Survey is estimated at $11,000.00

SECTION E. DOCUMENTATION

1. Attachments:

A. Level I Pre-acquisition Contaminants Surveys for the three tracts.
B. Memo from Refuge manager to Realty Specialist.

2. Literature Cited

Bolton, H.S., R.J. Breteler, B.W. Vigon, J.A. Scanlon, and S.L. Clark. 1985. National perspective on sediment quality. Battelle. Washington Environmental Program Office. Washington, DC. EPA Contract No. 68-01-6986.

Ingersoll C.G, P.S. Haverland, E.L. Brunson, T.J. Canfield, F.J. Dwyer, C.E. Henke, N.E. Kemble, D.R. Mount, and R.G. Fox. 1996. Calculation and evaluation of sediment effect concentrations for the amphipod Hyalella azteca and the midge Chironomus riparius. J. Great Lakes Res. 22(3):602-623.

Long, E.R., D.D. MacDonald, S.L. Smith, and F.D. Calder. 1995. Incidence of adverse biological effects within ranges of chemical concentrations in marine and estuarine sediments. Env. Mgmt. 19(1):81-97.

MacDonald, D.D. 1994. Approach to the assessment of sediment quality of Florida coastal waters. Vol. I - Development and evaluation of sediment quality assessment guidelines. Report for FL. DEP, Tallahassee, FL. Nov., 1994.

USFWS. 1993. Procedures for the decontamination of field and laboratory equipment. CdANRDA SOP. 1019.3707. 2 pp.

SECTION F. CERTIFICATION

I certify that to the best of my knowledge, the surveyed real property, or a portion therof, contains low levels of hazardous substances as determined by the environmental site assessment but that these levels are consistent with an urban, coastal CT area. There are no obvious signs of any effects of these substances. A Level III Survey is not required.

Ecological Services (Analyst)

Signed:_____ Print Name:_____

Date:_____ Title:____Environmental Contaminants Specialist_____

SECTION G. REPROGRAMMING

No reprogramming of funds is necessary.

SECTION H. APPROVAL

Regional Director (Bureau contact)

Signed:_____ Print Name:_____

Date:_____ Title:_____

LEVEL II PRE-ACQUISITION SURVEY OF PARCELS 3C-2 AND 4B-2:
GREAT MEADOWS MARSH, STRATFORD, CT

September, 1999
U.S. Fish and Wildlife Service, New England Field Office
Michael J. Bartlett, Supervisor

SECTION A. PROPERTY DESCRIPTION

Parcels 3C-2 and 4B-2 are within an area known as the Great Meadows Marsh located on the coast of Connecticut in the Town of Stratford, Fairfield County, CT (Bridgeport Quadrangle - USGS 7.5 minute series). Both 3C-2 (3.6 acres) and 4B-2 (7.1 acres) are owned by the Stratford Development Company (SDC) (Figure 1). The entire site is former salt marsh that was filled by the placement of dredged material from Bridgeport Harbor by the Army Corps of Engineers (ACOE) in the 1950's. More than 400 of the 612 acres owned by SDC on this site have been transferred to the U.S. Fish and Wildlife Service (Service) since August 1994. Much of the site is dominated by Phragmites and is traversed by man-made drainage channels. A dike used to contain dredged materials placed onsite by the ACOE during their dredging isolates the site from tidal influences except in the vicinity of four breaches which were constructed in 1983. Topography ranges from 0 feet msl to 12 feet above msl at the crest of the dike. Udorthents, smoothed constitute the primary soil type and consists of lands that have been previously altered as mentioned above. The Service proposes to both parcels for inclusion in the Stewart B. McKinney National Wildlife Refuge.

SECTION B. ISSUES

Prior to acquisition, the Service conducts contaminant surveys in accordance with Chapter 341 FW 3: Pre-Acquisition Environmental Site Assessments. This process is meant to determine whether there is a reasonable probability that a hazardous substance is located on a property in which the Service may wish to acquire an interest. Under Chapter 341 FW 3, if the answer to any question on a Level I Survey Checklist is anything other than "No", "None", or "Not Applicable" and there is insufficient information documented to conclude that no additional investigation is necessary, a Level II Survey may be required. On April 9, 1999, Realty Specialist Daniel Leahy completed a Level I Pre-acquisition Contaminant Survey (Attachment A). The statements on the checklist which had answers other than "No", "None" or "Not Applicable" are as follows:

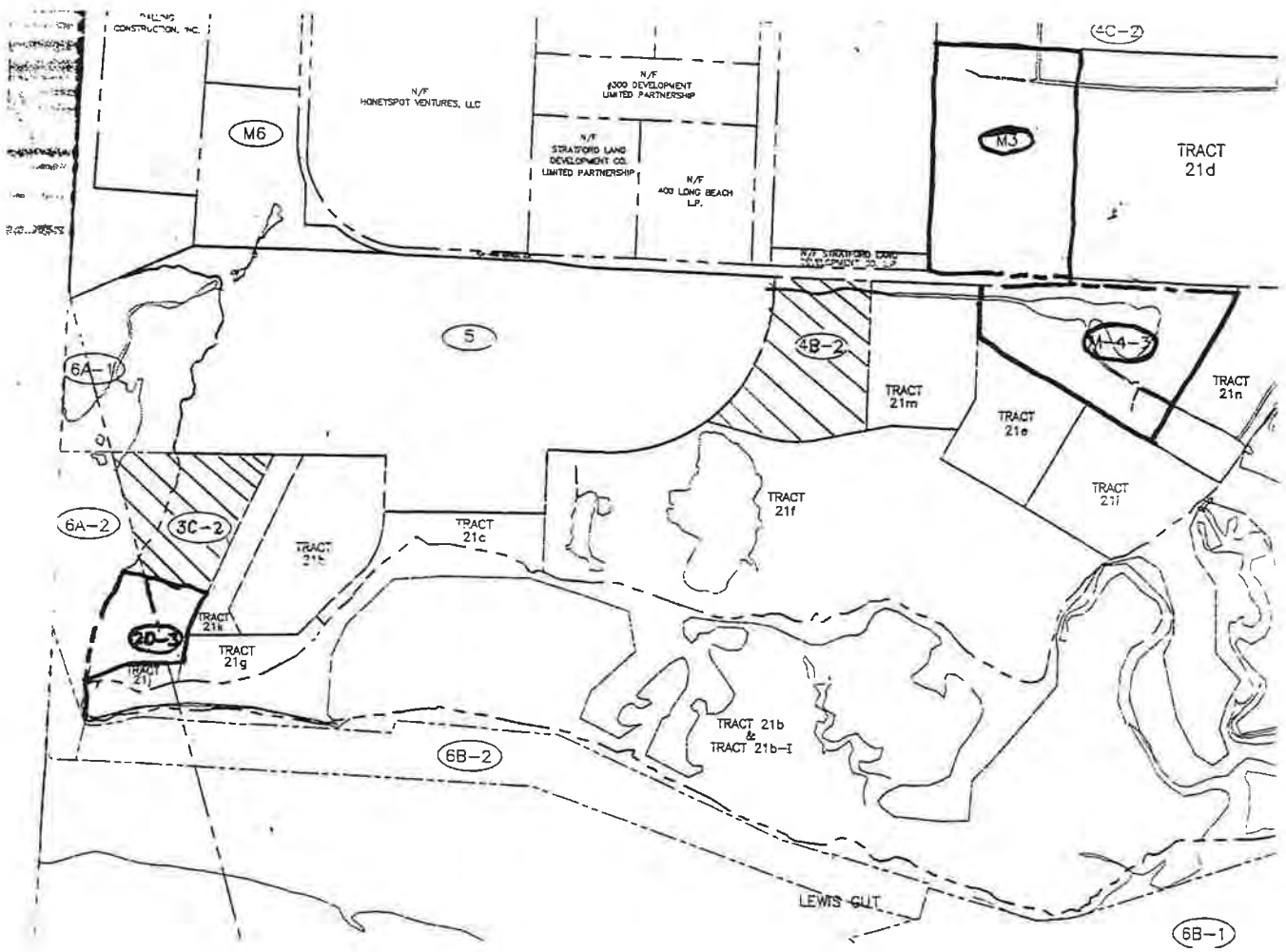
Section C. Site Inspection Screen

2. Other debris, 3. fills, 5. above ground storage tanks, 8. vegetation different from surrounding area, 11. stained ground, 12. unusual colors in water.

Section D. Record Searches

1. Past uses which might indicate potential problems, other, dredge materials, 2. Nearby land uses (commercial and industrial), 3. Known hazardous substance sites in vicinity

Figure 1. Strafford Development Corporation Parcelization Map showing the location of Parcels 3C-2 and 4B-2 (shaded). Parcels outlined in darker black are those parcels where the previous Level II samples were taken.



In April of 1999, a Level II was completed for Parcels M-3, M-4-3, and 2D-3 "*LEVEL II PRE-ACQUISITION SURVEY OF TRACTS 21P, 21Q, AND 21R: GREAT MEADOWS MARSH, STRATFORD, CT*". Six sediment samples were taken in each of the three parcels, and each sample was analyzed for metals, organochlorines, and grain size. Because Parcels 3C-2 and 4B-2 were adjacent or very near the three parcels that were previously sampled, there was no need for additional sampling. Data from the previous study will be utilized for this Level II analysis.

SECTION C. INVESTIGATION RESULTS FROM PREVIOUS LEVEL II

1. Results - Metals

Table 1. Heavy metal analytical results expressed as parts per million, dry weight.

	2D3			M3			M43		
Metal	**Min.**	**Max.**	**Mean***	**Min.**	**Max.**	**Mean***	**Min.**	**Max.**	**Mean***
Al	1040.0	8489.0	**2769.2**	4923.0	17805	**9440.0**	2690.0	12796	**6123.8**
As	0.85	3.86	**1.85**	3.38	15.70	**6.46**	2.93	14.30	**5.63**
B	0.50	5.28	**1.47**	0.58	75.50	**5.78**	3.04	22.60	**8.05**
Ba	6.16	50.50	**14.10**	28.90	74.30	**45.22**	30.30	84.40	**45.03**
Be	0.05	0.38	**0.13**	0.30	1.26	**0.54**	0.19	0.51	**0.33**
Cd	0.19	0.98	**0.37**	0.49	3.14	**1.25**	0.57	1.55	**0.93**
Cr	2.94	15.80	**7.37**	10.40	342.0	**36.96**	69.80	343.0	**120.95**
Cu	6.17	29.50	**12.35**	25.80	831.0	**91.56**	57.40	348.0	**148.4**
Fe	2667	16542	**5745.6**	10192	48019	**21307**	9421	34693	**15317**
Hg	0.01	0.14	**0.02**	0.01	0.30	**0.04**	0.06	0.59	**0.20**
Mg	556.0	4496.0	**1412.9**	2286.0	9335.0	**4847.9**	2256.0	6919.0	**3613.8**
Mn	26.9	138.0	**59.82**	75.50	596.0	**222.68**	72.50	201.0	**110.15**
Mo	0.50	1.16	**0.61**	0.57	9.40	**2.05**	1.39	7.72	**3.77**
Ni	2.80	8.37	**5.56**	7.63	33.80	**14.33**	7.12	26.30	**13.76**
Pb	4.42	29.70	**10.54**	5.34	124.0	**27.11**	36.70	188.0	**95.82**
Se	0.04	0.15	**0.05**	0.05	0.34	**0.10**	0.05	0.61	**0.16**

Sr	3.35	49.40	**10.58**	13.20	64.20	**28.64**	18.90	64.70	**36.17**
V	7.45	23.50	**14.10**	14.60	59.00	**31.48**	26.50	60.30	**35.28**
Z	15.20	59.50	**30.58**	41.30	445.0	**100.55**	27.60	125.0	**56.02**

*Means are expressed as geometric rather than arithmetic.

4. Results - Organics

With the exception of total PCBs and DDT and it's metabolites, all other analytes were below detection limits for all samples. Two out of 18 samples (M4302 and M4305) had total PCBs above the detection limits (0.991 and 0.669 ppm respectively). One out of 18 samples (M4305) had p,p'-DDD levels above the detection limit (0.025 ppm). Fourteen out of 18 samples had p,p'-DDE levels above the detection limit. Mean values for the three parcels are as follows: **2D3**-0.082 (n=4), **M3**-0.142 (n=4), **M43**-0.189 (n=6). Seven out of 18 samples had p,p'-DDT levels above the detection limit (range 0.017-0.091).

5. Discussion and Recommendations

Long et al. (1995) compiled literature values for biological effects of various chemicals in marine and estuarine sediments. Using percentiles, they came up with sediment quality criteria from which to judge the potential of concentrations of particular contaminants to cause biological effects. The lower 10th percentile of the effects data for each chemical was identified and referred to as the effects range-low (ERL). The 50th percentile is referred to as the effects range-median (ERM). Ingersoll et al. (1996) calculated probable effect Levels (PEL) using procedures as described by MacDonald (1994). Table 2 compares these sediment quality criteria to mean values found during this study.

Table 2. Sediment quality criteria and mean values reported for this study (ppm-dry weight).

Analyte	ERL	ERM	PEL	2D3	M3	M43
Al	-	-	60,000	2,769	9,440	6,123
As	8.2	70	48	1.85	6.46	5.63
B	-	-	-	1.47	5.78	8.05
Ba	-	-	-	14.10	45.22	45.03
Be	-	-	-	0.13	0.54	0.33
Cd	1.2	9.6	3.2	0.37	**1.25**	0.93

Analyte	ERL	ERM	PEL	2D3	M3	M43
Cr	81.0	370	120	7.37	36.96	**120.95**
Cu	34.0	270	100	12.35	**91.56**	**148.40**
Fe	-	-	-	5,746	21,307	15,317
Hg	0.15	0.71	-	0.02	0.04	**0.20**
Mg	-	-	1,200	**1,413**	**4,848**	**3,614**
Mn	-	-	-	59.82	222.7	110.15
Mo	-	-	-	0.61	2.05	3.77
Ni	20.9	51.6	33	5.56	14.33	13.76
Pb	46.7	218	82	10.54	27.11	**95.82**
Se	-	-	-	0.05	0.10	0.16
Sr	-	-	-	10.58	28.64	36.17
V	-	-	-	14.10	31.48	35.28
Z	150	410	540	30.58	100.55	56.02
PCB	0.027	0.180	0.240	-	-	**0.303**
p,p'-DDE	0.002	0.027	-	**0.082**	**0.142**	**0.189**

When sample results are compared with sediment reference values, it is obvious that low levels of metals are present on site. ERL values were exceeded in at least one parcel for Cd, Cr, Cu, Hg, and Pb, although none of these sites exceeded ERMs. Mg exceeded the PEL value in all three parcels. This is not surprising considering the urban nature of the site and the fact that low levels of metals are often associated with dredged materials. Although the total PCB value for Parcel M43 exceeded the ERM value, Long et al. (1995) tends to be a fairly conservative value. Environment Canada uses 1 ppm as a toxic effects threshold, and the US EPA considers 10 ppm as indicative of heavily polluted sediments. The levels of the DDT metabolite DDE in all three parcels are elevated. While there is some risk to aquatic resources, the levels do not approach the chronic marine equilibrium-partitioning threshold of 3.25 ppm of Bolton et al. (1985). When comparing contaminant levels in sediments, it is important to chose appropriate "benchmarks" from the surrounding area. Because this is an urban setting, levels of various constituents will be higher than in more pristine areas.

SECTION D. COST ESTIMATES

There are no projected remediation or other environmental cleanup costs for this site that will be incurred by the Service. The cost to the New England Field Office of preparation of this Level II Pre-Acquisition Survey is estimated at $500.00

SECTION E. DOCUMENTATION

1. Attachments:

A. Level I Pre-acquisition Contaminants Survey.

2. Literature Cited

Bolton, H.S., R.J. Breteler, B.W. Vigon, J.A. Scanlon, and S.L. Clark. 1985. National perspective on sediment quality. Battelle. Washington Environmental Program Office. Washington, DC. EPA Contract No. 68-01-6986.

Ingersoll C.G, P.S. Haverland, E.L. Brunson, T.J. Canfield, F.J. Dwyer, C.E. Henke, N.E. Kemble, D.R. Mount, and R.G. Fox. 1996. Calculation and evaluation of sediment effect concentrations for the amphipod Hyalella azteca and the midge Chironomus riparius. J. Great Lakes Res. 22(3):602-623.

Long, E.R., D.D. MacDonald, S.L. Smith, and F.D. Calder. 1995. Incidence of adverse biological effects within ranges of chemical concentrations in marine and estuarine sediments. Env. Mgmt. 19(1):81-97.

MacDonald, D.D. 1994. Approach to the assessment of sediment quality of Florida coastal waters. Vol. I - Development and evaluation of sediment quality assessment guidelines. Report for FL. DEP, Tallahassee, FL. Nov., 1994.

SECTION F. CERTIFICATION

I certify that to the best of my knowledge, the surveyed real property, or a portion therof, contains low levels of hazardous substances as determined by the environmental site assessment but that these levels are consistent with an urban, coastal CT area. There are no obvious signs of any effects of these substances. A Level III Survey is not required.

Ecological Services (Analyst)

Signed:_____ Print Name:_____

Date:_____ Title:___Environmental Contaminants Specialist_____

SECTION G. REPROGRAMMING

No reprogramming of funds is necessary.

SECTION H. APPROVAL

Regional Director (Bureau contact)

Signed:_____ Print Name:_____

Date:_____ Title:_____

LEVEL II PRE-ACQUISITION SURVEY OF TRACTS 21P, 21Q, AND 21R:
GREAT MEADOWS MARSH, STRATFORD, CT

April, 1999
U.S. Fish and Wildlife Service, New England Field Office
Michael J. Bartlett, Supervisor

SECTION A. PROPERTY DESCRIPTION

Tracts 21P, Q, and R are parcels within an area known as the Great Meadows Marsh located on the coast of Connecticut in the Town of Stratford, Fairfield County, CT (Bridgeport Quadrangle - USGS 7.5 minute series). A portion of Tract 21P falls within the Bridgeport town line. All three parcels are owned by the Stratford Development Company (SDC). Tract 21P (2.48 acres) is referred to as Parcel 2D-3, Tract 21Q (9.68 acres) is referred to as Parcel M-4-3, and Tract 21R (7.87 acres) is referred to as Parcel M-3 on the SDC Parcelization Maps (Figure 1). For purposes of clarity, all future reference will rely on the parcel number as opposed to the tract number. The entire site is former salt marsh that was filled by the placement of dredged material from Bridgeport Harbor by the Army Corps of Engineers (ACOE) in the 1950's. More than 400 of the 612 acres owned by SDC on this site have been transferred to the U.S. Fish and Wildlife Service (Service) since August 1994. Much of the site is dominated by Phragmites and is traversed by man-made drainage channels. A dike used to contain dredged materials placed onsite by the ACOE during their dredging isolates the site from tidal influences except in the vicinity of four breaches which were constructed in 1983. Topography ranges from 0 feet msl to 12 feet above msl at the crest of the dike. Udorthents, smoothed constitute the primary soil type and consists of lands that have been previously altered as mentioned above. The Service proposes to acquire all three tracts for inclusion in the Stewart B. McKinney National Wildlife Refuge.

SECTION B. ISSUES

Prior to acquisition, the Service conducts contaminant surveys in accordance with Chapter 341 FW 3: Pre-Acquisition Environmental Site Assessments. This process is meant to determine whether there is a reasonable probability that a hazardous substance is located on a property in which the Service may wish to acquire an interest. Under Chapter 341 FW 3, if the answer to any question on a Level I Survey Checklist is anything other than "No", "None", or "Not Applicable" and there is insufficient information documented to conclude that no additional investigation is necessary, a Level II Survey may be required. On April 9, 1999, Realty Specialist Daniel Leahy completed a Level I Pre-acquisition Contaminant Survey of the three tracts (Attachment A). The statements on the checklist which had answers other than "No", "None" or "Not Applicable" are as follows:

Section C. Site Inspection Screen

2. Other debris, 3. fills, 5. above ground storage tanks, 8. vegetation different from surrounding area, 11. stained ground, 12. unusual colors in water.

Section D. Record Searches

1. Past uses which might indicate potential problems, other, dredge materials, 2. Nearby land uses (commercial and industrial), 3. Known hazardous substance sites in vicinity

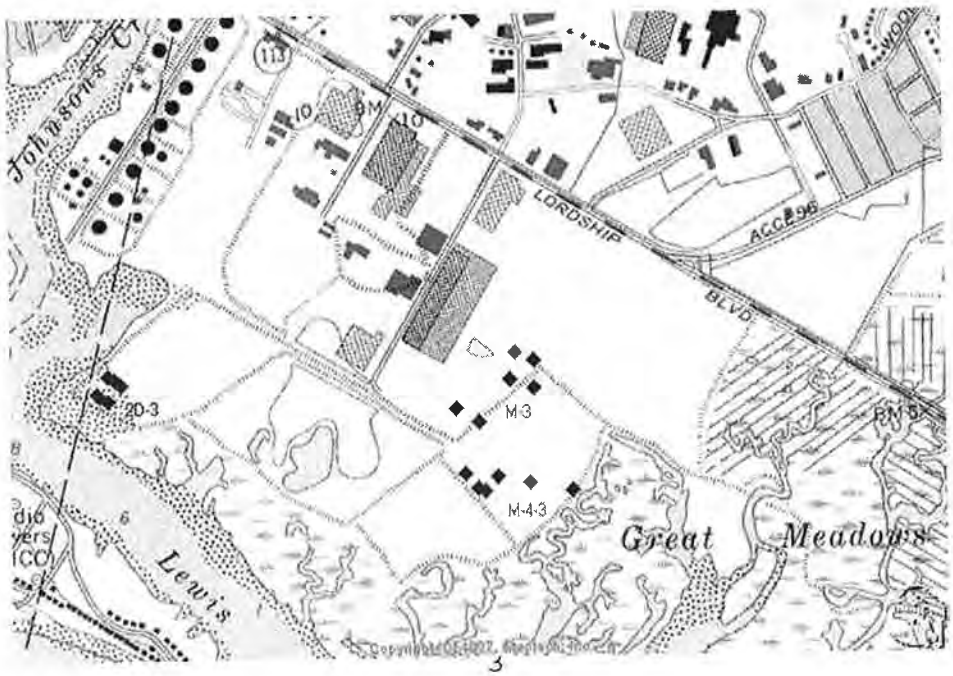
In talking with individuals familiar with the area, there was no reason to suspect contamination (Attachment B). Because of the possible levels of contaminants that might have been in the dredged materials from Bridgeport Harbor, however, the Service determined that a Level II Survey should be conducted. The Level II Survey would consist of a series of sediment samples. The remainder of this report is the methods, results, and recommendations of the Level II Survey.

SECTION C. INVESTIGATION RESULTS

1. Methods

Six sediment samples were taken in each of the three parcels. Locations were chosen to give the best overall coverage of the parcel (Figure 2), and all collection locations were marked using a Rockwell PLGR GPS receiver (Table 1). Sediments/soils were collected using a stainless steel corer. Because the northern section of Parcel 2D-3 and all of Parcel M-3 are scheduled for habitat enhancement activities (the top 24" of sediment are scheduled to be removed), samples were taken 24" below the surface. All other samples were taken at the surface (Table 1). Prior to each sample, the corer was decontaminated using standard FWS protocols (USFWS 1993). Samples were placed in 1000 ml chemically clean glass jars and placed on ice for transport to Concord, NH. Samples were stored at -20° C prior to shipment to the analytical lab. All samples were analyzed for metals, organochlorines, and grain size using methods as described in Appendix 1.

Figure 2. Locations where samples were collected.



3. Results - Metals

Table 2. Heavy metal analytical results expressed as parts per million, dry weight.

	2D3			M3			M43		
Metal	**Min.**	**Max.**	**Mean***	**Min.**	**Max.**	**Mean***	**Min.**	**Max.**	**Mean***
Al	1040.0	8489.0	**2769.2**	4923.0	17805	**9440.0**	2690.0	12796	**6123.8**
As	0.85	3.86	**1.85**	3.38	15.70	**6.46**	2.93	14.30	**5.63**
B	0.50	5.28	**1.47**	0.58	75.50	**5.78**	3.04	22.60	**8.05**
Ba	6.16	50.50	**14.10**	28.90	74.30	**45.22**	30.30	84.40	**45.03**
Be	0.05	0.38	**0.13**	0.30	1.26	**0.54**	0.19	0.51	**0.33**
Cd	0.19	0.98	**0.37**	0.49	3.14	**1.25**	0.57	1.55	**0.93**
Cr	2.94	15.80	**7.37**	10.40	342.0	**36.96**	69.80	343.0	**120.95**
Cu	6.17	29.50	**12.35**	25.80	831.0	**91.56**	57.40	348.0	**148.4**
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Mn	26.9	138.0	**59.82**	75.50	596.0	**222.68**	72.50	201.0	**110.15**
Mo	0.50	1.16	**0.61**	0.57	9.40	**2.05**	1.39	7.72	**3.77**
Ni	2.80	8.37	**5.56**	7.63	33.80	**14.33**	7.12	26.30	**13.76**
Pb	4.42	29.70	**10.54**	5.34	124.0	**27.11**	36.70	188.0	**95.82**
Se	0.04	0.15	**0.05**	0.05	0.34	**0.10**	0.05	0.61	**0.16**
Sr	3.35	49.40	**10.58**	13.20	64.20	**28.64**	18.90	64.70	**36.17**
V	7.45	23.50	**14.10**	14.60	59.00	**31.48**	26.50	60.30	**35.28**
Z	15.20	59.50	**30.58**	41.30	445.0	**100.55**	27.60	125.0	**56.02**

*Means are expressed as geometric rather than arithmetic.

4. Results - Organics

With the exception of total PCBs and DDT and it's metabolites, all other analytes were below detection limits for all samples. Two out of 18 samples (M4302 and M4305) had total PCBs above the detection limits (0.991 and 0.669 ppm respectively). One out of 18 samples (M4305) had p,p'-DDD levels above the detection limit (0.025 ppm). Fourteen out of 18 samples had p,p'-DDE levels above the detection limit. Mean values for the three parcels are as follows: **2D3**-0.082 (n=4), **M3**-0.142 (n=4), **M43**-0.189 (n=6). Seven out of 18 samples had p,p'-DDT levels above the detection limit (range 0.017-0.091). Individual sample results can be found in Appendix 1.

5. Discussion and Recommendations

Long et al. (1995) compiled literature values for biological effects of various chemicals in marine and estuarine sediments. Using percentiles, they came up with sediment quality criteria from which to judge the potential of concentrations of particular contaminants to cause biological effects. The lower 10th percentile of the effects data for each chemical was identified and referred to as the effects range-low (ERL). The 50th percentile is referred to as the effects range-median (ERM). Ingersoll et al. (1996) calculated probable effect Levels (PEL) using procedures as described by MacDonald (1994). Table 3 compares these sediment quality criteria to mean values found during this study.

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Analyte	ERL	ERM	PEL	2D3	M3	M43
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Be	-	-	-	0.13	0.54	0.33
Cd	1.2	9.6	3.2	0.37	**1.25**	0.93
Cr	81.0	370	120	7.37	36.96	**120.95**
Cu	34.0	270	100	12.35	**91.56**	**148.40**
Fe	-	-	-	5,746	21,307	15,317
Hg	0.15	0.71	-	0.02	0.04	**0.20**

Table 3 (Continued)						
Analyte	**ERL**	**ERM**	**PEL**	**2D3**	**M3**	**M43**
Mg	-	-	1,200	**1,413**	**4,848**	**3,614**
Mn	-	-	-	59.82	222.7	110.15
Mo	-	-	-	0.61	2.05	3.77
Ni	20.9	51.6	33	5.56	14.33	13.76
Pb	46.7	218	82	10.54	27.11	**95.82**
Se	-	-	-	0.05	0.10	0.16
Sr	-	-	-	10.58	28.64	36.17
V	-	-	-	14.10	31.48	35.28
Z	150	410	540	30.58	100.55	56.02
PCB	0.027	0.180	0.240	-	-	**0.303**
p,p'-DDE	0.002	0.027	-	**0.082**	**0.142**	**0.189**

When sample results are compared with sediment reference values, it is obvious that low levels of metals are present on site. ERL values were exceeded in at least one parcel for Cd, Cr, Cu, Hg, and Pb, although none of these sites exceeded ERMs. Mg exceeded the PEL value in all three parcels. This is not surprising considering the urban nature of the site and the fact that low levels of metals are often associated with dredged materials. Although the total PCB value for Parcel M43 exceeded the ERM value, Long et al. (1995) tends to be a fairly conservative value. Environment Canada uses 1 ppm as a toxic effects threshold, and the US EPA considers 10 ppm as indicative of heavily polluted sediments. The levels of the DDT metabolite DDE in all three parcels are elevated. While there is some risk to aquatic resources, the levels do not approach the chronic marine equilibrium-partitioning threshold of 3.25 ppm of Bolton et al. (1985). When comparing contaminant levels in sediments, it is important to chose appropriate "benchmarks" from the surrounding area. Because this is an urban setting, levels of various constituents will be higher than in more pristine areas.

SECTION D. COST ESTIMATES

There are no projected remediation or other environmental cleanup costs for this site that will be incurred by the Service. The cost to the New England Field Office of sample collection, analysis, and preparation of this Level II Pre-Acquisition Survey is estimated at $11,000.00

ECDMS ANALYTICAL REPORT
03/02/99

Catalog	Regional Study Id	Purchase Order	User Id	Lab Id
5030081	505Z	PACF-99-2011	R5NEFO	PACF

- Catalog Submitter: Andrew "Drew" Major - Concord, NH

- Lab Name: Patuxent Analytical Control Facility (PACF)

- Sections included in the report:

  - WEIGHT, % MOISTURE, ETC.
  - CONTAMINANT CONCENTRATIONS
  - DUPLICATES
  - QA/QC ANOMALIES
  - SOIL/SEDIMENT PARAMETERS
  - PROCEDURAL BLANKS
  - SPIKE RECOVERIES
  - ANALYTICAL METHODS

- Sections NOT included (NO DATA were found):

  - REFERENCE MATERIALS
  - RESULT MODIFERS

- Report Status:

  - ALL results are reported as 3 significant digits.

Pages	Results Rounded	Results too Large to Print	Lines Per Page	Columns Per Row
21	0	0	53	78

---------- Symbols and Abbreviations Used ----------

- The following may appear before a reported result (ex. < 1.234).

  < = Actual result is less than the reported detection limit.
  > = Actual result is greater than the result reported.

- Rounded results are preceded by an '*' (example: *.0253). Results were rounded in order to fit within the column and line widths used in the report.

- Results too large to print are represented by a series of '*' (example: ********). These values could not be rounded small enough to fit within the column and line widths used in the report.

WEIGHT, % MOISTURE, ETC.

Sample Number	Sample Matrix	Sample Weight(g)	Percent Moisture
2D304	Sediments	880	12.0
2D305	Sediments	910	15.5
2D306	Sediments	1210	28.5
M301	Sediments	890	19.8
M302	Sediments	820	33.7
M303	Sediments	1040	24.8
M304	Sediments	740	14.1
M305	Sediments	1010	47.3
M306	Sediments	680	47.1
M4301	Sediments	680	34.8
M4302	Sediments	760	55.9
M4303	Sediments	840	34.6
M4304	Sediments	500	51.5
M4305	Sediments	560	35.9
M4306	Sediments	620	12.9
2D301	Soils	950	2.96
2D302	Soils	1050	5.50
2D303	Soils	750	11.7

SOIL/SEDIMENT PARAMETERS

Sample Number	Percent Sand	Percent Silt	Percent Clay
2D301	98.0	1.00	.640
2D302	96.0	1.00	2.52
2D303	97.0	1.00	2.22
2D304	89.0	5.00	5.50
2D305	91.0	3.00	5.80
2D306	95.0	1.00	3.84
M301	86.0	1.00	13.2
M302	40.0	23.0	37.3
M303	82.0	2.00	16.2
M304	86.0	4.00	9.39
M305	19.0	41.0	40.6
M306	10.0	66.0	24.4
M4301	74.0	3.00	22.3
M4302	41.0	14.0	45.2
M4303	77.0	4.00	19.5
M4304	54.0	11.0	34.9
M4305	34.0	31.0	35.2
M4306	82.0	8.00	10.2

CONTAMINANT CONCENTRATIONS

Analyte	Sample Number	Sample Matrix	Dry Wt. (ppm)	DL Dry (ppm)	Wet Wt. (ppm)	DL Wet (ppm)
PCB-TOTAL	2D304	Sediments	< .0568	.0568	< .0500	.0500
	2D305	Sediments	< .0591	.0591	< .0500	.0500
	2D306	Sediments	< .0699	.0699	< .0500	.0500
	M301	Sediments	< .0623	.0623	< .0500	.0500
	M302	Sediments	< .0754	.0754	< .0500	.0500
	M303	Sediments	< .0664	.0664	< .0500	.0500
	M304	Sediments	< .0582	.0582	< .0500	.0500
	M305	Sediments	< .0948	.0948	< .0500	.0500
	M306	Sediments	< .0945	.0945	< .0500	.0500
	M4301	Sediments	< .0767	.0767	< .0500	.0500
	M4302	Sediments	.991	.113	.437	.0500
	M4303	Sediments	< .0765	.0765	< .0500	.0500
	M4304	Sediments	< .103	.103	< .0500	.0500
	M4305	Sediments	.669	.0780	.429	.0500
	M4306	Sediments	< .0574	.0574	< .0500	.0500
	2D301	Soils	< .0515	.0515	< .0500	.0500
	2D302	Soils	< .0529	.0529	< .0500	.0500
	2D303	Soils	< .0566	.0566	< .0500	.0500

PROCEDURAL BLANKS

Analyte	Lab Sample Number	Lab Sample Matrix	Result Total UG
Grain Size-Clay	BL- 1	Soil/Sediment	
Grain Size-Sand	BL- 1	Soil/Sediment	
Grain Size-Silt	BL- 1	Soil/Sediment	
HCB	BL- 1	Soil/Sediment	0.000
PCB-TOTAL	BL- 1	Soil/Sediment	0.000
alpha BHC	BL- 1	Soil/Sediment	0.000
alpha chlordane	BL- 1	Soil/Sediment	0.000
beta BHC	BL- 1	Soil/Sediment	0.000
cis-nonachlor	BL- 1	Soil/Sediment	0.000
dieldrin	BL- 1	Soil/Sediment	0.000

endrin	BL- 1	Soil/Sediment	0.000
gamma BHC	BL- 1	Soil/Sediment	0.000
gamma chlordane	BL- 1	Soil/Sediment	0.000
heptachlor epoxide	BL- 1	Soil/Sediment	0.000
mirex	BL- 1	Soil/Sediment	0.000
o,p'-DDD	BL- 1	Soil/Sediment	0.000
o,p'-DDE	BL- 1	Soil/Sediment	0.000
o,p'-DDT	BL- 1	Soil/Sediment	0.000
oxychlordane	BL- 1	Soil/Sediment	0.000
p,p'-DDD	BL- 1	Soil/Sediment	0.000
p,p'-DDE	BL- 1	Soil/Sediment	0.000
p,p'-DDT	BL- 1	Soil/Sediment	0.000
toxaphene	BL- 1	Soil/Sediment	0.000

PROCEDURAL BLANKS (Cont.)

Analyte	Lab Sample Number	Lab Sample Matrix	Result Total UG
trans-nonachlor	BL- 1	Soil/Sediment	0.000

DUPLICATES

Analyte	Sample Number	Sample Matrix	Wet Dry %	Initial Result (ppm/%)	Duplicate Result (ppm/%)	Average	Relative Percent Diff.
% Moisture	2D306	Sediments	%	28.5	29.0	28.7	1.68
Grain Size-Clay	2D302	Soils	%	2.52	2.62	2.57	3.89
Grain Size-Sand	2D302	Soils	%	96.0	96.0	96.0	0.000
Grain Size-Silt	2D302	Soils	%	1.00	1.00	1.00	0.000
HCB	2D306	Sediments	Dry	< .0140	< .0141	.00702	.680
PCB-TOTAL	2D306	Sediments	Dry	< .0699	< .0704	.0351	.680
alpha BHC	2D306	Sediments	Dry	< .0140	< .0141	.00702	.680
alpha chlordane	2D306	Sediments	Dry	< .0140	< .0141	.00702	.680
beta BHC	2D306	Sediments	Dry	< .0140	< .0141	.00702	.680
cis-nonachlor	2D306	Sediments	Dry	< .0140	< .0141	.00702	.680
dieldrin	2D306	Sediments	Dry	< .0140	< .0141	.00702	.680
endrin	2D306	Sediments	Dry	< .0140	< .0141	.00702	.680
gamma BHC	2D306	Sediments	Dry	< .0140	< .0141	.00702	.680
gamma chlordane	2D306	Sediments	Dry	< .0140	< .0141	.00702	.680
heptachlor epoxide	2D306	Sediments	Dry	< .0140	< .0141	.00702	.680
mirex	2D306	Sediments	Dry	< .0140	< .0141	.00702	.680
o,p'-DDD	2D306	Sediments	Dry	< .0140	< .0141	.00702	.680
o,p'-DDE	2D306	Sediments	Dry	< .0140	< .0141	.00702	.680
o,p'-DDT	2D306	Sediments	Dry	< .0140	< .0141	.00702	.680

DUPLICATES (Cont.)

Analyte	Sample Number	Sample Matrix	Wet Dry %	Initial Result (ppm/%)	Duplicate Result (ppm/%)	Average	Relative Percent Diff.
oxychlordane	2D306	Sediments	Dry	< .0140	< .0141	.00702	.680
p,p'-DDD	2D306	Sediments	Dry	< .0140	< .0141	.00702	.680
p,p'-DDE	2D306	Sediments	Dry	.108	.104	.106	3.61
p,p'-DDT	2D306	Sediments	Dry	< .0140	< .0141	.00702	.680
toxaphene	2D306	Sediments	Dry	< .0699	< .0704	.0351	.680
trans-nonachlor	2D306	Sediments	Dry	< .0140	< .0141	.00702	.680

SPIKE RECOVERIES

Analyte	Sample Number	Sample Matrix	Wet Dry %	Spike Level (ppm/%)	Amount Recovered (ppm/%)	* Spike / Background	Percent Recovery
HCB	2D302	Soils	Dry	.467	.466	41.3	99.7
PCB-TOTAL	2D302	Soils	Dry	4.67	5.50	82.5	118.
alpha BHC	2D302	Soils	Dry	.467	.402	41.3	86.1
alpha chlordane	2D302	Soils	Dry	.467	.445	41.3	95.1
beta BHC	2D302	Soils	Dry	.467	.561	41.3	120.
cis-nonachlor	2D302	Soils	Dry	.467	.508	41.3	109.
dieldrin	2D302	Soils	Dry	.467	.445	41.3	95.1
endrin	2D302	Soils	Dry	.467	.423	41.3	90.6
gamma BHC	2D302	Soils	Dry	.467	.413	41.3	88.3
gamma chlordane	2D302	Soils	Dry	.467	.434	41.3	92.9
heptachlor epoxide	2D302	Soils	Dry	.467	.423	41.3	90.6
mirex	2D302	Soils	Dry	.467	.519	41.3	111.
o,p'-DDD	2D302	Soils	Dry	.467	.381	41.3	81.6
o,p'-DDE	2D302	Soils	Dry	.467	.413	41.3	88.3
o,p'-DDT	2D302	Soils	Dry	.467	.550	41.3	118.
oxychlordane	2D302	Soils	Dry	.467	.550	41.3	118.
p,p'-DDD	2D302	Soils	Dry	.467	.466	41.3	99.7
p,p'-DDE	2D302	Soils	Dry	.467	.396	6.73	84.8
p,p'-DDT	2D302	Soils	Dry	.467	.550	41.3	118.
trans-nonachlor	2D302	Soils	Dry	.467	.508	41.3	109.

* For a spike to be a valid measure of method accuracy, this ratio must be higher than 1.0.

QA/QC FREQUENCY ANOMALIES

BLANKS: The required number of blanks analyses were performed.

DUPLICATES: The required number of duplicate sample analyses were performed.

SPIKES: The required number of spiked sample analyses were performed.

QA/QC LIMIT OF DETECTION

Limits of Detection were within the contract requirements.

QA/QC ANOMALIES - DUPLICATES

All duplicate results were within normal limits.

QA/QC ANOMALIES - SPIKES

All spiked sample results were within normal limits.

QA/QC COMMENTS

QA/QC and analytical results were approved by: John Moore (PACF).

ANALYTICAL METHODS

This section describes the methods used for analysis by analyte.

Method Codes: 004

Lab Matrix	Analyte(s)
Soil/Sediment	HCB
	PCB-TOTAL
	alpha BHC
	alpha chlordane
	beta BHC
	cis-nonachlor
	dieldrin
	endrin
	gamma BHC
	gamma chlordane
	heptachlor epoxide
	mirex
	o,p'-DDD
	o,p'-DDE
	o,p'-DDT
	oxychlordane
	p,p'-DDD
	p,p'-DDE
	p,p'-DDT
	toxaphene
	trans-nonachlor

METHOD CODE: 004

LABORATORY: Patuxent Analytical Control Facility

Analytical Methodology for Organochlorines for Tissue

IV. The analytical methods, including preparation, Soxhlet extraction, and lipid removal are described by Cromartie et al., 1975. Glass extraction thimbles were used. The silica gel separation of the pesticides from PCBs was different from the above reference in that four fractions were used instead of three to enable the separation of dieldrin and endrin from the rest of the pesticides. The pesticides in each fraction were quantified with a gas-liquid chromatograph (GLC), equipped with a 63Ni electron capture detector. The GLC column used was a 30m MEGABORE coated with a 1.0 micron film of 7% cyanopropyl 7% phenyl polysiloxane. Residues in 10% of the samples were confirmed by gas chromatography/mass spectrometry (GC/MS). The nominal lower limit of detection is 0.01 ppm for pesticides and 0.05 ppm for PCBs based on a 10 g aliquot wet weight.

ANALYTICAL METHODS (Cont.)

Reference

Cromartie, E.W., W.L. Reichel, L.N. Locke, A.A. Belisle, T.E. Kaiser, T.G. Lamont, B.M. Mulhern, R.M. Prouty, and D.M. Swineford. 1975. Residues of organochlorine pesticides and polychlorinated biphenyls and autopsy data for Bald Eagles, 1971-72. Pestic. Monit. J. 9:11-14.

ANALYTICAL METHODS

This section describes the methods used for analysis by analyte.

Method Codes: 020

Lab Matrix	Analyte(s)
Soil/Sediment	% Moisture

METHOD CODE: 020

LABORATORY: Patuxent Analytical Control Facility

Analytical Methodology for Percent Moisture

XX. Preweigh pan. Add aliquot to tared pan. Allow sample to dry 24 hours in an oven at 200 degrees Fahrenheit. Samples are then placed in a desiccator to cool. Record pan + dry weight.

Percent Moisture = 1 - (pan + dry - pan weight / original aliquot) * 100.

ANALYTICAL METHODS

This section describes the methods used for analysis by analyte.

Method Codes: 025

Lab Matrix	Analyte(s)
Soil/Sediment	Grain Size-Clay
	Grain Size-Sand
	Grain Size-Silt

METHOD CODE: 025

LABORATORY: Patuxent Analytical Control Facility

Grain Size Analysis

XXV. A 15 to 20 gram homogenized sample is placed in a large glass jar. The sample is treated with 50 to 100 ml of Hydrogen Peroxide to oxidize organic matter. The sample is washed with distilled water to remove soluble salts. 400 ml of Sodium Hexametaphosphate (5.5g/L) is added to disperse the sample. The sample is shaken for 24 hours. After shaking, the sample is filtered through a 62.5 micron screen into a 1000 ml graduated cylinder. The sample is rinsed with dispersant in order that all fine-grain sediment is washed into the cylinder. This separates the gravel sand fraction (on the screen) from the silt/clay fraction (in the cylinder). The coarse fraction is washed into a pre-weighed beaker with distilled water and placed in a 100 degree oven for 24 hours. The sample is allowed to cool. The sample is weighed and weights recorded on the data sheets.

The silt/clay size material is determined by settling. A graduated cylinder is filled to exactly 1 liter. The sample is stirred and left to stand for one day. The sample is stirred vigorously. After removing the stirring rod, a 20 ml aliquot is taken from a depth of 20 cm after 20 seconds. This is the 4 phi aliquot and the total weight of the silt + clay fraction. The aliquot is placed in a pre-weighed beaker. At the 2 hour and 3 minute time another 20 ml aliquot is taken at the 10 cm depth. This is the 8 phi aliquot. Pipette the suspension into a different pre-weighed beaker. The beakers are dried overnight and cooled. The beakers are weighed, and the percent sand, silt, and clay fractions are determined.

SEDIMENT SAMPLING OF TRACT 21-a, POND A, AND POND B: GREAT MEADOWS MARSH, STRATFORD, CT

November, 2001
U.S. Fish and Wildlife Service, New England Field Office
Michael J. Bartlett, Supervisor

Background

In April, 1999, the Service examined heavy metal and organochlorine levels in sediments from three tracts of land in Great Meadows Marsh as part of a Level II Pre-Acquisition Survey. The results indicated low levels of heavy metals, DDE, and PCBs in sediments (Appendix 1). Prior to restoration actions in the marsh, CT DEP requested additional contaminant sampling of constituents not analyzed in the Level II study. Specifically, CT DEP requested that sediment samples from the restoration area and two ponds be analyzed for chromium (both trivalent and hexavalent), pesticides, chlorinated herbicides, semivolatile organics, ETPH (extractable total petroleum hydrocarbon), PCBs, TOC, and grain size.

Methods

Sediment samples were collected from Tract 21-a, Pond A, and Pond B (Figure 1) using standard FWS sample collection, QA/QC, and preservation protocols. Three samples (A1-2, B1-2, and C1-2) were collected from Tract 21-a. One sample was collected from each of the ponds. Samples were shipped to Environmental Science Corporation, Middletown, CT under chain of custody (Appendix 2).

Results

With the exception of TOC, grain size, and chromium, all other analytes were below detection limits (Appendix 3). As per CT DEP guidance, constituents not detected will not be considered constituents of concern and need not be further evaluated. All of the chromium detected was in the trivalent (Cr^{+3}) form (Appendix 3).

Discussion

Long et al. (1995) compiled literature values for biological effects of various chemicals in marine and estuarine sediments. Using percentiles, they came up with sediment quality criteria from which to judge the potential of concentrations of particular contaminants to cause biological effects. The lower 10^{th} percentile of the effects data for each chemical was identified and referred to as the effects range-low (ERL). The 50^{th} percentile is referred to as the effects range-median (ERM). Ingersoll et al. (1996) calculated probable effect Levels (PEL) using procedures as described by MacDonald (1994). Table 1 compares these sediment quality criteria to mean values found during this study. All results are reported as ppm dry weight.

Table 1. Sediment quality criteria and Cr^{+3} levels in sediments from Great Meadows Marsh

Analyte	ERL	ERM	PEL	Pond A	Pond B	A1-2	B1-2	C1-2
Cr^{+3}	81.0	370.0	120.0	09.5	23.2	78.0	72.0	46.0

When we compare these levels to the CT Residential Direct Exposure Criteria (Appendix 4) using the 20 times rule (the worst case leachate that would be possible), levels are far below threshold concentrations.

Conclusions

Levels of contaminants measured in Tract 21-a, Pond A, and Pond B do not pose a threat to the public or to wildlife. Pending approval of these results by CT DEP, contaminant levels do not preclude the initiation of restoration activites.

Literature Cited

Ingersoll C.G, P.S. Haverland, E.L. Brunson, T.J. Canfield, F.J. Dwyer, C.E. Henke, N.E. Kemble, D.R. Mount, and R.G. Fox. 1996. Calculation and evaluation of sediment effect concentrations for the amphipod Hyalella azteca and the midge Chironomus riparius. J. Great Lakes Res. 22(3):602-623.

Long, E.R., D.D. MacDonald, S.L. Smith, and F.D. Calder. 1995. Incidence of adverse biological effects within ranges of chemical concentrations in marine and estuarine sediments. Env. Mgmt. 19(1):81-97.

MacDonald, D.D. 1994. Approach to the assessment of sediment quality of Florida coastal waters. Vol. I - Development and evaluation of sediment quality assessment guidelines. Report for FL. DEP, Tallahassee, FL. Nov., 1994.

Sample	Type	Wt	lat	long	% Moist	Al	As	B	Ba
2D301	Soils	950	410948	730943	2.35	1040	0.976	0.502	6.16
2D302	Soils	1050	410948	730944	5.73	1840	0.845	0.496	11.1
2D303	Soils	750	410948	730945	11	1980	1.72	0.556	13.3
2D304	Sediments	880	410949	730942	9.13	3161	2.89	4.68	11.1
2D305	Sediments	910	410950	730943	10.1	4435	2.57	5.28	15.4
2D306	Sediments	1210	410950	730944	33	8489	3.86	3.02	50.5
Mean						**2769.163**	**1.854423**	**1.47579**	**14.0977**
M301	Sediments	890	410951	730854	19.7	5447	4.92	1.86	39.4
M302	Sediments	820	410945	730856	35.7	14256	7.7	8.88	73.1
M303	Sediments	1040	410946	730901	24.3	4923	3.38	0.579	28.9
M304	Sediments	740	410952	730856	14	6425	3.5	1.83	33.7
M305	Sediments	1010	410949	730857	47.4	17805	15.7	28.3	74.3
M306	Sediments	680	410947	730903	48.9	16182	10.3	75.5	41
Mean						**9440.001**	**6.456982**	**5.782711**	**45.21533**
M4301	Sediments	680	410940	730901	44.7	5595	2.93	22.6	41.5
M4302	Sediments	760	410941	730902	65.7	2690	4.83	18.2	26.4
M4303	Sediments	840	410940	730900	26.9	6218	4.39	3.83	37.9
M4304	Sediments	500	410940	730850	49.3	7914	8.21	6.35	84.4
M4305	Sediments	560	410944	730857	35.7	12796	14.3	8.92	78.5
M4306	Sediments	620	410941	730859	13.3	5565	4.36	3.04	30.3
Mean						**6123.829**	**5.628692**	**8.045724**	**45.02886**

Be	Cd	Cr	Cu	Fe	Hg	Mg	Mn	Mo	Ni
0.0578	0.191	2.94	6.17	2667	0.01	556	26.9	0.502	2.8
0.0844	0.321	7.41	10.4	3955	0.0181	914	43.6	0.496	5.74
0.11	0.29	10.2	12.1	4178	0.00944	978	50.6	1.16	8.37
0.149	0.293	5.45	13.5	5973	0.0106	1630	75	0.519	4.01
0.179	0.536	8.37	11.5	8262	0.0108	2184	74.6	0.51	4.94
0.375	0.983	15.8	29.5	16542	0.141	4496	138	0.704	11
0.132319	**0.374186**	**7.369264**	**12.35453**	**5745.581**	**0.017382**	**1412.877**	**59.81977**	**0.614458**	**5.552773**
0.301	0.787	10.6	37.4	11760	0.0107	2672	121	0.572	7.79
0.796	1.87	113	271	28889	0.143	7700	337	2.72	23.9
0.291	0.492	10.4	25.8	10192	0.0118	2286	75.5	0.579	7.63
0.3	0.69	13.3	30.8	13354	0.0221	3239	137	1.58	7.95
1.26	3.14	342	831	42152	0.296	9335	596	5.48	33.8
0.979	2.38	45	88	48019	0.0388	9129	485	9.4	22.7
0.543594	**1.245536**	**36.96165**	**91.55509**	**21307.88**	**0.040756**	**4847.956**	**222.6786**	**2.045824**	**14.33161**
0.345	0.816	105	116	10840	0.131	3390	82	6.01	26.3
0.412	1.42	79.6	240	9421	0.594	2716	109	1.39	18.4
0.206	0.732	79	57.4	14462	0.0785	3479	91.4	2.89	7.73
0.478	0.896	198	348	19613	0.431	4455	150	5.98	14.9
0.514	1.55	343	312	34693	0.494	6919	201	7.72	17.1
0.187	0.566	69.8	61.7	12853	0.0571	2256	72.5	2.56	7.12
0.332253	**0.934669**	**120.9458**	**148.4568**	**15317.6**	**0.205019**	**3613.841**	**110.146**	**3.766092**	**13.7595**

Pb	Se	Sr	V	Zn
9.26	0.0413	3.35	7.45	15.2
14	0.0491	5.6	15.7	32.2
29.7	0.152	6.63	23.5	47.7
4.42	0.0474	49.4	8.85	25.7
6.62	0.0471	11.5	13.8	22.9
12.2	0.0633	19.8	23.4	59.5
10.54442	**0.059317**	**10.57563**	**14.09917**	**30.57857**
14.3	0.0487	16	18.9	44.3
44	0.0627	40.4	44.9	206
5.34	0.0486	13.2	14.6	41.3
34.8	0.0548	18.3	24.2	57.6
124	0.303	55.1	55	445
27.4	0.342	64.2	59	107
27.11317	**0.097188**	**28.64412**	**31.47858**	**100.5537**
89	0.184	30.9	30.5	47.8
68.1	0.609	38.9	32.5	61.7
121	0.0535	18.9	26.5	32.7
188	0.0725	62.9	40.6	92.9
153	0.187	64.7	60.3	125
36.7	0.177	24.2	30	27.6
95.82371	**0.155952**	**36.16513**	**35.28301**	**56.0208**

APPENDIX B

Consultations

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Narragansett Laboratory
Restoration Center
28 Tarzwell Drive
Narragansett, RI 02882
Phone: +1 401-782-3338
Fax: +1 401-782-3201

January 9, 2017

Tom Chapman, Supervisor
U.S. Fish and Wildlife Service
New England Field Office
70 Commercial Street, Suite 300
Concord, New Hampshire 03301

RE: Section 7 Consultation, Lordship Pt/Raymark NRDA Restoration, Stratford, CT

Dear Mr. Chapman:

The National Oceanic and Atmospheric Administration (NOAA) is submitting this consultation letter on behalf of and in coordination with the Lordship Pt and Raymark Industries Natural Resource Damage Assessment (NRDA) Trustee Council (hereafter, the "Trustees") which includes the U.S. Fish and Wildlife Service (USFWS), NOAA, and the State of Connecticut, represented by the Connecticut Department of Energy and Environmental Protection (CT DEEP). The Trustees are currently preparing and planning to publically release a Draft Restoration Plan and Environmental Assessment (RP/EA). The purpose of this letter is to complete and document the analysis of the anticipated effects of these potential salt marsh and other coastal restoration actions on species protected under the Endangered Species Act.

Please find attached narrative descriptions and graphics depicting the proposed restoration project sites. You will note that multiple marsh restoration sites are proposed within the USFWS McKinney National Wildlife Refuge; one or more stone groins are being considered for removal at Long Beach, and a living shoreline and artificial reef project is proposed for expansion on the north shore of Lordship Pt. These project alternatives will be further described in detail and assessed for potential impacts in the forthcoming Draft RP/EA. Upfront endangered species consultation and input from the USFWS will be beneficial to and incorporated into the Draft RP/EA.

The Trustees queried the Environmental Conservation On-line system (ECOS), Information for Planning and Conservation (IPaC) database in December 2016 for federally-listed threatened and endangered species. According to the ECOS-IPaC query results, four species are listed and may be found in or near the project alternative areas: piping plover (*Charadrius melodus* – threatened status), which use coastal beach and intertidal habitats; roseate tern (*Sterna dougallii dougallii* – endangered status), which use coastal beaches and open Atlantic Ocean habitats; red knot (*Calidris canutus rufa* – threatened), which use coastal beaches, rocky shores, and mud flats; and the northern long-eared bat (*Myotis septentrionalis* – threatened), which use terrestrial forest habitats. The Trustees have considered whether each project alternative could have an effect on any of these listed species, their habitats, or proposed or designated critical habitats, and provide a summary, herein (Table 1).

Table 1. ESA species potentially associated with the NRDA restoration project areas

Species	Potential for Lordship Pt/Raymark NRDA Restoration to have an Effect
Piping plover	The GMU salt marsh projects may affect but not likely to adversely affect. The marsh restoration may provide food organisms to foraging plover. The Long Beach groin and Lordship Pt living shoreline projects would occur in sand beach areas known to be used by piping plover and may take place in the vicinity of plover nesting area. Conversely, the proposed construction activities for either the groin removals or the living shoreline installation projects are expected to occur during the time period of September 1 – March 30 when piping plover are not expected to be present in these areas. Further USFWS consultation may be required to ensure no adverse effects to piping plover result from the construction or site maintenance activities.
Roseate tern	The GMU salt marsh projects may affect but not likely to adversely affect. The marsh restoration may provide food organisms to foraging terns. The Long Beach groin and Lordship Pt living shoreline projects would occur in sand beach areas known to be used by terns and may take place in the vicinity of tern nesting area. Conversely, the proposed construction activities for either the groin removals or the living shoreline installation projects are expected to occur during the time period of September 1 – March 30 when terns are not expected to be present in these areas. Further USFWS consultation may be required to ensure no adverse effects to terns result from the construction or site maintenance activities for any of the project alternatives. The marsh restoration, groin removal and/or living shoreline projects are expected to result in enhancement of habitat for fishes such as Atlantic silverside and bay anchovy that are used by terns as forage species.
Red knot	No effect. No known red knot occurrences have been documented in any of the project alternative areas. Construction activities for the groin removals or the living shoreline implementation along sandy beach and open Long Island Sound are expected to occur during the time period of September 1 – March 30 when red knot are not present in this area.
Northern long-eared bat	No effect. The project is not expected to substantially impact forest habitat. The proposed GMU Alternatives 2 and 4marsh restoration may result in the removal or loss of one or more trees, likely smaller-diameter trees. The trees would be removed during the period of October 1 – December 31, followed by excavation and grading of fill soils to restore salt marsh habitat or enhance terrapin nesting habitat. Northern long-eared bats are not expected to be present in this site, and if remotely present, would likely be using larger, nearby trees that are not expected to be altered, as hibernacula.

Based on the species information and output from the IPaC database, we conclude that one or more of the project alternatives may have an effect but is not likely to adversely affect piping plover or roseate tern. Further, the project is not likely to adversely affect northern long-eared bat, and would have no effect on red knot or others listed as threatened or endangered species, their habitats, or proposed or designated critical habitats. We request that the USFWS thoroughly consider this determination and provide the Trustees with a written response on its evaluation.

Please refer to the supplemental details about the proposed project, attached. Should you require additional information regarding the project, please do not hesitate to contact me at 401-782-3338, James.G.Turek@noaa.gov. Thank you for your timely consideration and response.

Sincerely,

James Turek
Restoration Ecologist
NOAA Restoration Center

cc: D. Major, M. Sperduto – USFWS
R. Jacobson, N. DeBarros – CT DEEP

Lordship Pt. and Raymark Industries NRDA Cases
Natural Resources Injury Restoration
Stratford, CT
Summary of Project Alternatives
December 2016

The purpose of the proposed restoration action is to compensate the public for injury and losses to natural resources in estuarine waters within Stratford, Connecticut caused by the release of hazardous substances from the Lordship Pt. and Raymark Industries Sites. The Lordship Pt and Raymark Trustee Council (LPRTC) seeks to use funds from the Lordship Pt settlement and the Raymark Industries bankruptcy agreement to implement natural resource injury restoration. Compensatory restoration actions are necessary to address natural resource injuries, and the services provided by those resources, in the past and into the future. Multiple restoration alternatives have been identified (Figure 1) and are described, as follows:

McKinney NWR Great Meadows Unit (GMU), Salt Marsh Restoration

Marsh Restoration Project Goals:

1. Restore salt marsh communities to provide estuarine fishery habitat and other ecological functions and services
2. Enhance disturbed wetland and bordering coastal upland habitats to provide greater ecological functions and services

Project Objectives:

1. Restore salt marsh community types including both low marsh dominated by smooth cordgrass (*Spartina alterniflora*) and high marsh dominated by salt hay (*S. patens*), salt grass (*Distichlis spicata*) and other species
2. Avoid or minimize adverse impacts to existing wetlands
3. Protect or restore state-listed marsh pink (*Sabatia stellaris*) habitat and marsh pink populations
4. Protect or enhance state-listed northern diamondback terrapin (*Malaclemys t. terrapin*) nesting habitat
5. Maintain or enhance forested and scrub-shrub habitat for songbirds
6. Restore or enhance salt marsh habitat for state-listed saltmarsh sparrow (*Ammodramus caudacutus)* and seaside sparrow (*A. maritimus*)
7. Maintain and enhance native communities by controlling invasive vegetation
8. Control salt marsh mosquito production
9. Maintain or improve public access and education
10. Provide marsh research opportunities and project performance monitoring

Marsh Restoration Project Alternatives: For each of the fill removal and tidal creek restoration projects (Refer to Alternative Figures 2-5, below), the project design objectives are to re-establish grade elevations supporting a native salt marsh plant community and establishing conditions favoring a more resilient coastal habitat to address storms and sea-level rise.

Figure 1: Lordship Pt and Raymark Injury Restoration Alternatives, Stratford, CT

1. **Alternative 1: Tidal Connection to Ponds and Marsh Creation –** Two ponds and existing wet *Phragmites* totaling ~3.7 acres would be connected to existing intertidal creek channels to provide regular tidal exchange (Figure 3). The work would involve the construction of two connecting channels by excavating and grading ~280 feet of intertidal channel to connect the ponds with nearby salt marsh creeks. The freshwater ponds would be converted to intertidal marsh habitat dominated by smooth cordgrass. This alternative would minimize impacts to and enhance terrapin nesting habitat along the existing sandy, man-made berm. Foot access along the berm could be maintained but limited to avoid secondary impacts to terrapin nesting habitat. Marsh elevations and hydrology affecting the habitat between and along the perimeter of the two ponds would be restored to provide marsh pink habitat in the restored high marsh area between the two ponds. This alternative may also include marsh pink propagation and planting program with oversight by CT DEEP.

2. **Alternative 2: 6.5-Acre Fill Removal and Channel Construction –** Targeted fill removal and channel construction would occur in a tidally-restricted and filled area southeast of the GMU parking lot and east of Alternative 1 (Figure 3). Channel construction is needed in the poorly drained, *Phragmites*-dominated southern portion of this area to provide regular tidal exchange and fish access, and to also address the significant production of nuisance mosquitoes (The berm restricts tidal exchange, making the site favorable to producing hordes of salt marsh mosquitoes). Fill removal (~1.5 acres) would occur in the northern portion of this area along with perimeter berm removal to restore to high and low marsh elevations. Target marsh elevations would be ~4.5-5.0 ft NGVD to provide mix of high and low marsh communities. Existing marsh with documented marsh pink populations would be protected or enhanced by the proposed work. This alternative may also include marsh pink propagation and planting program. Excavated fill would be placed in targeted areas to minimize existing wetland impacts and protect or enhance existing forested and/or scrub-shrub habitat used by songbirds along the western border of this area.

3. **Alternative 3: 5.6-Acre Channel Construction and Berm Removal –** Targeted fill removal (~2.5 acres) at berms and construction of channels are proposed east and southeast of Alternative 2 (Figure 4). The focus of this work would be channel construction to improve regular tidal exchange at the existing poorly-drained low marsh (and to eliminate mosquito production, as described above); removal of perimeter berm to provide marsh plain tidal sheet flow; and cleaning and/or repair of an existing culvert under the GMU public walking trail to enhance tidal exchange via the culvert. Additional tidal channel connections would be tied into previously excavated channels to the west of this site. Target marsh elevations would be ~4.5-5.0 ft NGVD to provide mix of high and low marsh communities. This alternative could also include marsh pink propagation and planting program. As part of this alternative, minor grade increases in the existing foot-access trail would be provided to maintain public access. Excavated fill soils would be strategically placed in on-site uplands or disposed of off-site.

4. **Alternative 4: 2.2-Acre Fill Removal –** Greater fill removal (up to ~5-foot fill cut) would occur to restore low and high marsh immediately north of Alternative 3 and west of the man-made pond (Figure 5). Target marsh elevations would be ~4.5-5.0 ft NGVD to provide mix of high and low marsh communities. Channels would also be excavated as a component of this alternative with connection into previously excavated channels to the west of this site. This alternative could also include marsh pink propagation and planting program. Excavated fill soils would be strategically placed in on-site uplands or disposed of off-site.

5. **Alternative 5: Enhance 1.75-Acre Tidal Pond Hydrology –** This alternative would be to remove and modify the existing defunct flap gate on the culvert discharging flows from the man-made pond. The existing flap gate has a corroded hole in the structure. The flap gate would be removed, and tidal flow would be established provided impacts to up-gradient infrastructure would not be adversely affected. Alternatively, a tide gate or managed weir (AgriDrain water control structure or equivalent) would be installed to allow increased, regular tidal exchange with the pond, but limit tidal flooding to prevent flooding of up-gradient industrial warehouses and infrastructure(to be further assessed). USFWS GMU staff would be required to manage and maintain the structure, following an operation and maintenance plan that would be developed as part of this alternative. This alternative would enhance tidal habitat conditions within the ~1.75-acre shallow-water pond and potentially affect additional surrounding marsh area bordering the pond.

6. **Alternative 6: Invasive Plant Mowing/Cutting and Herbicide Management –** Areas within the GMU and located within or bordering the previously described project alternatives are adversely affected by common reed (*Phragmites australis*), Russian olive (*Elaeagnus angustifolia*) and other non-native, invasive plant species. The invasive plant control would be accomplished by one or more mowings of common reed, cutting of Russian olive, and one or more herbicide applications to control these plants. Work would be completed by experienced and licensed pesticide applicators and restoration specialists contracted through CT DEEP or USFWS. A total of up to 10 acres of the GMU would be addressed by this alternative, and be carried out over a 5+-year period.

Accomplishing project goals will require working collaboratively with the USFWS McKinney NWR and other stakeholders to manage for trust species and to strive to achieve regional habitat restoration goals. Any and all combinations of the alternatives are being considered, and will be presented in a Restoration Plan (RP) and Environmental Assessment (EA) to be released by the LPRTC to the public for review and comment. The number and extent of the alternatives that are implemented will be commensurate with the level of funding needed for projected work activities and a contingency for unanticipated work items, and the amount of available funding.

Figure 2: Aerial View, GMU Marsh Restoration Alternatives

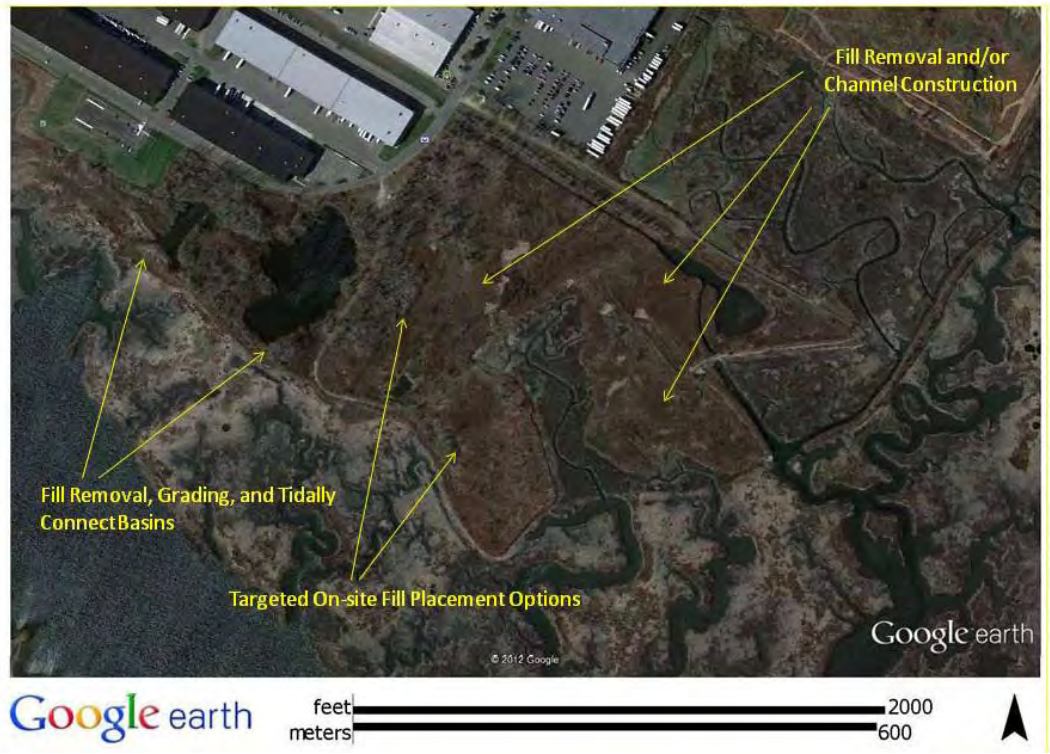


Figure 3: GMU Marsh Restoration Alternative 1

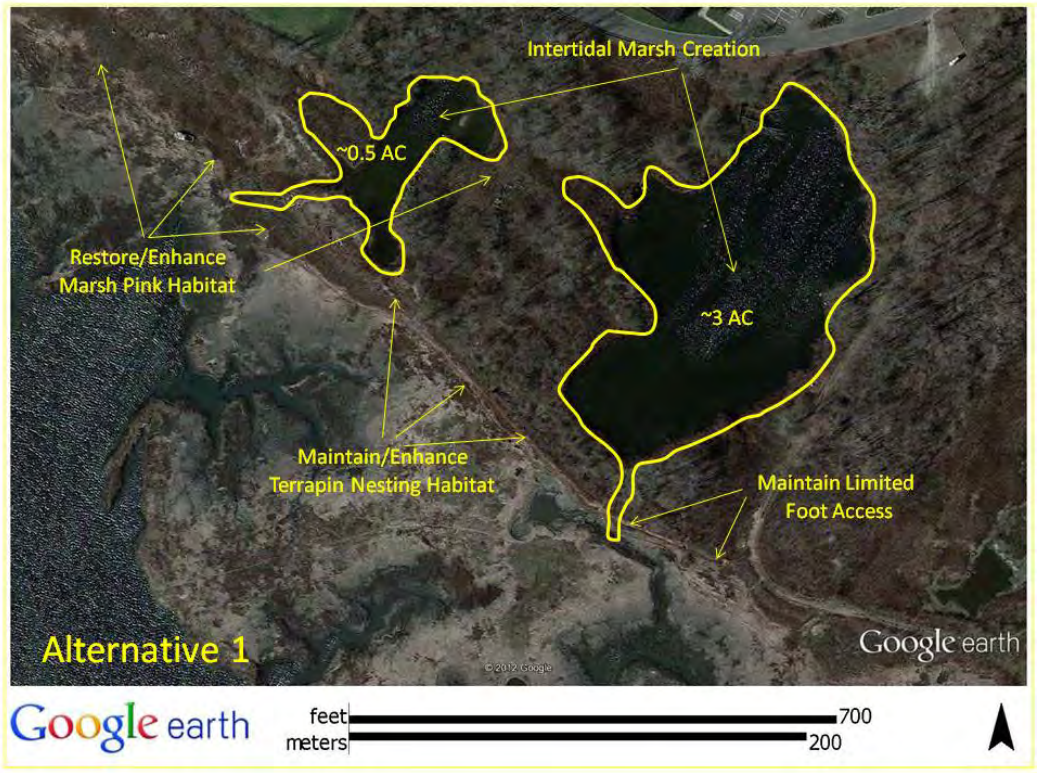


Figure 4: GMU Marsh Restoration Alternative 2

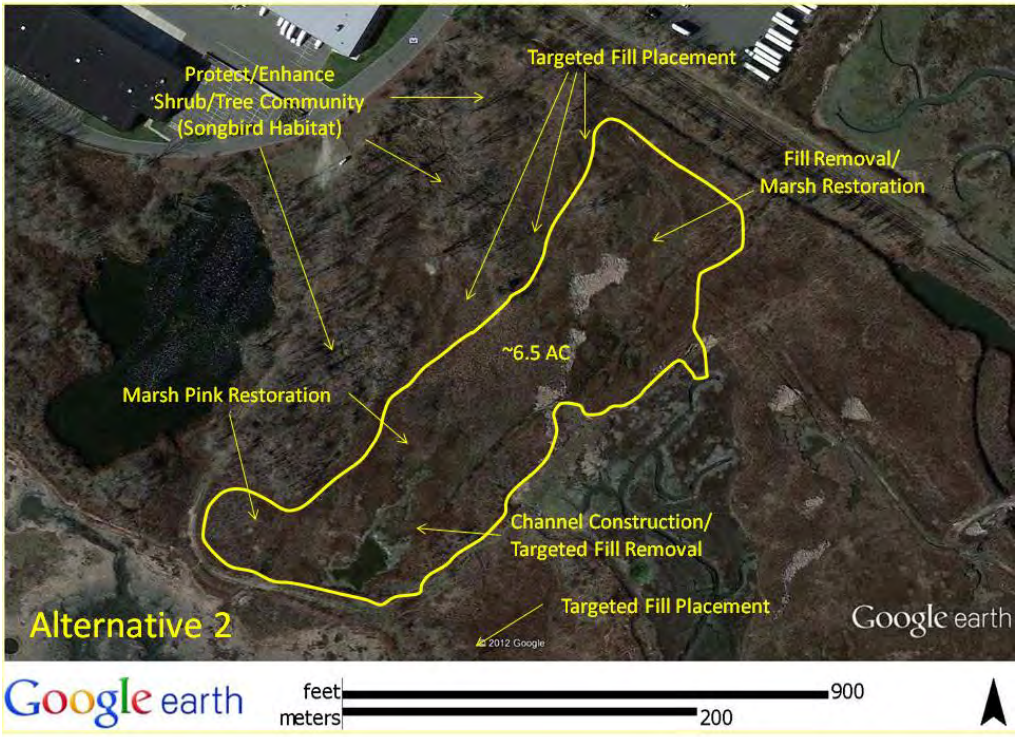
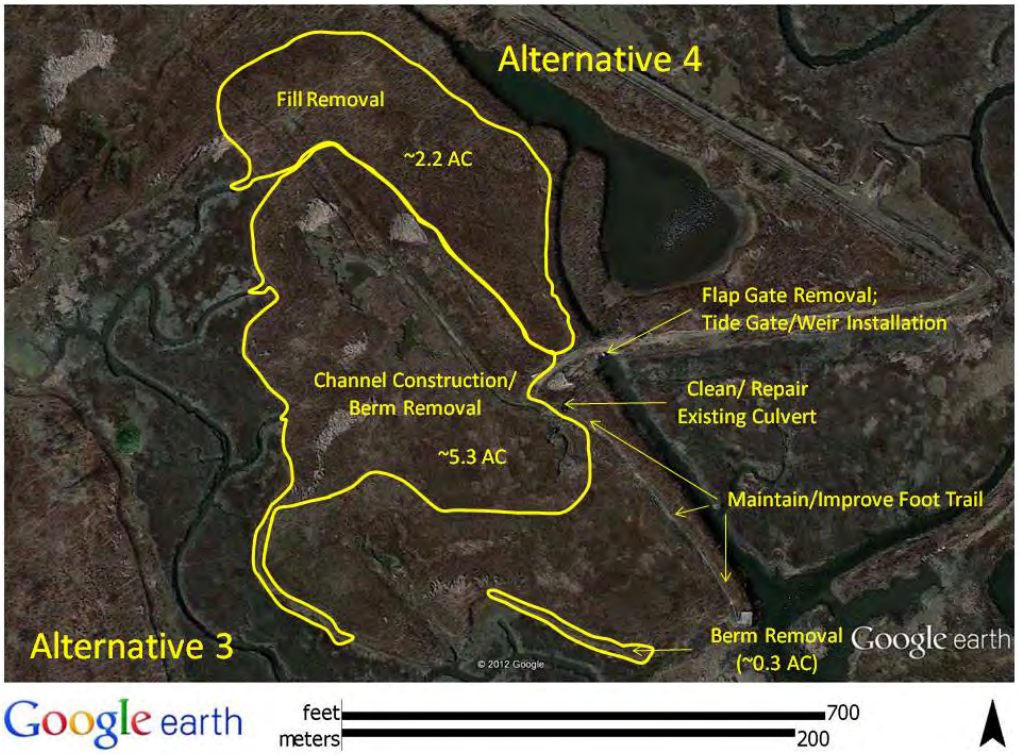


Figure 5: GMU Marsh Restoration Alternatives 3 and 4



Long Beach Groin Removal

Project Goals:

1. Restore sub-tidal and intertidal marine/estuarine habitat providing fish and macro-benthic habitats and other ecological functions and services
2. Restore natural coastal sediment transport process

Project Objectives:

1. Remove up to seven stone groins to restore natural sub-tidal waters and benthic community
2. Allow natural sediment transport along Long Beach to restore a naturally functioning coastal shoreline
3. Provide coastal geology research opportunities and project performance monitoring

Alternative 7: Stone Groin(s) Removal

The project site is along the Long Beach barrier beach bordering Long Island Sound, with Lewis Gut on the backside of this barrier beach (Figure 6). The site is located south of the McKinney GMU, and site access is off Oak Bluff Avenue, with public access to the beach system. A town-owned parking lot is situated immediately north of the two easternmost groins. West Beach Drive and multiple residences are located east of Long Beach. The project would consist of the removal of up to seven stone groins located along Long Island Sound and beachfront. A total of 0.8 acres of subtidal and intertidal habitat would be restored with the removal of all seven groins. Removal of the groins would restore unimpeded longshore transport of coastal sediments. It is expected that the groin removal would occur either by equipment accessing the site through the parking lot at the end of Oak Bluff Avenue, or by crane or excavator on a barge for relaying stone to disposal or re-use, transfer site. One consideration in the removal of the groins would be to remove and place the stone on a barge, and to then relocate and reuse the stone for coastal habitat restoration (e.g., living shoreline) at a nearby site. Higher project costs would result if the rock is disposed of and would require truck transport to approval disposal site. An estimated 8,500 CY of large rock would be excavated if all seven groins are removed.

Figure 6: Long Beach Groin Removal Alternative

Lordship Pt. North Living Shoreline

Project Goals:

1. Restore salt marsh and enhance intertidal and sub-tidal habitats and benthic community
2. Increase ecological resiliency of coastal habitats

Project Objectives:

1. Restore smooth cordgrass and salt hay fringe marsh
2. Enhance intertidal and sub-tidal habitats by establishing hard substrates benefiting Eastern oyster (*Crassostrea virginica*) community
3. Provide coastal geology research opportunities and project performance monitoring
4. Increase coastal resiliency by abating wave energies, minimizing vertical intertidal and horizontal erosion, and allow for sediment deposition to protect bordering upland coastal habitat for songbirds and other wildlife

Alternative 8: Installation of Living Shoreline

The 27.8-acre Lordship Pt. project site is located on the northwest shore of Stratford Pt. and the west side of the Housatonic River estuary (Figure 7). The project, proposed by DuPont and its project partners, would include: (1) sub-title reef ball installation; (2) intertidal reef ball installation; (3) low marsh fringe restoration; and (4) high marsh fringe.

The proposed living shoreline reef will consist of four individual segments oriented parallel to the existing shoreline; segments will range in length from approximately 150 to 250 ft with overlapping ends to reduce edge effects and associated scour, which has been observed at the periphery of the pilot project (See description and Figure 8, below). Overlap will be achieved by having two segments located closer to shore and two segments further from shore.

Segments are proposed to facilitate tidal exchange in the intertidal marsh that will be established landward of the reef. Segments closer to shore will be located approximately 100 ft seaward of MHW, corresponding to the ~+0.5-ft bathymetric contour. This elevation generally corresponds to the historical seaward extent of the marsh at the site. Seaward reef segments will be located approximately 175 ft seaward of MHW, generally corresponding to the -1.0 ft bathymetric contour. Far-shore segments will be approximately 250 ft in length and will be constructed of two rows of reef balls approximately 6 ft in diameter and 4.5 ft in height; this design will result in a far-shore reef crest height consistent with the near-shore segments.

The target wave attenuation for the proposed artificial reef is between 40% and 60% for a 2-year return storm. The intertidal marsh is also expected to attenuate wave forces and increase the sediment stability.

Both low and high marsh will be established landward of the reef balls using transplants of locally-obtained *Spartina* plants, or purchase of plants from regional commercial nursery providing plants of local genotype.

A pilot project was previously completed by DuPont at the site. In May 2014, the project partners installed 64 cement Reef Balls™ each 1m high by 1.2m wide (3ft X 4ft) in two equal length rows of 160 ft and 8-ft width. The reef was placed in the intertidal zone approximately 100 ft seaward from the high tide line as a means to abate wave energy, allow for sediment deposition, and protect transplanted smooth cordgrass. Approximately 3 linear feet of scour protection, consisting of 2- to 3-inch median diameter stone, approximately four to six inches deep, was placed adjacent to and seaward of the artificial reef.

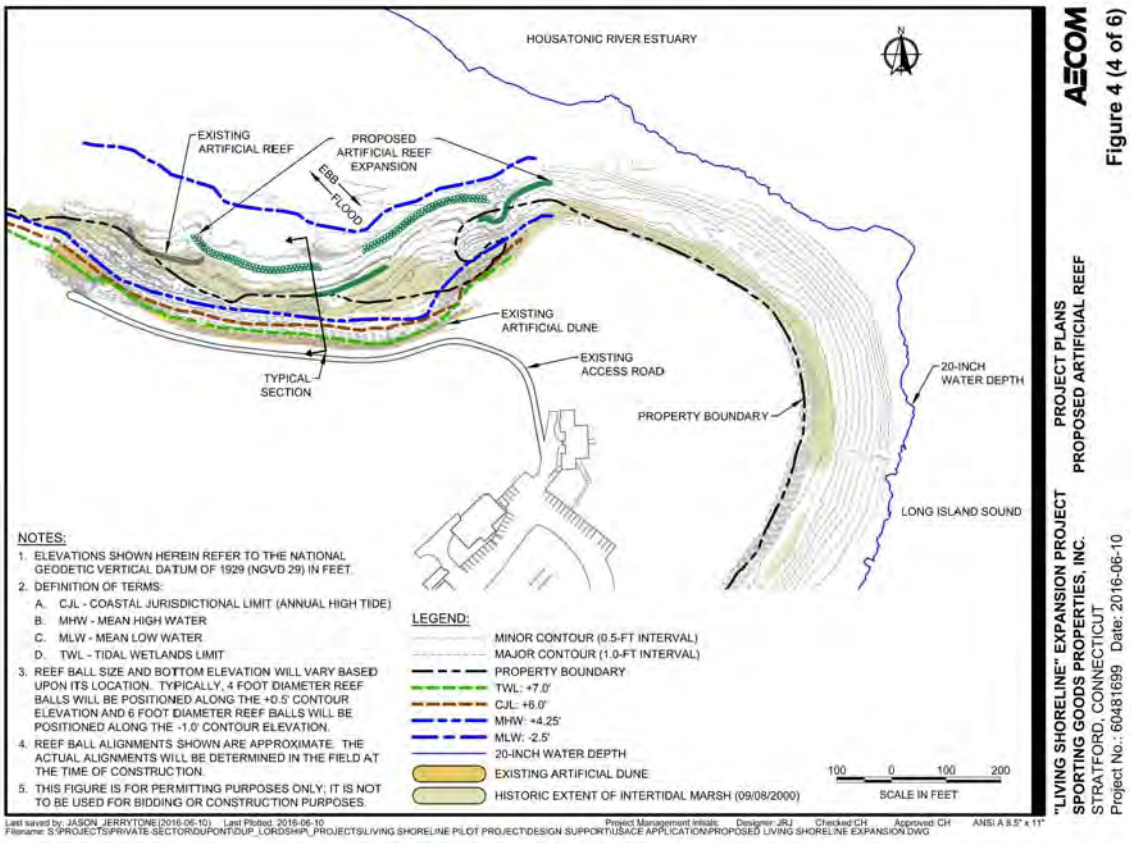
Project partners include: Sacred Heart University, Audubon CT of the National Audubon Society, the National Fish and Wildlife Foundation, and DuPont. Performance monitoring has been ongoing to examine how to expedite recovery of the interconnected habitats of an estuary and examine the sequencing of the installment of each habitat component. DuPont is in the process of securing regulatory permits and is expected to complete its own EFH assessment and submittal for the living shoreline project.

As the restored habitats mature, they are expected to become increasingly important as a migratory stop-over site for a variety of wildlife, including the monarch butterfly that has recently suffered from a dramatic population decline. It will also provide valuable shelter, stopover and wintering habitat for migratory birds, waterfowl and, most recently, snowy owls. The intertidal habitats including the reef structures and fringing marsh will become important nursery areas for fish, shellfish and other macrobenthos.

DuPont is the owner of both the existing living shoreline as well as the proposed living shoreline project. Connecticut Audubon CT continues to haze birds at the site to prevent waterfowl and other birds from potentially feeding on remnant lead shot that has been exposed following site remedial as a result of erosion and winnowing of sediments where coarser and denser sediments remain while less dense sediments are removed via winds and currents in the shallow water zone.

Figure 7: Lordship Pt North Living Shoreline Alternative

Figure 8: Lordship Pt Living Shoreline Site Conditions and Design Components



United States Department of the Interior

FISH AND WILDLIFE SERVICE

New England Field Office
70 Commercial Street, Suite 300
Concord, NH 03301-5087
http://www.fws.gov/newengland

May 12, 2017

James Turek
NOAA Restoration Center
28 Tarzwell Drive
Narragansett, RI 02882

Dear Mr. Turek:

Re: Lordship Point/Raymark NRDA Restoration, Stratford, CT

This responds to your correspondence, dated January 9, 2017, requesting our concurrence with your determination that the above referenced project may affect, but is not likely to adversely affect the federally threatened piping plover (*Charadrius melodus*) or the federally endangered roseate tern (*Sterna dougallii dougallii*), and will have no effect on the federally threatened northern long-eared bat (*Myotis septentrionalis*) or red knot (*Calidris canutus rufa*). In a follow-up email dated March 24, 2017 to Ms. Cynthia Corsair of this office, you clarified your determination for the northern long-eared bat and red knot, and requested concurrence that the project may affect, but is not likely to adversely affect these species. Your request and our response are provided in accordance with section 7 of the Endangered Species Act (87 Stat. 884, as amended; 16 U.S.C. 1531, et seq.).

The proposed project involves several restoration alternatives that will be released in a Draft Restoration Plan and Environmental Assessment by the Lordship Point and Raymark Industries Natural Resources Damage Assessment Trustees Council (Trustees), which includes representatives from the U.S. Fish and Wildlife Service (Service), the National Oceanic and Atmospheric Administration, and the Connecticut Department of Energy and Environmental Protection. The Trustees have identified a collective set of salt marsh restoration projects at the Stewart B. McKinney National Wildlife Refuge Great Meadows Unit (GMU) as the Preferred Alternative. Two Non-Preferred Alternatives will also be included for evaluation in the forthcoming Draft Restoration Plan/Environmental Assessment: 1) removal or modification of Long Beach stone groins; and 2) installation of a living shoreline along Short Beach.

The piping plover is a small shorebird that inhabits coastal beaches and associated tidal areas that provide suitable foraging and nesting habitat. The Preferred Alternative (McKinney GMU salt marsh restoration) and one of the Non-Preferred Alternatives (living shoreline) would not occur

in suitable piping plover nesting habitat, but could occur in potential foraging habitat. The project area of the second Non-Preferred Alternative (stone groin removal) does contain suitable piping plover nesting habitat. All construction activities related to the proposed marsh restoration activities will occur between September 1 and March 30, when breeding piping plovers are not anticipated to be present. If any early (March) or late (September) transient, migrating individuals stop in the action area at the time of construction, disturbance is expected to have insignificant or discountable effects.

It is unlikely that any of the project alternatives would adversely affect piping plover foraging or nesting habitat. We anticipate the marsh restoration will beneficially affect piping plovers, because all alternatives will restore the salt marsh and enhance intertidal and subtidal habitats and the associated benthic community. Although the stone groin removal may occur in marginal piping plover nesting habitat, we understand that the beach habitat will be returned to the original configuration. For these reasons, we concur with your determination that the projects may affect, but are not likely to adversely affect the piping plover.

The roseate tern is exclusively marine, usually breeding on small islands, and rarely on sand dunes at the ends of barrier beaches. During the breeding season (April to July), they forage over shallow bays, tidal inlets and channels, tide-rips and sandbars over which tidal currents run rapidly. None of the three alternatives' project areas contain suitable roseate tern nesting or foraging habitat. During pre-migratory staging in August and September, roseate terns feed over coastal waters between Long Island, New York, and Maine. During this time, they rest and roost on islands and outer beaches. All construction activities related to these projects will occur between September 1 and March 30, when the majority of roseate terns have migrated to their wintering grounds. Almost all pre-migratory roseate terns stage off of Cape Cod and it is likely that only transient individuals may pass through the project area. If any late, transient individuals are present in the action area at the time of construction, disturbance is expected to have insignificant or discountable effects. We anticipate the marsh restoration will beneficially affect roseate terns, because all alternatives will restore the salt marsh and enhance intertidal and subtidal habitats and the associated benthic community. Therefore, we concur with your determination that the projects may affect, but are not likely to adversely affect the roseate tern.

The red knot is a highly migratory shorebird that breeds in Arctic Canada and may be present in Connecticut during spring and fall migration. Red knots are restricted to coastal and rocky shores, and often forage on mudflats along the shoreline. All three alternatives' project areas may contain suitable red knot foraging habitat. Construction activities related to these projects will occur between September 1 and March 30 when most adults and young of the year are not anticipated to be present during construction. If any late, transient migrating individuals are present in the action area at the time of construction, disturbance is expected to have insignificant or discountable effects, because there is sufficient available foraging and roosting habitat adjacent to the project area that will not be disturbed. We anticipate the marsh restoration will beneficially affect the red knot, because all alternatives will restore the salt marsh and enhance intertidal and subtidal habitats and the associated benthic community. Therefore, we concur with your determination that the projects may affect, but are not likely to adversely affect the red knot.

The northern long-eared bat is a forest-dependent species. Suitable habitat for this species is not present within the action areas of the two Non-Preferred Alternatives (stone groin removal and living shoreline). The forested areas within the Preferred Alternative (McKinney GMU salt marsh restoration) action area may support summer roosting habitat for the northern long-eared bat. The proposed restoration at this site may include the cutting of a small number of trees greater than 3" diameter at breast height. Due to the small number of trees that will be removed as a result of this project, long-term habitat impacts are not expected. In addition, given the small area of potential northern long-eared bat habitat that would be affected, the likelihood of adverse effects to the species is discountable. Therefore, we concur with your determination that the project may affect, but is not likely to adversely affect the northern long-eared bat. Further, although this project may affect the northern long-eared bat, there are no effects beyond those previously disclosed in the Service's programmatic biological opinion for the final 4(d) rule dated January 5, 2016. Any taking that may occur incidental to this project is not prohibited under the final 4(d) rule (50 CFR §17.40(o)). This project is consistent with the description of the proposed action in the programmatic biological opinion, and the 4(d) rule does not prohibit incidental take of the northern long-eared bat that may occur as a result of this project.

We suggest the Trustees implement the following voluntary conservation measures, if possible, to further avoid adverse effects to the northern long-eared bat:

1. perform northern long-eared bat surveys[1] according to the most recent Range-wide Indiana Bat/Northern Long-eared Bat Summer Survey Guidelines. Benefits from agencies voluntarily performing northern long-eared bat surveys include:
   a. surveys will help Federal agencies meet their responsibilities under section 7(a)(1) of the Endangered Species Act. The Service and partners will use the survey data to better understand habitat use and distribution of northern long-eared bats, track the status of the species, evaluate threats and impacts, and develop effective conservation and recovery actions. Active participation of Federal agencies in survey efforts will lead to a more effective conservation strategy for the northern long-eared bat;
   b. should the Service reclassify the species as endangered in the future, an agency with a good understanding of how the species uses habitat based on surveys within its action areas could inform greater flexibility under section 7(a)(2) of the Endangered Species Act. Such information could facilitate an expedited consultation and incidental take statement that may, for example, exempt taking associated with tree removal during the active season, but outside of the pup season, in known occupied habitat.

2. apply additional voluntary conservation measures, where appropriate, to reduce the impacts of activities on northern long-eared bats. Conservation measures include:

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[1] When suitable habitat for a listed species is present and effects to the species are reasonably foreseeable, the Service recommends species surveys to enable fact-specific analysis of effects and fact-specific development of conservation measures. Rather than conduct habitat and/or species surveys, a project proponent and action agency may choose to assume presence of the species. However, assuming presence usually makes the analysis of effects significantly more difficult (because the specific nature of the species' presence is not known) and can lead to the incorporation of conservation measures that might otherwise not be needed if surveys were to be conducted and the species were not to be found.

a. conduct tree removal activities outside of the northern long-eared bat pup season (June 1 to July 31) and/or the active season (April 1 to October 31). This will minimize impacts to pups at roosts not yet identified;
b. avoid clearing suitable spring staging and fall swarming habitat within a 5-mile radius of known or assumed northern long-eared bat hibernacula during the staging and swarming seasons (April 1 to May 15 and August 15 to November 14, respectively);
c. manage forests to ensure a continual supply of snags and other suitable maternity roost trees;
d. minimize use of herbicides and pesticides. If necessary, spot treatment is preferred over aerial application; and
e. participate in actions to manage and reduce the impacts of white-nose syndrome on northern long-eared bat. Actions needed to investigate and manage white-nose syndrome are described in a national plan the Service developed in coordination with other state and Federal agencies.

Further consultation with us under section 7 of the Endangered Species Act is not required. If the project plans change such that listed species or their habitats may be affected in a manner not considered in this letter, please contact us to determine if additional consultation is necessary.

Thank you for your cooperation, and please contact Ms. Corsair at (401) 213-4416 if you need any further assistance.

Sincerely yours,

Thomas R. Chapman
Supervisor
New England Field Office

cc: Reading file
D. Major, USFWS, NEFO NRDAR Program
Rick Jacobson, CTDEEP
ES: CCorsair:5-12-17:401-213-4416

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Narragansett Laboratory
Restoration Center
28 Tarzwell Drive
Narragansett, RI 02882
Phone: +1 401-782-3338
Fax: +1 401-782-3201

July 26, 2016

Alison Verkade
National Marine Fisheries Service
Office of Habitat Conservation
55 Great Republic Drive
Gloucester, MA 01930

RE: EFH Consultation Materials, Lordship Pt. and Raymark Injury Restoration, Stratford, CT

Dear Ms. Verkade:

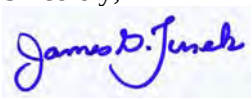
The National Oceanic and Atmospheric Administration (NOAA) Restoration Center is submitting these materials on behalf of the federal and state Trustees for the Lordship Pt. and Raymark Industries cases, requesting an Essential Fish Habitat (EFH) consultation on multiple restoration projects being considered as part of a Restoration Plan (RP) and Environmental Assessment (EA) to address natural resource injuries associated with the above-referenced Sites in Stratford, Connecticut. The forthcoming RP/EA will address injury restoration alternatives for both the Lordship Pt. and Raymark Industries contaminant release Sites. Trustees for these natural resource damages cases include NOAA, the U.S. Fish and Wildlife Service (USFWS), and the Connecticut Department of Energy and Environmental Protection (CT DEEP).

The enclosed project materials address a total of eight restoration alternatives in estuarine and marine coastal waters and tidal marshes associated with the Great Meadows Unit of the McKinney National Wildlife Refuge (NWR) and nearby Housatonic River Estuary and Long Island Sound. Six of the project alternatives (fill removal, tide gate removal, and invasive plant management) would be located within the McKinney NWR salt marshes while one would be located along Long Beach bordering Long Island Sound (stone groin removal). The final project alternative, a living shoreline project, would be located on the west side of the Housatonic River Estuary and immediately northwest of Stratford Pt.

The Trustees seek to comply with NEPA including addressing EFH for the aforementioned restoration alternatives. The enclosed materials include EFH assessment worksheets for the salt marsh restoration and groin removal projects. It is our understanding that the proponents for the living shoreline project are expected to submit their EFH assessment as a separate document. The attached materials include project narratives, figures depicting proposed project locations, and EFH materials. We anticipate that these projects will largely have beneficial impacts to EFH with adverse impacts limited to minor release of sediments, temporary increases in water column turbidity, and construction noise over a maximum 4-month period.

The Trustees appreciate your timely review of and response to these materials. Please do not hesitate to contact me, should you have questions or seek supplemental information for completing the EFH consultation and any requisite accompanying recommendations.

Sincerely,



James G. Turek
Restoration Ecologist
NOAA Restoration Center

cc:

D. Major, M. Sperduto, USFWS
R. Jacobson, CT DEEP
J. Catena, J. Shenot, NMFS

NOAA FISHERIES
GREATER ATLANTIC REGIONAL FISHERIES OFFICE
Essential Fish Habitat (EFH) Consultation Guidance
EFH ASSESSMENT WORKSHEET

Introduction:

The Magnuson-Stevens Fishery Conservation and Management Act (MSA) mandates that federal agencies conduct an essential fish habitat (EFH) consultation with NOAA Fisheries regarding any of their actions authorized, funded, or undertaken that may adversely affect EFH.
An adverse effect means any impact that reduces the quality and/or quantity of EFH. Adverse effects may include direct or indirect physical, chemical, or biological alterations of the waters or substrate and loss of, or injury to, benthic organisms, prey species and their habitat, and other ecosystem components. Adverse effects to EFH may result from actions occurring within EFH or outside of EFH and may include site-specific or habitat-wide impacts, including individual, cumulative, or synergistic consequences of actions.

This worksheet has been designed to assist in determining whether a consultation is necessary and in preparing EFH assessments. This worksheet should be used as your EFH assessment or as a guideline for the development of your EFH assessment. At a minimum, all the information required to complete this worksheet should be included in your EFH assessment. If the answers in the worksheet do not fully evaluate the adverse effects to EFH, we may request additional information in order to complete the consultation.

An expanded EFH assessment may be required for more complex projects in order to fully characterize the effects of the project and the avoidance and minimization of impacts to EFH. While the EFH worksheet may be used for larger projects, the format may not be sufficient to incorporate the extent of detail required, and a separate EFH assessment may be developed. However, regardless of format, the analysis outlined in this worksheet should be included for an expanded EFH assessment, along with additional information that may be necessary. This additional information includes:

- the results of on-site inspections to evaluate the habitat and site-specific effects
- the views of recognized experts on the habitat or the species that may be affected
- a review of pertinent literature and related information
- an analysis of alternatives to the action that could avoid or minimize the adverse effects on EFH.

Your analysis of adverse effects to EFH under the MSA should focus on impacts to the habitat for all life stages of species with designated EFH, rather than individual responses of fish species. Fish habitat includes the substrate and benthic resources (e.g., submerged

aquatic vegetation, shellfish beds, salt marsh wetlands), as well as the water column and prey species.

Consultation with us may also be necessary if a proposed action results in adverse impacts to other NOAA-trust resources. Part 6 of the worksheet is designed to help assess the effects of the action on other NOAA-trust resources. This helps maintain efficiency in our interagency coordination process. In addition, further consultation may be required if a proposed action impacts marine mammals or threatened and endangered species for which we are responsible. Staff from our Greater Atlantic Regional Fisheries Office, Protected Resources Division should be contacted regarding potential impacts to marine mammals or threatened and endangered species.

Instructions for Use:

Federal agencies must submit an EFH assessment to NOAA Fisheries as part of the EFH consultation. Your EFH assessment must include:

1) A description of the proposed action.
2) An analysis of the potential adverse effects of the action on EFH, and the managed species.
3) The federal agency's conclusions regarding the effects of the action on EFH.
4) Proposed mitigation if applicable.

In order for this worksheet to be considered as your EFH assessment, you must answer the questions in this worksheet fully and with as much detail as available. Give brief explanations for each answer.

Federal action agencies or the non-federal designated lead agency should submit the completed worksheet to NOAA Fisheries Greater Atlantic Regional Fisheries Office, Habitat Conservation Division (HCD) with the public notice or project application. Include project plans showing existing and proposed conditions, all waters of the U.S. on the project site, with mean low water (MLW), mean high water (MHW), high tide line (HTL), and water depths clearly marked and sensitive habitats mapped, including special aquatic sites (submerged aquatic vegetation, saltmarsh, mudflats, riffles and pools, coral reefs, and sanctuaries and refuges), hard bottom habitat areas and shellfish beds, as well as any available site photographs.

For most consultations, NOAA Fisheries has 30 days to provide EFH conservation recommendations once we receive a complete EFH assessment. Submitting all necessary information at once minimizes delays in review and keeps review timelines consistent. Delays in providing a complete EFH assessment can result in our consultation review period extending beyond the public comment period for a particular project.

The information contained on the HCD website (http://www.greateratlantic.fisheries.noaa.gov/habitat/) will assist you in completing this worksheet. The HCD website contains information regarding: the EFH consultation process; Guide to EFH Designations which provides a geographic species list; Guide to EFH Species Descriptions which provides the legal description of EFH as well as important ecological information for each species and life stage; and other EFH reference documents including examples of EFH assessments and EFH consultations.

Our website also includes a link to the NOAA EFH Mapper (http://www.habitat.noaa.gov/protection/efh/efhmapper/index.html). We would note that the EFH Mapper is currently being updated and revised. Should you use the EFH Mapper to identify federally managed species with designated EFH in your project area, we recommend checking this list against the Guide to Essential Fish Habitat Designations in the Northeast (http://www.greateratlantic.fisheries.noaa.gov/hcd/index2a.htm) to ensure a complete and accurate list is provided.

EFH ASSESSMENT WORKSHEET FOR FEDERAL AGENCIES (modified 3/2016)

PROJECT NAME: Injury restoration, Lordship Pt and Raymark damage settlements

DATE: July 2016

PROJECT NO.:

LOCATION (Water body, county, physical address): Long Island Sound, Housatonic River and Bridgeport Harbor, Stewart McKinney NWR, Long Beach, off Lordship Boulevard, Stratford, CT

PREPARER: James Turek, Restoration Ecologist, NMFS RC

Step 1: Use the Habitat Conservation Division EFH webpage's Guide to Essential Fish Habitat Designations in the Northeastern United States to generate the list of designated EFH for federally-managed species for the geographic area of interest (http://www.greateratlantic.fisheries.noaa.gov/hcd/index2a.htm). Use the species list as part of the initial screening process to determine if EFH for those species occurs in the vicinity of the proposed action. The list can be included as an attachment to the worksheet. Make a preliminary determination on the need to conduct an EFH consultation.

1. INITIAL CONSIDERATIONS		
EFH Designations	**Yes**	**No**
Is the action located in or adjacent to EFH designated for eggs? **List the species:** winter flounder, windowpane flounder	X	
Is the action located in or adjacent to EFH designated for larvae? **List the species:** winter flounder, windowpane flounder, winter skate, little skate	X	
Is the action located in or adjacent to EFH designated for juveniles? **List the species:** winter flounder, windowpane flounder, winter skate, little skate	X	

Is the action located in or adjacent to EFH designated for adults or spawning adults? **List the species:** winter flounder, windowpane flounder, silver and red hakes	X	
If you answered no to all questions above, then EFH consultation is not required - go to Section 5. If you answered yes to any of the above questions proceed to Section 2 and complete remainder of the worksheet.		

Step 2: In order to assess impacts, it is critical to know the habitat characteristics of the site before the activity is undertaken. Use existing information, to the extent possible, in answering these questions. Identify the sources of the information provided and provide as much description as available. These should not be yes or no answers. Please note that there may be circumstances in which new information must be collected to appropriately characterize the site and assess impacts. Project plans that show the location and extent of sensitive habitats, as well as water depths, the HTL, MHW and MLW should be provided.

2. SITE CHARACTERISTICS

Site Characteristics	Description
Is the site intertidal, sub-tidal, or water column?	McKinney NWR sites are intertidal marsh and mud flats; The Long Beach sites are both inter- and sub-tidal habitats.
What are the sediment characteristics?	McKinney NWR marsh sites are peat and inorganic sand and gravel; Long Beach and Lordship Pt. sites are sand, gravel and shell fragment substrates
Is there submerged aquatic vegetation (SAV) at or adjacent to project site? If so describe the SAV species and spatial extent.	SAVs are not present at the sites
Are there wetlands present on or adjacent to the site? If so, describe the spatial extent and vegetation types.	McKinney NWR sites include *Spartina*-dominated and *Phragmites*-dominated marsh. Proposed work would beneficially affect these marshes
Is there shellfish present at or adjacent to the project site? If so, please describe	American oyster, hard clam and soft clam are present in tidal marsh channels and nearby waters

the spatial extent and species present.	These species may be locally abundant, but species abundance has not been quantified
Are there mudflats present at or adjacent to the project site? If so please describe the spatial extent.	Mudflats are present within intertidal marsh creek channels in the McKinney NWR
Is there rocky or cobble bottom habitat present at or adjacent to the project site? If so, please describe the spatial extent.	Unlikely; there may be localized cobble and shell areas in the proximity of the Long Beach groin sites
Is Habitat Area of Particular Concern (HAPC) designated at or near the site? If so for which species, what type habitat type, size, characteristics?	No
What is the typical salinity, depth and water temperature regime/range?	Full salinity seawater and brackish water; depths <5 ft MLW, temperatures <4 degrees C to >20 C
What is the normal frequency of site disturbance, both natural and man-made?	McKinney NWR marshes have been affected by past disposal of dredged soils; Long Beach shoreline has been affected by seven stone groins
What is the area of proposed impact (work footprint & far afield)?	Potential McKinney NWR marsh restoration areas may affect up to 30 acres with fill removal, marsh channel reconstruction, and plant management groin removals would affect up to 0.8 acres

Step 3: This section is used to describe the anticipated impacts from the proposed action on the physical/chemical/biological environment at the project site and areas adjacent to the site that may be affected.

Impacts	Y	N	Description
Nature and duration of activity(s). Clearly describe the activities proposed and the duration of any disturbances.			Soil excavation and grading for wetland restoration is expected to occur over an estimated 4-6-month period. Soil erosion BMPs will be deployed to minimize release of soils to nearby wetlands. Removal of stone groins to restore intertidal flats and sub-tidal waters would be expected to occur over a 1-2-month period.
Will the benthic community be disturbed? If no, why not? If yes, describe in detail how the benthos will be impacted.	X		Short-term, temporary benthic habitat impacts are expected to occur if the Long Beach groins are removed. Large stones would be removed by large crane, causing minor sediment releases but would quickly dissipate with presence of longshore currents.
Will SAV be impacted? If no, why not? If yes, describe in detail how the SAV will be impacted. Consider both direct and indirect impacts. Provide details of any SAV survey conducted at the site.		X	Eelgrass and other SAV species are not found in the project area. A follow-up survey will be completed in summer 2016 to verify current habitat conditions.
Will salt marsh habitat be impacted? If no, why not? If yes, describe in detail how wetlands will be impacted. What is the aerial extent of the impacts? Are the effects temporary or permanent?	X		McKinney NWR marsh will be beneficially affected by removing fill from the marsh plain or constructing tidal channels in the marsh to restore tidal exchange and marsh health. The beneficial impacts total up to 20 acres depending on the alternatives selected for injury restoration implementation.
Will mudflat habitat be impacted? If no, why not? If yes, describe in detail how mudflats will be impacted. What is the aerial extent of the impacts? Are the effects temporary or permanent?		X	Mudflats are present within the McKinney NWR Great Marsh Unit but will not be substantially affected by the proposed restoration. Minor temporary releases of sediment to mudflats may occur during the construction but would be localized and of short-term duration. Increasing tidal exchange in Alternative 5 would enhance mudflat and water column conditions in the pond.
Will shellfish habitat be impacted? If so, provide in detail how the shellfish habitat will be impacted. What is the aerial extent of the impact?		X	Shellfish including hard clam and American oyster would be beneficially affected by the removal of the Long Beach groins. Marsh restoration within the McKinney NWR Great Marsh Unit is inhabited by oyster, hard clam and soft clam although no significant adverse impacts and minor beneficial impacts are expected.

Provide details of any shellfish survey conducted at the site.			No recent shellfish surveys have been completed at the project sites, other than field observations documenting species presence (e.g., oyster in the marsh creeks, hard clam in the sub-tidal waters near the groin sites).
Will hard bottom (rocky, cobble, gravel) habitat be impacted at the site? If so, provide in detail how the hard bottom will be impacted. What is the aerial extent of the impact?		X	Sand and gravel substrate could be beneficially affected by the Long Beach groin removals.
Will sediments be altered and/or sedimentation rates change? If no, why not? If yes, describe how.	X		Longshore sediment transport would be beneficially affected if one or more groins are removed from the Long Beach shoreline. Marsh sediments would benefit at McKinney NWR with fill removal.
Will turbidity increase? If no, why not? If yes, describe the causes, the extent of the effects, and the duration.	X		Temporary increases in turbidity may result from soil excavation and channel reconstruction at the McKinney NWR. Short-term turbidity may also be expected with the groin removals but water column conditions would return to baseline within hours of groin removal.
Will water depth change? What are the current and proposed depths?	X		Diurnal tidal flooding of the restored marsh would increase if fill is removed from the McKinney NWR marshes. Removal of the flap gate for Alternative 5 would restore diurnal tidal exchange to the pond.
Will contaminants be released into sediments or water column? If yes, describe the nature of the contaminants and the extent of the effects.		X	No contaminated sediments are expected to be released to the water column.
Will tidal flow, currents, or wave patterns be altered? If no, why not? If yes, describe in detail how.	X		Tidal flow will increase in the McKinney NWR marshes if fill soils are removed and normal diurnal tidal exchange occurs to restore healthy *Spartina*-dominated salt marsh. Alternative 5 with flap gate removal will increase tidal exchange to the pond.
Will ambient salinity or temperature regime change? If no, why not? If yes, describe in detail how and the effects of the change.	X		Salinity and temperature would likely change only with Alternative 5 and tidal exchange restoration in the pond. Salinity would increase while water temperatures would likely seasonally decrease with tidal inflows.

Will water quality be altered? If no, why not? If yes, describe in detail how. If the effects are temporary, describe the duration of the impact.	X		Water quality would improve in the pond with implementation of Alternative 5. Normal diurnal tidal exchange would result if the flap gate is removed from the pond, increasing dissolved oxygen levels.
Will ambient noise levels change? If no, why not? If yes, describe in detail how. If the effects are temporary, describe the duration and degree of impact.	X		Temporary construction noise is expected to be generated by trucks and other equipment as well as by laborers working at the site. The work period would likely be a maximum of four months, depending on the number of sites implemented, and work would likely occur during the fall and winter seasons.
Does the action have the potential to impact prey species of federally managed fish with EFH designations?	X		The proposed projects are expected to have largely beneficial impacts to prey species such as Atlantic silverside, mummichog, striped killifish which use salt marshes and shallow subtidal habitats for foraging, cover and spawning.

Step 4: This section is used to evaluate the consequences of the proposed action on the functions and values of EFH as well as the vulnerability of the EFH species and their life stages. Identify which species (from the list generated in Step 1) will be adversely impacted from the action. Assessment of EFH impacts should be based upon the site characteristics identified in Step 2 and the nature of the impacts described within Step 3. The Guide to EFH Descriptions webpage (http://www.greateratlantic.fisheries.noaa.gov/hcd/list.htm) should be used during this assessment to determine the ecological parameters/preferences associated with each species listed and the potential impact to those parameters.

4. EFH ASSESSMENT			
Functions and Values	**Y**	**N**	**Describe habitat type, species and life stages to be adversely impacted**
Will functions and values of EFH be impacted for:			
Spawning **If yes, describe in detail**		X	Winter flounder and window pane flounder spawning habitat would be beneficially restored with removal of the stone groins. Groin removals and marsh restoration

how, and for which species. Describe how adverse effects will be avoided and minimized.			activities would only occur during non-spawning periods of these species.
<u>Nursery</u> **If yes, describe in detail how and for which species. Describe how adverse effects will be avoided and minimized.**	X		Juvenile winter and windowpane flounder and winter and little skate may be expected to use the sub-tidal waters along Long Beach and tidal marsh creeks in McKinney NWR. Sediment controls BMPs will be employed with soil excavation to restore tidal marshes and creeks. Removal of stone from the groins may temporarily increase localized turbidity in the water column; no significant impacts to these juvenile fishes would be expected.
<u>Forage</u> **If yes, describe in detail how and for which species. Describe how adverse effects will be avoided and minimized.**	X		As similarly noted above, forage fishes may be expected to use the sub-tidal waters along Long Beach and tidal marsh creeks in McKinney NWR. Sediment controls BMPs will be employed with soil excavation to restore tidal marshes and creeks. Removal of stone from the groins may temporarily increase localized turbidity in the water column; no significant impacts to these juvenile fishes would be expected.
<u>Shelter</u> **If yes, describe in detail how and for which species. Describe how adverse effects will be avoided and minimized.**	X		Fishes may be expected to use the sub-tidal waters at and near the Long Beach groins; and marshes and creeks in McKinney NWR. Sediment controls BMPs will be employed with soil excavation to restore tidal marshes and creeks. Removal of stone from the groins may eliminate cover habitat for fishes, and would be expected to avoid disturbances and relocate to nearby habitats.
Will impacts be temporary or permanent? Describe the duration of the impacts.			Most of the impacts described herein would be temporary, limited to a construction period of 3-4 months. Removal of one or more stone groins would be permanent loss of cover habitat but would result in offsetting foraging habitat for other fish species.
Will compensatory mitigation be used? If no, why not? Describe plans for mitigation and how this will offset impacts to EFH. Include a conceptual compensatory mitigation plan, if applicable.		X	The purpose of the proposed projects is to restore and compensate for contaminant injuries to estuarine fishes and macrobenthos. The intent of the projects is to compensate for interim losses and injuries resulting from the Lordship Pt. damage settlement and Raymark bankruptcy agreement where contaminant releases adversely affected estuarine fishes including EFH species and benthic invertebrates.

Step 5: This section provides the federal agency's determination on the degree of impact to EFH from the proposed action. The EFH determination also dictates the type of EFH consultation that will be required with NOAA Fisheries.

Please note: if information provided in the worksheet is insufficient to allow NOAA Fisheries to complete the EFH consultation additional information will be requested.

5. DETERMINATION OF IMPACT

	/	Federal Agency's EFH Determination
Overall degree of adverse effects on EFH (not including compensatory mitigation) will be: **(check the appropriate statement)**		**There is no adverse effect on EFH or no EFH is designated at the project site.** **EFH Consultation is not required**
	X	**The adverse effect on EFH is not substantial.** **This means that the adverse effects are either no more than minimal, temporary, or that they can be alleviated with minor project modifications or conservation recommendations.** **This is a request for an abbreviated EFH consultation.**
		The adverse effect on EFH is substantial. **This is a request for an expanded EFH consultation**

Step 6: Consultation with NOAA Fisheries may also be required if the proposed action results in adverse impacts to other NOAA-trust resources, such as anadromous fish, shellfish, crustaceans, or their habitats as part of the Fish and Wildlife Coordination Act Some examples of other NOAA-trust resources are listed below. Inquiries regarding potential impacts to marine mammals or threatened/endangered species should be directed to NOAA Fisheries' Protected Resources Division.

6. OTHER NOAA-TRUST RESOURCES IMPACT ASSESSMENT	
Species known to occur at site (list others that may apply)	**Describe habitat impact type (i.e., physical, chemical, or biological disruption of spawning and/or egg development habitat, juvenile nursery and/or adult feeding or migration habitat). Please note, impacts to federally listed species of fish, sea turtles, and marine mammals must be coordinated with the GARFO Protected Resources Division.**
alewife	Possible juvenile use of McKinney NWR marshes and Long Beach
American eel	Possible juvenile use of McKinney NWR marshes and Long Beach
American shad	
Atlantic menhaden	Possible juvenile use of McKinney NWR marshes and Long Beach sub-tidal waters
blue crab	Juvenile and adults may use McKinney NWR marshes and Long Beach sub-tidal waters
blue mussel	
blueback herring	Possible juvenile use of McKinney NWR marshes and Long Beach
eastern oyster	Present in low densities in McKinney NWR marsh creeks and Long Beach sub-tidal waters
horseshoe crab	Adults may use Long Beach sub-tidal waters and to a limited extent, McKinney NWR tidal creeks
quahog	Present in McKinney NWR marsh creeks and Long Beach sub-tidal waters
soft-shell clams	Present in McKinney NWR marsh creeks
striped bass	Juvenile and adults may use McKinney NWR marsh creeks and Long Beach sub-tidal waters
other species:	Juvenile black sea bass and summer flounder may seasonally use the nearshore waters along Long Beach as foraging and cover habitat

Useful Links

National Wetland Inventory Maps
http://www.fws.gov/wetlands/

EPA's National Estuaries Program
http://www.epa.gov/nep/information-about-local-estuary-programs

Northeast Regional Ocean Council (NROC) Data Portal
http://www.northeastoceandata.org/

Mid-Atlantic Regional Council on the Ocean (MARCO) Data Portal
http://portal.midatlanticocean.org/

Resources by State:

Maine
Eelgrass maps
http://www.maine.gov/dmr/rm/eelgrass/
Maine Office of GIS Data Catalog
http://www.maine.gov/megis/catalog/
Casco Bay Estuary Partnership
http://www.cascobayestuary.org/
Maine GIS Stream Habitat Viewer
http://mapserver.maine.gov/streamviewer/index.html

New Hampshire
New Hampshire's Statewide GIS Clearinghouse, NH GRANIT
http://www.granit.unh.edu/
New Hampshire Coastal Viewer
http://www.granit.unh.edu/nhcoastalviewer/

Massachusetts
Eelgrass maps
http://maps.massgis.state.ma.us/images/dep/eelgrass/eelgrass_map.htm
MADMF Recommended Time of Year Restrictions Document
http://www.mass.gov/eea/docs/dfg/dmf/publications/tr-47.pdf
Massachusetts Bays National Estuary Program
http://www.mass.gov/eea/agencies/mass-bays-program/
Buzzards Bay National Estuary Program
http://buzzardsbay.org/
Massachusetts Division of Marine Fisheries
http://www.mass.gov/eea/agencies/dfg/dmf/
Massachusetts Office of Coastal Zone Management
http://www.mass.gov/eea/agencies/czm/

Rhode Island
Eelgrass maps
http://www.savebay.org/file/2012_Mapping_Submerged_Aquatic_Vegetation_final_report_4_2013.pdf
Narraganset Bay Estuary Program

http://www.dem.ri.gov/programs/benviron/water/wetlands/wetldocs.htm
Rhode Island Division of Marine Fisheries
http://www.dem.ri.gov/
Rhode Island Coastal Resources Management Council
http://www.crmc.ri.gov/

Connecticut
Eelgrass Maps
https://www.fws.gov/northeast/ecologicalservices/pdf/wetlands/2012_CT_Eelgrass_Final_Report_11_26_2013.pdf
Long Island Sound Study
http://longislandsoundstudy.net/
CT GIS Resources
http://www.ct.gov/deep/cwp/view.asp?a=2698&q=323342&deepNav_GID=1707 CT
DEEP Office of Long Island Sound Programs and Fisheries
http://www.ct.gov/deep/
CT Bureau of Aquaculture Shellfish Maps
http://www.ct.gov/doag/cwp/view.asp?a=3768&q=451508&doagNav=
CT River Watershed Council
http://www.ctriver.org/

New York
Eelgrass report
http://www.dec.ny.gov/docs/fish_marine_pdf/finalseagrassreport.pdf
Peconic Estuary Program
http://www.peconicestuary.org/
NY/NJ Harbor Estuary
http://www.harborestuary.org/

New Jersey
Submerged Aquatic Vegetation mapping
http://crssa.rutgers.edu/projects/coastal/sav/
Barnegat Bay Partnership
http://bbp.ocean.edu/pages/1.asp

Delaware
Partnership for the Delaware Estuary
http://www.delawareestuary.org/
Center for Delaware Inland Bays
http://www.inlandbays.org/

Maryland
Submerged Aquatic Vegetation mapping
http://data.imap.maryland.gov/datasets/da64df6bd4124ce9989e6c186a7906a7_0
MERLIN
http://geodata.md.gov/imaptemplate/?appid=a8ec7e2ff4c34a31bc1e9411ed8e7a7e
Maryland Coastal Bays Program
http://www.mdcoastalbays.org/

Virginia
Submerged Aquatic Vegetation mapping
http://web.vims.edu/bio/sav/maps.html

Lordship Pt. and Raymark Industries
Natural Resources Injury Restoration
Stratford, CT
Summary of Project Alternatives
July 2016

The purpose of the proposed restoration action is to compensate the public for injury and losses to natural resources in estuarine waters within Stratford, Connecticut caused by the release of hazardous substances from the Lordship Pt. and Raymark Industries Sites. Compensatory restoration actions are needed to restore lost natural resources, and the services provided by those resources, in the past and into the future.

McKinney NWR Great Meadows Unit (GMU), Salt Marsh Restoration

Marsh Restoration Project Goals:

1. Restore salt marsh communities to provide estuarine fishery habitat and other ecological functions and services
2. Enhance disturbed wetland and bordering coastal upland habitats to provide greater ecological functions and services

Project Objectives:

1. Restore salt marsh community types including both low marsh dominated by smooth cordgrass (*Spartina alterniflora*) and high marsh dominated by salt hay (*S. patens*), salt grass (*Distichlis spicata*) and other species
2. Avoid or minimize adverse impacts to existing wetlands
3. Protect or restore state-listed marsh pink (*Sabatia stellaris*) habitat and marsh pink populations
4. Protect or enhance state-listed northern diamondback terrapin (*Malaclemys t. terrapin*) nesting habitat
5. Maintain or enhance forested and scrub-shrub habitat for songbirds
6. Restore or enhance salt marsh habitat for state-listed saltmarsh sparrow (*Ammodramus caudacutus)* and seaside sparrow (*A. maritimus*)
7. Maintain and enhance native communities by controlling invasive vegetation
8. Control salt marsh mosquito production
9. Maintain or improve public access and education
10. Provide marsh research opportunities and project performance monitoring

Marsh Restoration Project Alternatives:

1. **Alternative 1: Tidal Connection to Ponds and Marsh Creation –** Two ponds and existing wet *Phragmites* totaling ~3.7 acres would be connected to existing intertidal creek channels to provide regular tidal exchange. The work would involve the construction of two connecting channels by excavating and grading ~280 feet of intertidal channel to connect the ponds with nearby salt marsh creeks. The freshwater ponds would be

converted to intertidal marsh habitat dominated by smooth cordgrass. This alternative would minimize impacts to and enhance terrapin nesting habitat along the existing sandy, man-made berm. Foot access along the berm could be maintained but limited to avoid secondary impacts to terrapin nesting habitat. Marsh elevations and hydrology affecting the habitat between and along the perimeter of the two ponds would be restored to provide marsh pink habitat in the restored high marsh area between the two ponds. This alternative may also include marsh pink propagation and planting program with oversight by CT DEEP.

2. **Alternative 2: 6.5-Acre Fill Removal and Channel Construction –** Targeted fill removal and channel construction would occur in a tidally-restricted and filled area southeast of the GMU parking lot and east of Alternative 1. Channel construction is needed in the poorly drained, *Phragmites*-dominated southern portion of this area to provide regular tidal exchange and fish access, and to also address the significant production of nuisance mosquitoes (The berm restricts tidal exchange, making the site favorable to producing hordes of salt marsh mosquitoes). Fill removal (~1.5 acres) would occur in the northern portion of this area along with perimeter berm removal to restore to high and low marsh elevations. Target marsh elevations would be ~4.5-5.0 ft NGVD to provide mix of high and low marsh communities. Existing marsh with documented marsh pink populations would be protected or enhanced by the proposed work. This alternative may also include marsh pink propagation and planting program. Excavated fill would be placed in targeted areas to minimize existing wetland impacts and protect or enhance existing forested and/or scrub-shrub habitat used by songbirds along the western border of this area.

3. **Alternative 3: 5.6-Acre Channel Construction and Berm Removal –** Targeted fill removal (~2.5 acres) at berms and construction of channels are proposed east and southeast of Alternative 2. The focus of this work would be channel construction to improve regular tidal exchange at the existing poorly-drained low marsh (and to eliminate mosquito production, as described above); removal of perimeter berm to provide marsh plain tidal sheet flow; and cleaning and/or repair of an existing culvert under the GMU public walking trail to enhance tidal exchange via the culvert. Additional tidal channel connections would be tied into previously excavated channels to the west of this site. Target marsh elevations would be ~4.5-5.0 ft NGVD to provide mix of high and low marsh communities. This alternative could also include marsh pink propagation and planting program. As part of this alternative, minor grade increases in the existing foot-access trail would be provided to maintain public access. Excavated fill soils would be strategically placed in on-site uplands or disposed of off-site.

4. **Alternative 4: 2.2-Acre Fill Removal –** Greater fill removal (up to ~5-foot fill cut) would occur to restore low and high marsh immediately north of Alternative 3 and west of the man-made pond. Target marsh elevations would be ~4.5-5.0 ft NGVD to provide mix of high and low marsh communities. Channels would also be excavated as a component of

this alternative with connection into previously excavated channels to the west of this site. This alternative could also include marsh pink propagation and planting program. Excavated fill soils would be strategically placed in on-site uplands or disposed of off-site.

5. **Alternative 5: Enhance 1.75-Acre Tidal Pond Hydrology –** This alternative would be to remove and modify the existing defunct flap gate on the culvert discharging flows from the man-made pond. The existing flap gate has a corroded hole in the structure. The flap gate would be removed, and tidal flow would be established provided impacts to up-gradient infrastructure would not be adversely affected. Alternatively, a tide gate or managed weir (AgriDrain water control structure or equivalent) would be installed to allow increased, regular tidal exchange with the pond, but limit tidal flooding to prevent flooding of up-gradient industrial warehouses and infrastructure(to be further assessed). USFWS GMU staff would be required to manage and maintain the structure, following an operation and maintenance plan that would be developed as part of this alternative. This alternative would enhance tidal habitat conditions within the ~1.75-acre shallow-water pond and potentially affect additional surrounding marsh area bordering the pond.

6. **Alternative 6: Invasive Plant Mowing/Cutting and Herbicide Management –** Areas within the GMU and located within or bordering the previously described project alternatives are adversely affected by common reed (*Phragmites australis*), Russian olive (*Elaeagnus angustifolia*) and other non-native, invasive plant species. The invasive plant control would be accomplished by one or more mowings of common reed, cutting of Russian olive, and one or more herbicide applications to control these plants. Work would be completed by experienced and licensed pesticide applicators and restoration specialists contracted through CT DEEP or USFWS. A total of up to 10 acres of the GMU would be addressed by this alternative, and be carried out over a 5+-year period.

Accomplishing project goals will require working collaboratively with the USFWS McKinney NWR and other stakeholders to manage for trust species and to strive to achieve regional habitat restoration goals. Any and all combinations of the alternatives are being considered, and will be presented in a Restoration Plan (RP) and Environmental Assessment (EA) released to the public for review and comment. The number and extent of the alternatives that are implemented will be commensurate with the level of funding needed for projected work activities and a contingency for unanticipated work items, and the amount of available funding.

Long Beach Groin Removal

Project Goals:

1. Restore sub-tidal and intertidal marine/estuarine habitat providing fish and macro-benthic habitats and other ecological functions and services
2. Restore natural coastal sediment transport process

Project Objectives:

1. Remove up to seven stone groins to restore natural sub-tidal waters and benthic community
2. Allow natural sediment transport along Long Beach to restore a naturally functioning coastal shoreline
3. Provide coastal geology research opportunities and project performance monitoring

Alternative 7: Stone Groin(s) Removal

The project site is along the Long Beach barrier beach bordering Long Island Sound, with Lewis Gut on the backside of this barrier beach. The site is located south of the McKinney GMU, and site access is off Oak Bluff Avenue, with public access to the beach system. A town-owned parking lot is situated immediately north of the two easternmost groins. West Beach Drive and multiple residences are located east of Long Beach. The project would consist of the removal of up to seven stone groins located along Long Island Sound and beachfront. A total of 0.8 acres of subtidal and intertidal habitat would be restored with the removal of all seven groins. Removal of the groins would restore unimpeded longshore transport of coastal sediments. One consideration in the removal of the groins would to remove and place the stone on a barge, and to then relocate and reuse the stone for coastal habitat restoration at a nearby site. Higher project costs would result if the rock is disposed of and would require truck transport to approval disposal site. An estimated 8,500 CY of large rock would be excavated if all seven groins are removed.

Lordship Pt. North Living Shoreline

Project Goals:

1. Restore salt marsh and enhance intertidal and sub-tidal habitats and benthic community
2. Increase ecological resiliency of coastal habitats

Project Objectives:

1. Restore smooth cordgrass and salt hay fringe marsh
2. Enhance intertidal and sub-tidal habitats by establishing hard substrates benefiting Eastern oyster (*Crassostrea virginica*) community
3. Provide coastal geology research opportunities and project performance monitoring
4. Increase coastal resiliency by abating wave energies, minimizing vertical intertidal and horizontal erosion, and allow for sediment deposition to protect bordering upland coastal habitat for songbirds and other wildlife

Alternative 8: Installation of Living Shoreline

The 27.8-acre Lordship Pt. project site is located on the northwest shore of Stratford Pt. and the west side of the Housatonic River estuary. The project, proposed by DuPont and its project

partners, would include: (1) sub-title reef ball installation; (2) intertidal reef ball installation; (3) low marsh fringe restoration; and (4) high marsh fringe.

The proposed living shoreline reef will consist of four individual segments oriented parallel to the existing shoreline; segments will range in length from approximately 150 to 250 ft with overlapping ends to reduce edge effects and associated scour, which has been observed at the periphery of the pilot project (See description, below). Overlap will be achieved by having two segments located closer to shore and two segments further from shore.

Segments are proposed to facilitate tidal exchange in the intertidal marsh that will be established landward of the reef. Segments closer to shore will be located approximately 100 ft seaward of MHW, corresponding to the ~+0.5-ft bathymetric contour. This elevation generally corresponds to the historical seaward extent of the marsh at the site. Seaward reef segments will be located approximately 175 ft seaward of MHW, generally corresponding to the -1.0 ft bathymetric contour. Far-shore segments will be approximately 250 ft in length and will be constructed of two rows of reef balls approximately 6 ft in diameter and 4.5 ft in height; this design will result in a far-shore reef crest height consistent with the near-shore segments.

The target wave attenuation for the proposed artificial reef is between 40% and 60% for a 2-year return storm. The intertidal marsh is also expected to attenuate wave forces and increase the sediment stability.

Both low and high marsh will be established landward of the reef balls using transplants of locally-obtained *Spartina* plants, or purchase of plants from regional commercial nursery providing plants of local genotype.

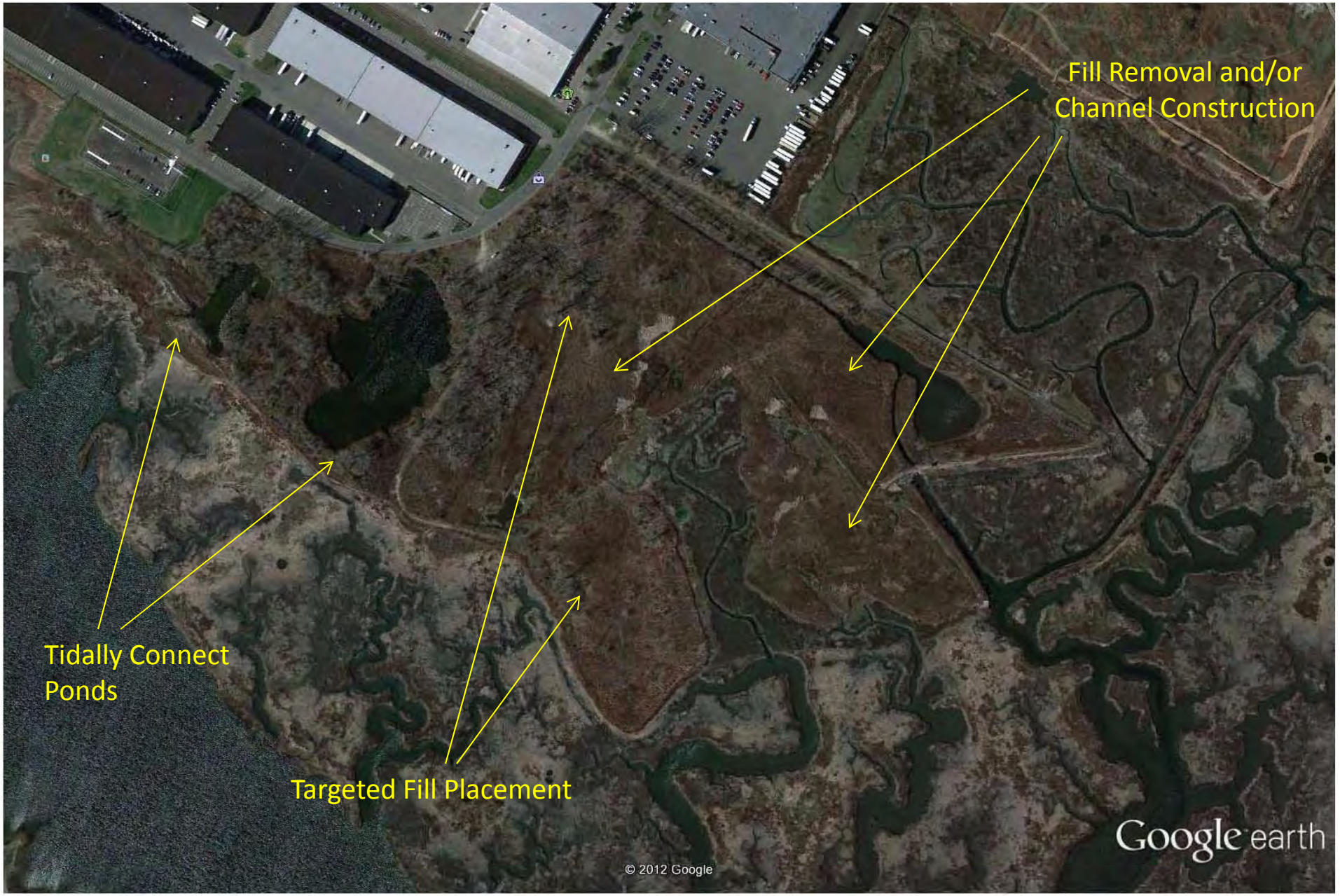
A pilot project was previously completed by DuPont at the site. In May 2014, the project partners installed 64 cement Reef Balls™ each 1m high by 1.2m wide (3ft X 4ft) in two equal length rows of 160 ft and 8-ft width. The reef was placed in the intertidal zone approximately 100 ft seaward from the high tide line as a means to abate wave energy, allow for sediment deposition, and protect transplanted smooth cordgrass. Approximately 3 linear feet of scour protection, consisting of 2- to 3-inch median diameter stone, approximately four to six inches deep, was placed adjacent to and seaward of the artificial reef.

Project partners include: Sacred Heart University, Audubon CT of the National Audubon Society, the National Fish and Wildlife Foundation, and DuPont. Performance monitoring has been ongoing to examine how to expedite recovery of the interconnected habitats of an estuary and examine the sequencing of the installment of each habitat component. DuPont is in the process of securing regulatory permits and is expected to complete its own EFH assessment and submittal for the living shoreline project.

As the restored habitats mature, they are expected to become increasingly important as a migratory stop-over site for a variety of wildlife, including the monarch butterfly that has recently suffered from a dramatic population decline. It will also provide valuable shelter,

stopover and wintering habitat for migratory birds, waterfowl and, most recently, snowy owls. The intertidal habitats including the reef structures and fringing marsh will become important nursery areas for fish, shellfish and other macrobenthos.

DuPont is the owner of both the existing living shoreline as well as the proposed living shoreline project. Connecticut Audubon CT continues to haze birds at the site to prevent waterfowl and other birds from potentially feeding on remnant lead shot that has been exposed following site remedial as a result of erosion and winnowing of sediments where coarser and denser sediments remain while less dense sediments are removed via winds and currents in the shallow water zone.



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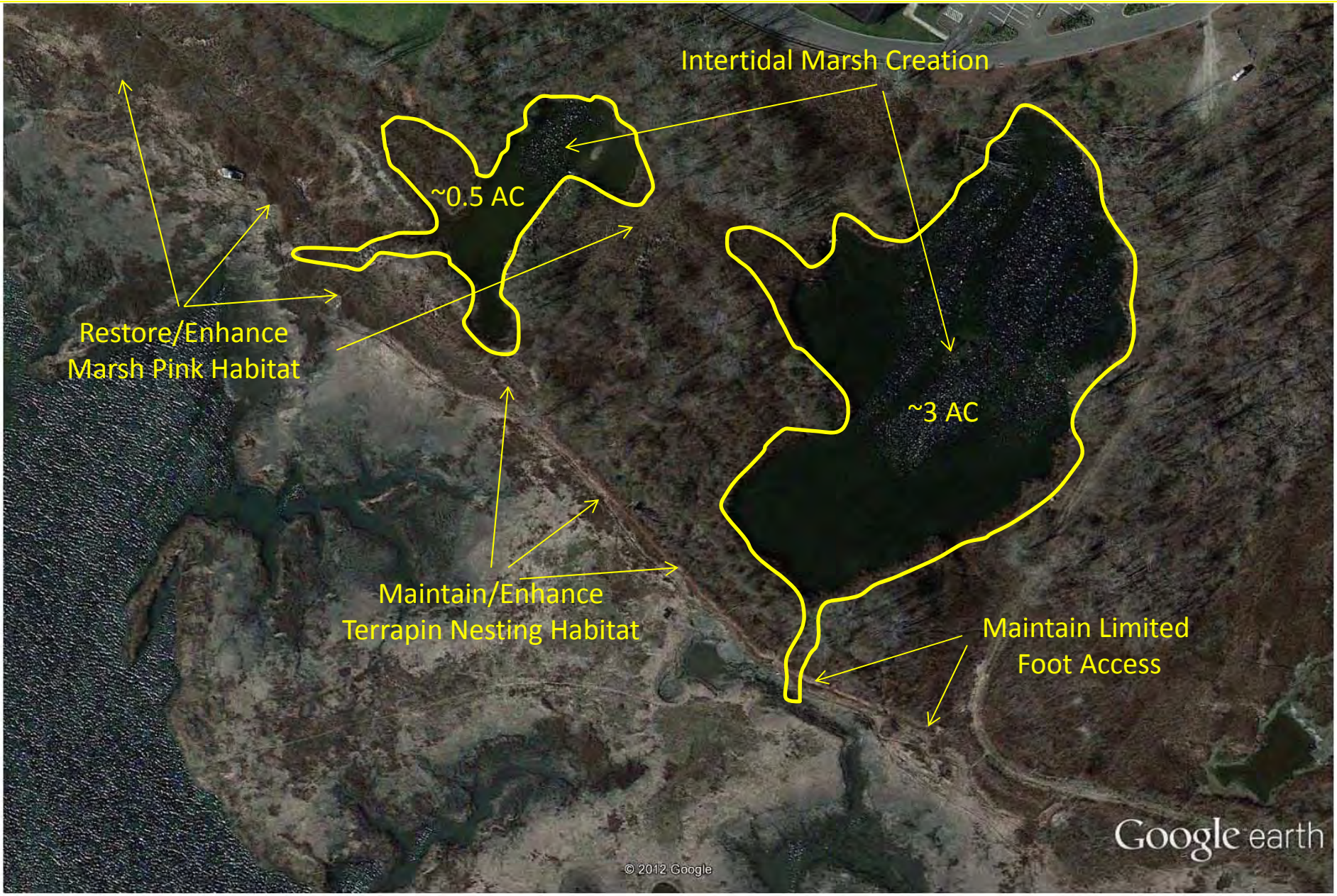

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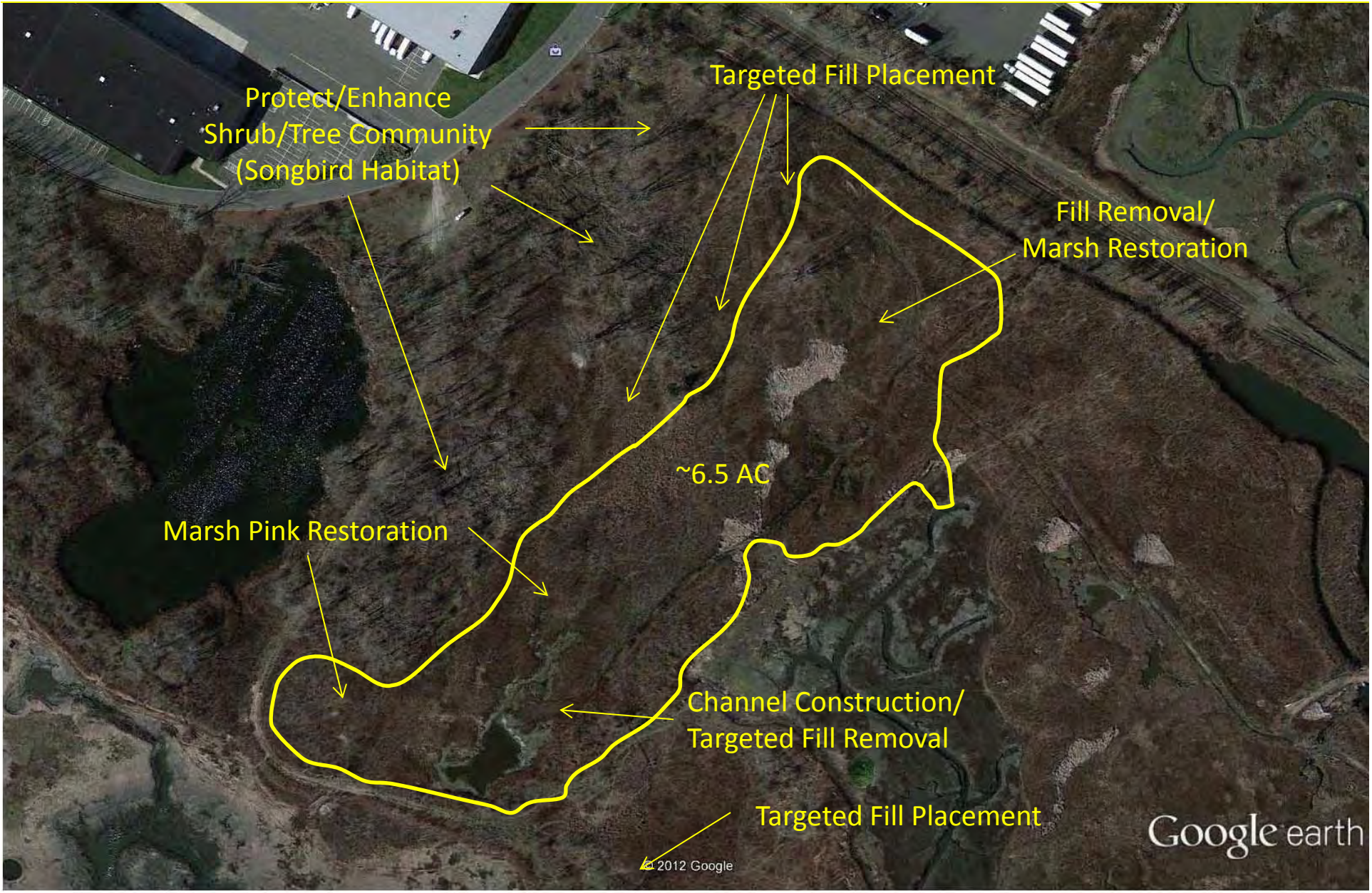

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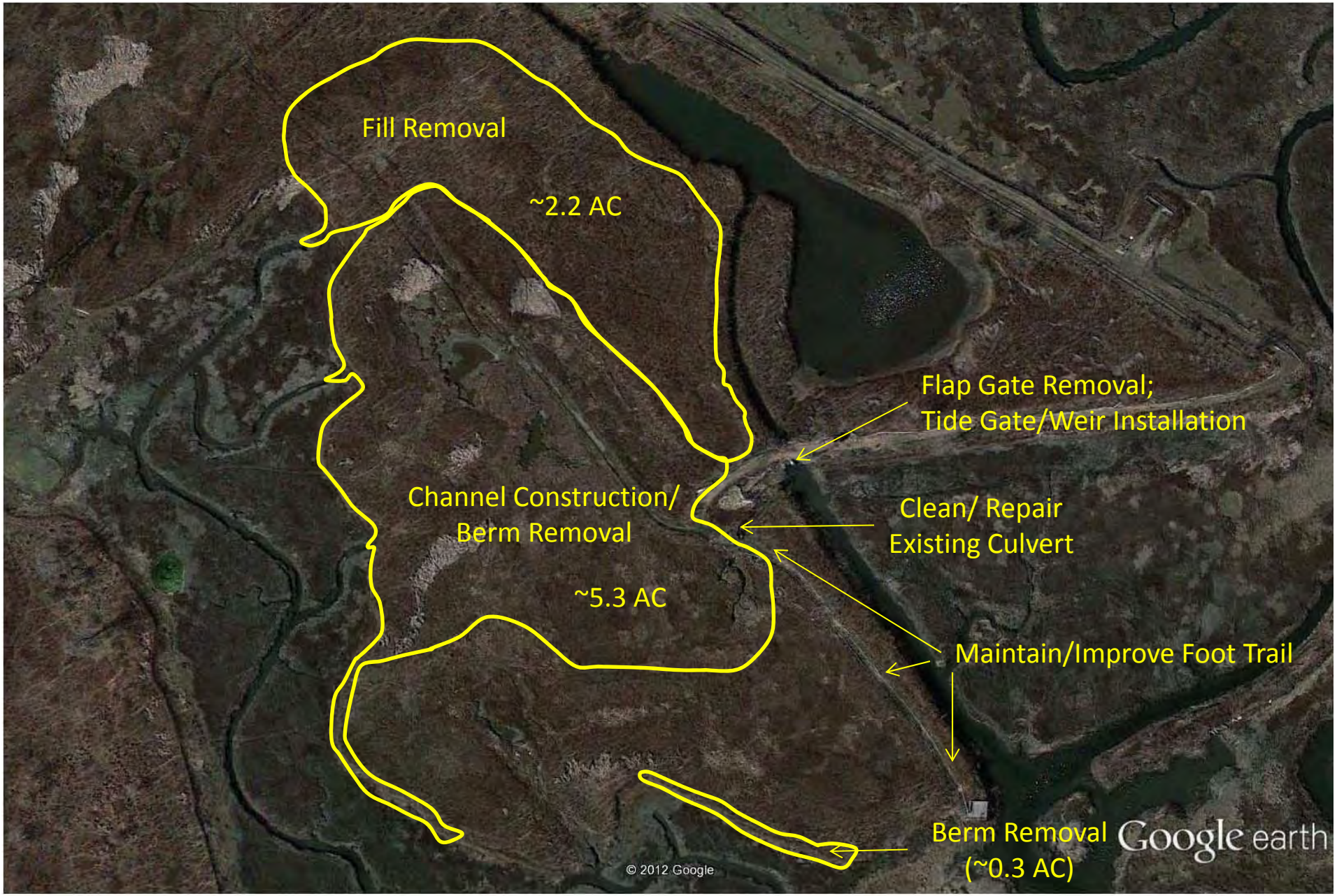

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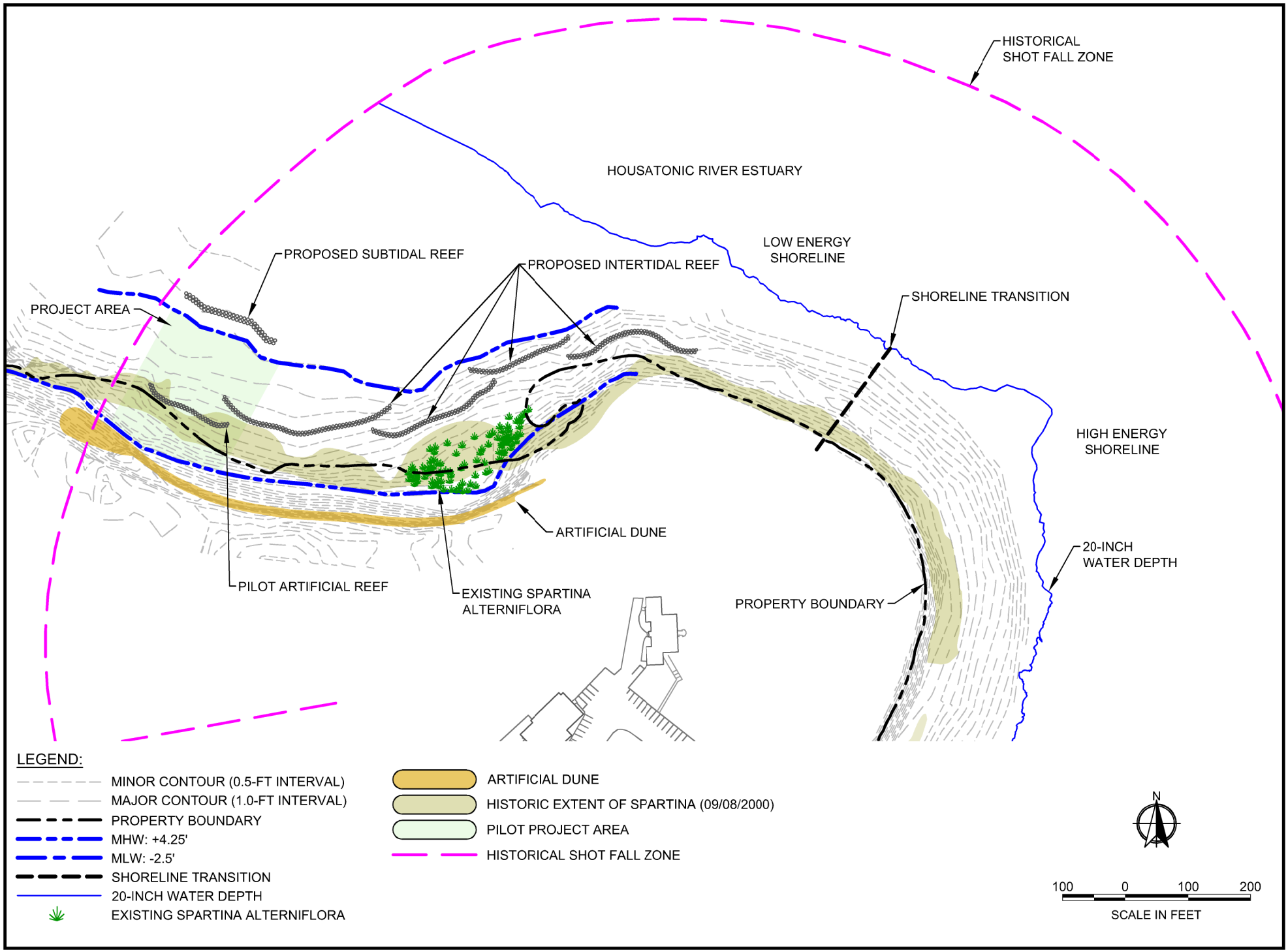

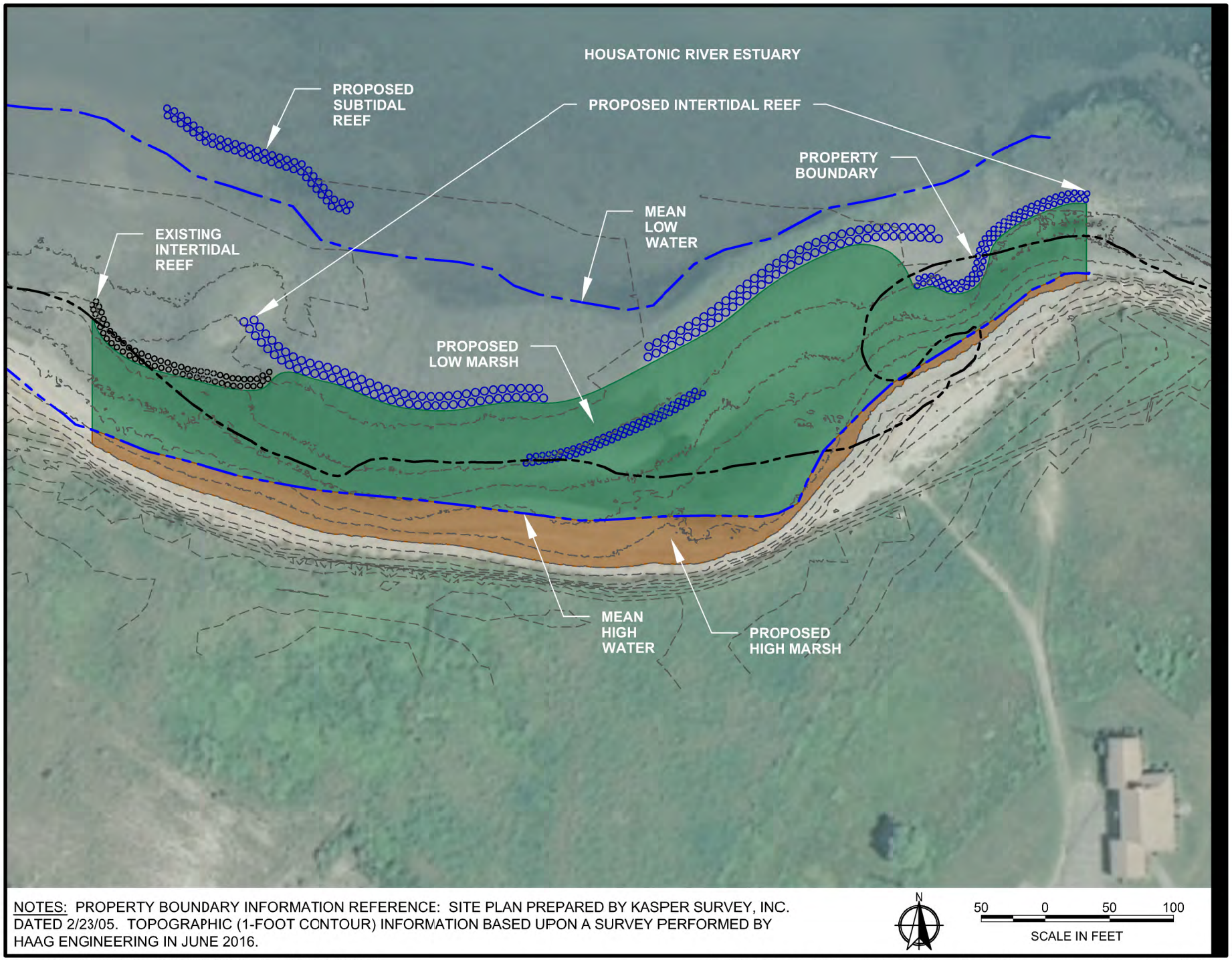

NOTES: PROPERTY BOUNDARY INFORMATION REFERENCE: SITE PLAN PREPARED BY KASPER SURVEY, INC. DATED 2/23/05. TOPOGRAPHIC (1-FOOT CONTOUR) INFORMATION BASED UPON A SURVEY PERFORMED BY HAAG ENGINEERING IN JUNE 2016.

N

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SCALE IN FEET

AECOM

Figure 1

PROPOSED REEF & MARSH LOCATIONS

"LIVING SHORELINE" EXPANSION PROJECT
SPORTING GOODS PROPERTIES, INC.
STRATFORD, CONNECTICUT
Project No.: 60481699 Date: 2016-07-08

Last saved by: JASON_JERRYTONE(2016-07-08) Last Plotted: 2016-07-08 Project Management Initials: Designer: JRJ Checked:CH Approved: CH ANSI A 8.5" x 11"
Filename: S:\PROJECTS\PRIVATE-SECTOR\DUPONT\DUP_LORDSHIP_PROJECTS\LIVING SHORELINE PILOT PROJECT\DESIGN SUPPORT\REEF AERIAL MAP\REEF & MARSH PROJECT LOCATION MAP.DWG

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Narragansett Laboratory
Restoration Center
28 Tarzwell Drive
Narragansett, RI 02882
Phone: +1 401-782-3338
Fax: +1 401-782-3201

December 23, 2016

Catherine Labadia
Deputy State Historic Preservation Officer
One Constitutional Plaza
Hartford, Connecticut 06103

RE: Section 106 Consultation – Proposed Restoration Alternatives,
Lordship Pt and Raymark NRDA Cases, Stratford, CT

Dear Dr. Labadia:

The National Oceanic and Atmospheric Administration (NOAA) as lead federal agency, and the U.S. Fish and Wildlife Service (USFWS) as participating federal agency, are submitting project information for restoration alternatives proposed for addressing natural resource injuries associated with the Lordship Pt and Raymark Industries cases in Stratford, Connecticut. This letter is to initiate formal consultation with the Connecticut State Historic Preservation Office (SHPO) in accordance with Section 106 of the National Historic Preservation Act of 1966 (36 CFR 800).

Please find attached narrative descriptions and graphics depicting the restoration projects proposed. You will note that multiple marsh restoration sites are proposed within the USFWS McKinney National Wildlife Refuge; one or more stone groins are being considered for removal at Long Beach, and a living shoreline and artificial reef project is proposed for expansion on the north shore of Lordship Pt. These project alternatives will be further described in detail and assessed for potential impacts in a forthcoming Restoration Plan and Environmental Assessment (RP/EA). Upfront consultation and input from the SHPO will beneficial to and incorporated into the RP/EA. We also welcome any considerations for potential archaeological concerns, and whether specific Tribal Historic Preservation Office(s) should also be consulted.

Thank you for the timely review of and response on these Section 106 consultation materials. Should you seek additional information, please do not hesitate to contact me at: 401-782-3338 or James.G.Turek@noaa.gov.

Sincerely,

James G. Turek
NOAA Restoration Center
Restoration Ecologist

cc: D. Major, USFWS
R. Jacobson, CTDEEP

Lordship Pt. and Raymark Industries NRDA Cases
Natural Resources Injury Restoration
Stratford, CT
Summary of Project Alternatives
December 2016

The purpose of the proposed restoration action is to compensate the public for injury and losses to natural resources in estuarine waters within Stratford, Connecticut caused by the release of hazardous substances from the Lordship Pt. and Raymark Industries Sites. The Lordship Pt and Raymark Trustee Council (LPRTC) seeks to use funds from the Lordship Pt settlement and the Raymark Industries bankruptcy agreement to implement natural resource injury restoration. Compensatory restoration actions are necessary to address natural resource injuries, and the services provided by those resources, in the past and into the future. Multiple restoration alternatives have been identified (Figure 1) and are described, as follows:

McKinney NWR Great Meadows Unit (GMU), Salt Marsh Restoration

Marsh Restoration Project Goals:

1. Restore salt marsh communities to provide estuarine fishery habitat and other ecological functions and services
2. Enhance disturbed wetland and bordering coastal upland habitats to provide greater ecological functions and services

Project Objectives:

1. Restore salt marsh community types including both low marsh dominated by smooth cordgrass (*Spartina alterniflora*) and high marsh dominated by salt hay (*S. patens*), salt grass (*Distichlis spicata*) and other species
2. Avoid or minimize adverse impacts to existing wetlands
3. Protect or restore state-listed marsh pink (*Sabatia stellaris*) habitat and marsh pink populations
4. Protect or enhance state-listed northern diamondback terrapin (*Malaclemys t. terrapin*) nesting habitat
5. Maintain or enhance forested and scrub-shrub habitat for songbirds
6. Restore or enhance salt marsh habitat for state-listed saltmarsh sparrow (*Ammodramus caudacutus)* and seaside sparrow (*A. maritimus*)
7. Maintain and enhance native communities by controlling invasive vegetation
8. Control salt marsh mosquito production
9. Maintain or improve public access and education
10. Provide marsh research opportunities and project performance monitoring

Marsh Restoration Project Alternatives: For each of the fill removal and tidal creek restoration projects (Refer to Alternative Figures 2-5, below), the project design objectives are to re-establish grade elevations supporting a native salt marsh plant community and establishing conditions favoring a more resilient coastal habitat to address storms and sea-level rise.

Figure 1: Lordship Pt and Raymark Injury Restoration Alternatives, Stratford, CT

1. **Alternative 1: Tidal Connection to Ponds and Marsh Creation –** Two ponds and existing wet *Phragmites* totaling ~3.7 acres would be connected to existing intertidal creek channels to provide regular tidal exchange (Figure 3). The work would involve the construction of two connecting channels by excavating and grading ~280 feet of intertidal channel to connect the ponds with nearby salt marsh creeks. The freshwater ponds would be converted to intertidal marsh habitat dominated by smooth cordgrass. This alternative would minimize impacts to and enhance terrapin nesting habitat along the existing sandy, man-made berm. Foot access along the berm could be maintained but limited to avoid secondary impacts to terrapin nesting habitat. Marsh elevations and hydrology affecting the habitat between and along the perimeter of the two ponds would be restored to provide marsh pink habitat in the restored high marsh area between the two ponds. This alternative may also include marsh pink propagation and planting program with oversight by CT DEEP.

2. **Alternative 2: 6.5-Acre Fill Removal and Channel Construction –** Targeted fill removal and channel construction would occur in a tidally-restricted and filled area southeast of the GMU parking lot and east of Alternative 1 (Figure 3). Channel construction is needed in the poorly drained, *Phragmites*-dominated southern portion of this area to provide regular tidal exchange and fish access, and to also address the significant production of nuisance mosquitoes (The berm restricts tidal exchange, making the site favorable to producing hordes of salt marsh mosquitoes). Fill removal (~1.5 acres) would occur in the northern portion of this area along with perimeter berm removal to restore to high and low marsh elevations. Target marsh elevations would be ~4.5-5.0 ft NGVD to provide mix of high and low marsh communities. Existing marsh with documented marsh pink populations would be protected or enhanced by the proposed work. This alternative may also include marsh pink propagation and planting program. Excavated fill would be placed in targeted areas to minimize existing wetland impacts and protect or enhance existing forested and/or scrub-shrub habitat used by songbirds along the western border of this area.

3. **Alternative 3: 5.6-Acre Channel Construction and Berm Removal –** Targeted fill removal (~2.5 acres) at berms and construction of channels are proposed east and southeast of Alternative 2 (Figure 4). The focus of this work would be channel construction to improve regular tidal exchange at the existing poorly-drained low marsh (and to eliminate mosquito production, as described above); removal of perimeter berm to provide marsh plain tidal sheet flow; and cleaning and/or repair of an existing culvert under the GMU public walking trail to enhance tidal exchange via the culvert. Additional tidal channel connections would be tied into previously excavated channels to the west of this site. Target marsh elevations would be ~4.5-5.0 ft NGVD to provide mix of high and low marsh communities. This alternative could also include marsh pink propagation and planting program. As part of this alternative, minor grade increases in the existing foot-access trail would be provided to maintain public access. Excavated fill soils would be strategically placed in on-site uplands or disposed of off-site.

4. **Alternative 4: 2.2-Acre Fill Removal –** Greater fill removal (up to ~5-foot fill cut) would occur to restore low and high marsh immediately north of Alternative 3 and west of the man-made pond (Figure 5). Target marsh elevations would be ~4.5-5.0 ft NGVD to provide mix of high and low marsh communities. Channels would also be excavated as a component of this alternative with connection into previously excavated channels to the west of this site. This alternative could also include marsh pink propagation and planting program. Excavated fill soils would be strategically placed in on-site uplands or disposed of off-site.

5. **Alternative 5: Enhance 1.75-Acre Tidal Pond Hydrology –** This alternative would be to remove and modify the existing defunct flap gate on the culvert discharging flows from the man-made pond. The existing flap gate has a corroded hole in the structure. The flap gate would be removed, and tidal flow would be established provided impacts to up-gradient infrastructure would not be adversely affected. Alternatively, a tide gate or managed weir (AgriDrain water control structure or equivalent) would be installed to allow increased, regular tidal exchange with the pond, but limit tidal flooding to prevent flooding of up-gradient industrial warehouses and infrastructure(to be further assessed). USFWS GMU staff would be required to manage and maintain the structure, following an operation and maintenance plan that would be developed as part of this alternative. This alternative would enhance tidal habitat conditions within the ~1.75-acre shallow-water pond and potentially affect additional surrounding marsh area bordering the pond.

6. **Alternative 6: Invasive Plant Mowing/Cutting and Herbicide Management –** Areas within the GMU and located within or bordering the previously described project alternatives are adversely affected by common reed (*Phragmites australis*), Russian olive (*Elaeagnus angustifolia*) and other non-native, invasive plant species. The invasive plant control would be accomplished by one or more mowings of common reed, cutting of Russian olive, and one or more herbicide applications to control these plants. Work would be completed by experienced and licensed pesticide applicators and restoration specialists contracted through CT DEEP or USFWS. A total of up to 10 acres of the GMU would be addressed by this alternative, and be carried out over a 5+-year period.

Accomplishing project goals will require working collaboratively with the USFWS McKinney NWR and other stakeholders to manage for trust species and to strive to achieve regional habitat restoration goals. Any and all combinations of the alternatives are being considered, and will be presented in a Restoration Plan (RP) and Environmental Assessment (EA) to be released by the LPRTC to the public for review and comment. The number and extent of the alternatives that are implemented will be commensurate with the level of funding needed for projected work activities and a contingency for unanticipated work items, and the amount of available funding.

Figure 2: Aerial View, GMU Marsh Restoration Alternatives

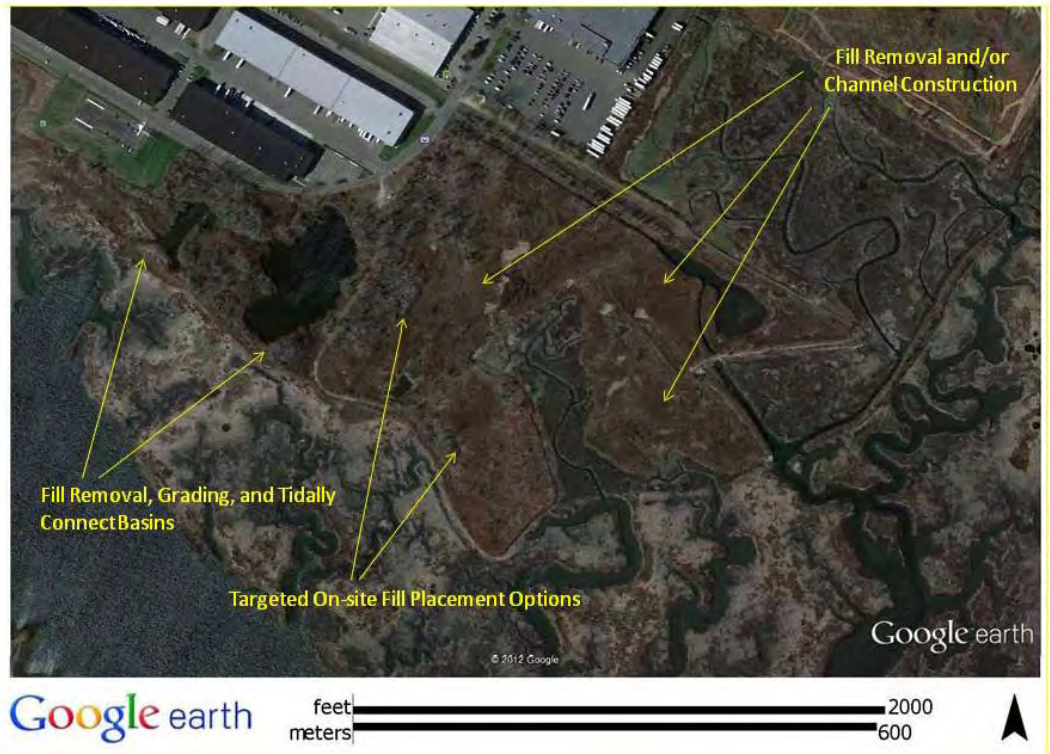


Figure 3: GMU Marsh Restoration Alternative 1

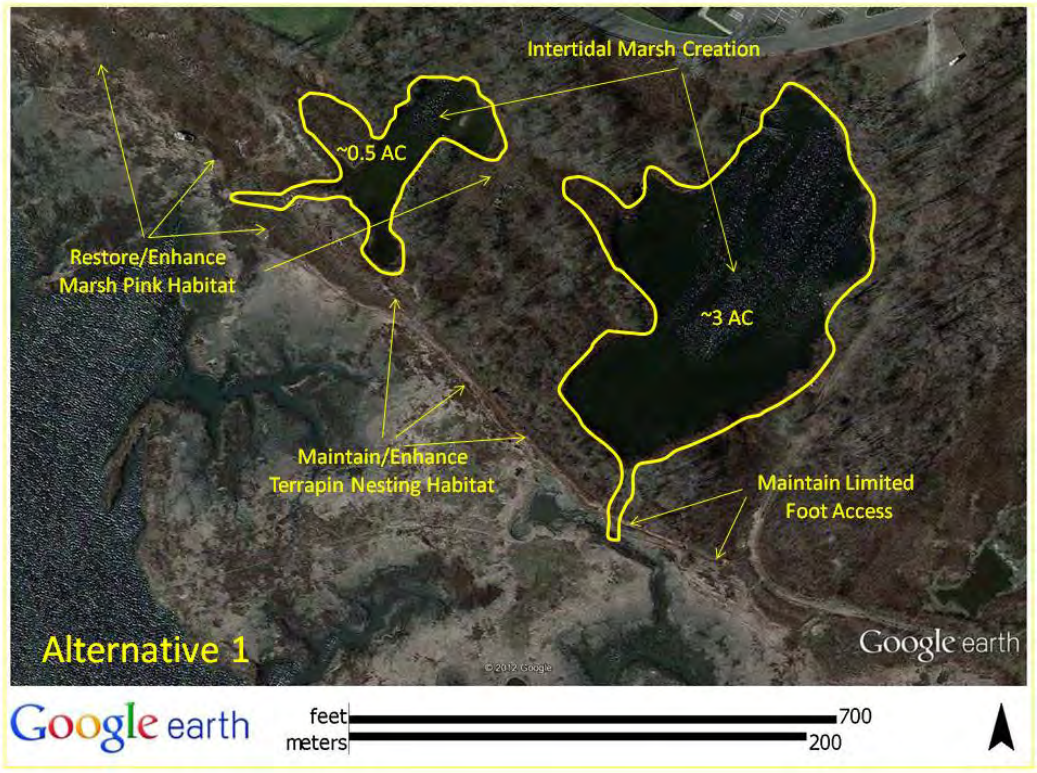


Figure 4: GMU Marsh Restoration Alternative 2

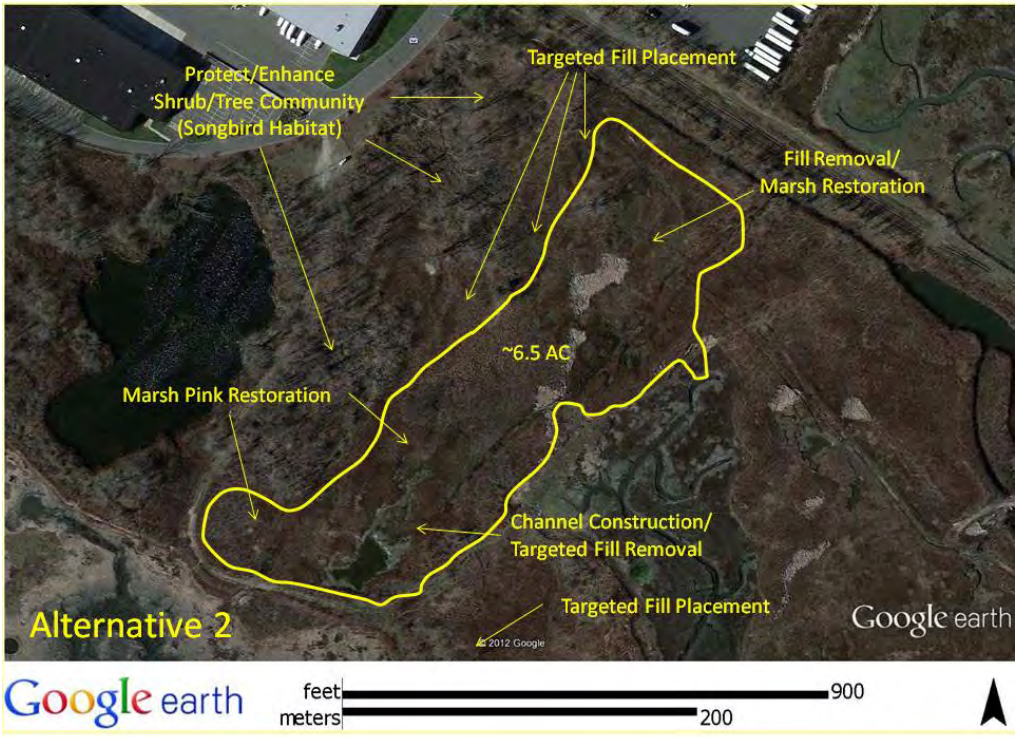
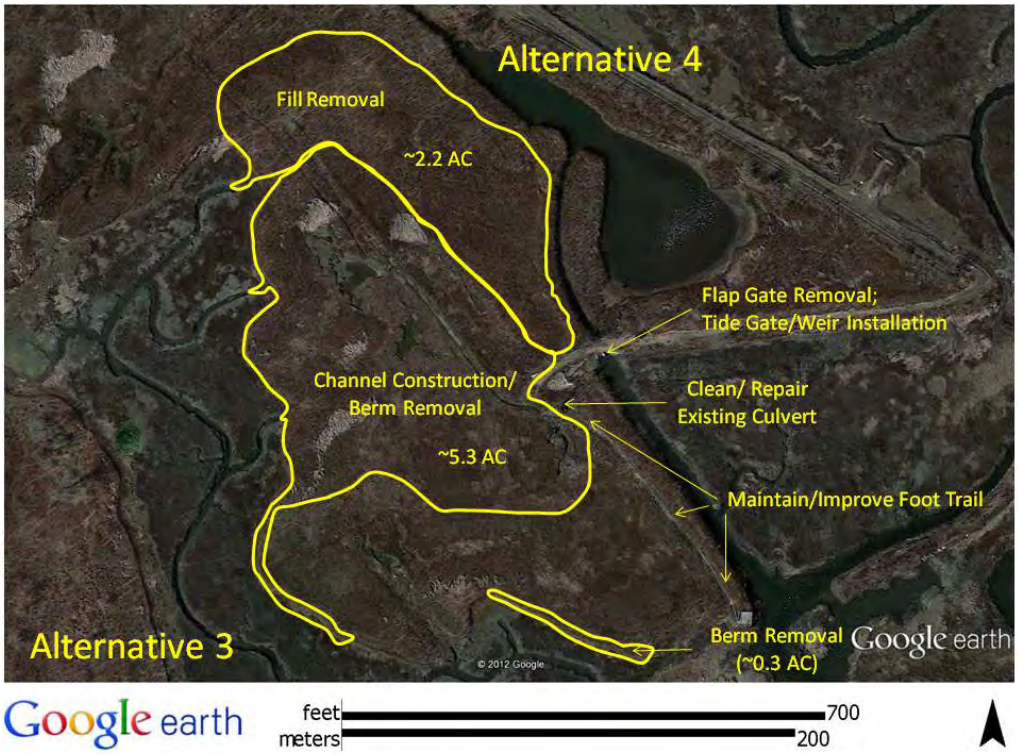


Figure 5: GMU Marsh Restoration Alternatives 3 and 4



Long Beach Groin Removal

Project Goals:

1. Restore sub-tidal and intertidal marine/estuarine habitat providing fish and macro-benthic habitats and other ecological functions and services
2. Restore natural coastal sediment transport process

Project Objectives:

1. Remove up to seven stone groins to restore natural sub-tidal waters and benthic community
2. Allow natural sediment transport along Long Beach to restore a naturally functioning coastal shoreline
3. Provide coastal geology research opportunities and project performance monitoring

Alternative 7: Stone Groin(s) Removal

The project site is along the Long Beach barrier beach bordering Long Island Sound, with Lewis Gut on the backside of this barrier beach (Figure 6). The site is located south of the McKinney GMU, and site access is off Oak Bluff Avenue, with public access to the beach system. A town-owned parking lot is situated immediately north of the two easternmost groins. West Beach Drive and multiple residences are located east of Long Beach. The project would consist of the removal of up to seven stone groins located along Long Island Sound and beachfront. A total of 0.8 acres of subtidal and intertidal habitat would be restored with the removal of all seven groins. Removal of the groins would restore unimpeded longshore transport of coastal sediments. It is expected that the groin removal would occur either by equipment accessing the site through the parking lot at the end of Oak Bluff Avenue, or by crane or excavator on a barge for relaying stone to disposal or re-use, transfer site. One consideration in the removal of the groins would be to remove and place the stone on a barge, and to then relocate and reuse the stone for coastal habitat restoration (e.g., living shoreline) at a nearby site. Higher project costs would result if the rock is disposed of and would require truck transport to approval disposal site. An estimated 8,500 CY of large rock would be excavated if all seven groins are removed.

Figure 6: Long Beach Groin Removal Alternative

Lordship Pt. North Living Shoreline

Project Goals:

1. Restore salt marsh and enhance intertidal and sub-tidal habitats and benthic community
2. Increase ecological resiliency of coastal habitats

Project Objectives:

1. Restore smooth cordgrass and salt hay fringe marsh
2. Enhance intertidal and sub-tidal habitats by establishing hard substrates benefiting Eastern oyster (*Crassostrea virginica*) community
3. Provide coastal geology research opportunities and project performance monitoring
4. Increase coastal resiliency by abating wave energies, minimizing vertical intertidal and horizontal erosion, and allow for sediment deposition to protect bordering upland coastal habitat for songbirds and other wildlife

Alternative 8: Installation of Living Shoreline

The 27.8-acre Lordship Pt. project site is located on the northwest shore of Stratford Pt. and the west side of the Housatonic River estuary (Figure 7). The project, proposed by DuPont and its project partners, would include: (1) sub-title reef ball installation; (2) intertidal reef ball installation; (3) low marsh fringe restoration; and (4) high marsh fringe.

The proposed living shoreline reef will consist of four individual segments oriented parallel to the existing shoreline; segments will range in length from approximately 150 to 250 ft with overlapping ends to reduce edge effects and associated scour, which has been observed at the periphery of the pilot project (See description and Figure 8, below). Overlap will be achieved by having two segments located closer to shore and two segments further from shore.

Segments are proposed to facilitate tidal exchange in the intertidal marsh that will be established landward of the reef. Segments closer to shore will be located approximately 100 ft seaward of MHW, corresponding to the ~+0.5-ft bathymetric contour. This elevation generally corresponds to the historical seaward extent of the marsh at the site. Seaward reef segments will be located approximately 175 ft seaward of MHW, generally corresponding to the -1.0 ft bathymetric contour. Far-shore segments will be approximately 250 ft in length and will be constructed of two rows of reef balls approximately 6 ft in diameter and 4.5 ft in height; this design will result in a far-shore reef crest height consistent with the near-shore segments.

The target wave attenuation for the proposed artificial reef is between 40% and 60% for a 2-year return storm. The intertidal marsh is also expected to attenuate wave forces and increase the sediment stability.

Both low and high marsh will be established landward of the reef balls using transplants of locally-obtained *Spartina* plants, or purchase of plants from regional commercial nursery providing plants of local genotype.

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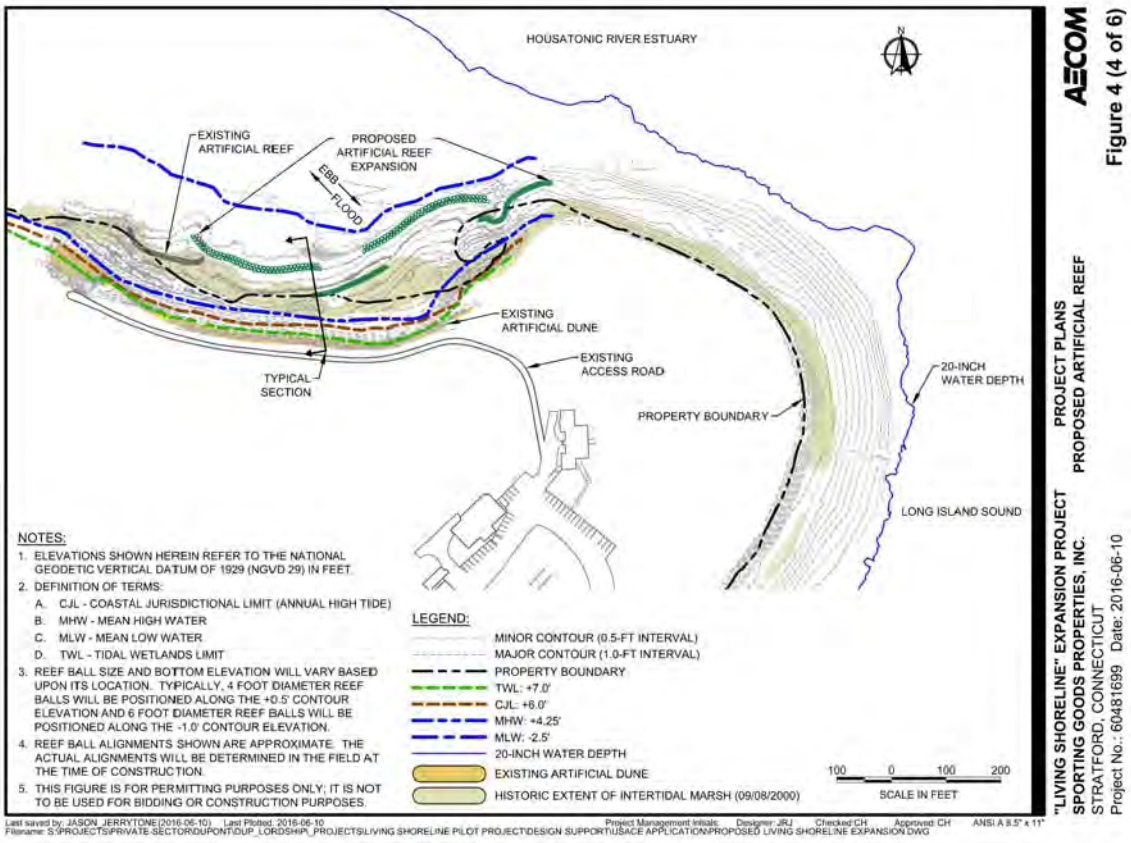
DuPont is the owner of both the existing living shoreline as well as the proposed living shoreline project. Connecticut Audubon CT continues to haze birds at the site to prevent waterfowl and other birds from potentially feeding on remnant lead shot that has been exposed following site remedial as a result of erosion and winnowing of sediments where coarser and denser sediments remain while less dense sediments are removed via winds and currents in the shallow water zone.

Figure 7: Lordship Pt North Living Shoreline Alternative

Figure 8: Lordship Pt Living Shoreline Site Conditions and Design Components



APPENDIX C

Trustee Agency Draft RP/EA Approvals

U.S. Department of Commerce
National Oceanic and Atmospheric Administration
Approval of the Draft Restoration Plan and Environmental Assessment for the Lordship Point Gun Club Site and Raymark Industries Site
Stratford, Connecticut

In accordance with Trustee protocol regarding documentation for Natural Resource Damage Assessment and Restoration (NRDAR) projects, the National Oceanic and Atmospheric Administration is providing its approval of the Draft Restoration Plan/Environmental Assessment (Draft RP/EA) for the Lordship Point Gun Club Site and Raymark Industries Site, Stratford, Connecticut. This approval does not extend to the Final RP/EA.

The Draft RP/EA shall be released for public review and comment for a minimum of 30 days. After consideration of the public comments received, the Draft RP/EA may be revised, with the Final RP/EA to address such comments.

Approved by:

Christopher Doley
Principal Trustee Representative and Division Chief
NOAA Restoration Center

10-25-2018
Date:

U.S. Department of the Interior
U.S. Fish and Wildlife Service
Approval of the Draft Restoration Plan and Environmental Assessment for the Lordship Point Gun Club Site and Raymark Industries Site
Stratford, Connecticut

In accordance with U.S. Department of the Interior (Department) policy regarding documentation for natural resource damage assessment and restoration projects (521 DM 3), the Authorized Official for the Department must demonstrate approval of the draft and final restoration plans and their associated National Environmental Policy Act documentation, with concurrence from the Department's Office of the Solicitor.

The Authorized Official for the Lordship Point and Raymark cases is the Regional Director for the U.S. Fish and Wildlife Service's Northeast Region.

By the signatures below, the Draft Restoration Plan/Environmental Assessment (RP/EA) for the Lordship Point Gun Club Site and Raymark Industries Site is hereby approved. This approval does not extend to the Final RP/EA. The Draft RP/EA shall be released for public review and comment for a minimum of 30 days. After consideration of the public comments received, the RP/EA may be revised, with the Final RP/EA to address such comments.

Approved by:

Wendi Weber
Acting Regional Director
Northeast Region
U.S. Fish and Wildlife Service

25 OCT 2018
Date:

Concurred:

Mark Barash
Senior Attorney
Northeast Region
Office of the Solicitor

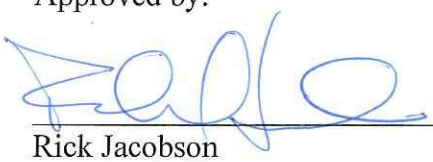
10/25/2018
Date:

State of Connecticut
Connecticut Department of Energy and Environmental Protection
Approval of the Draft Restoration Plan and Environmental Assessment for the Lordship Point Gun Club Site and Raymark Industries Site
Stratford, Connecticut

In accordance with Trustee protocol regarding documentation for Natural Resource Damage Assessment and Restoration (NRDAR) projects, the State of Connecticut is providing its approval of the Draft Restoration Plan/Environmental Assessment (Draft RP/EA) for the Lordship Point Gun Club Site and Raymark Industries Site, Stratford, Connecticut. This approval does not extend to the Final RP/EA.

The Draft RP/EA shall be released for public review and comment for a minimum of 30 days. After consideration of the public comments received, the Draft RP/EA may be revised, with the Final RP/EA to address such comments.

Approved by:



9/13/18

Rick Jacobson
State Trustee Representative and Director
Wildlife Division
Connecticut Department of Energy and Environmental Protection

Date: